Investigating the Measurement of, and Interrelationship Between Resilience, Hardiness, Grit in a Population of Navy SEAL Candidates

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Effective managers and leaders require resilience, hardiness, and grit to persist in the face of great adversity. To that end, we examine these traits separately and together to refine them into the most parsimonious and reliable measures possible. We utilize a sample of basic underwater and demolition (BUD/s) U.S. Navy SEAL candidates and address several claims about the nature of the instruments. Our findings include more parsimonious measures, the rewording of several items to enhance reliability, and a finding that it takes a combination of all three to navigate the stressors of leadership on the edge.

Keywords: resilience, hardiness, grit, measurement, interrelationships, confirmatory factor analysis

INTRODUCTION

Elite performance in high-stress environments of business, sports, academics and the military require specific individual traits to overcome setbacks and engender sustained superior performance despite the long, slow grind. Over the last several decades, the traits of resilience, hardiness, and grit have been cited for their role in affecting this performance (e.g., Bartone et al., 2009; Duckworth et al., 2019; Loftus et al., 2020; Maddi et al., 2012, 2017; Tugade & Fredrickson 2004). Despite research supporting these traits' role in affecting performance, there is limited understanding of the distinctions between the traits. In many popular settings, the terms "resilience," "hardiness," and "grit" are often used interchangeably. However, in an academic context they are argued to be theoretically and empirically distinct traits (Georgelous-Sherry & Kelly, 2019) with nuanced differences between each. Another notable discrepancy with the terms

resilience, hardiness, and grit is that at times they are described as abilities, attributes, characteristics, noncognitive traits, personality traits, processes, skills, or some variation of this nomenclature (e.g., Credé et al., 2017; Duckworth et al., 2007; Kobasa, 1979; Rimfeld et al., 2016; Seery et al., 2010; Tugade et al., 2004). This study uses the term traits for these concepts and considers them as malleable patterns of behavior that can be improved and/or degraded.

For the most part, each trait has been researched in isolation from one another, primarily because these concepts evolved in different time periods and in literature focused on unique performance outcomes. Relatively little research has investigated all three traits simultaneously, either from a measurement or predictive validity perspective. Several instruments for these concepts have been developed and validated in recent years, but based on these instruments, it is unknown how resilience, hardiness, and grit relate to one another in a variety of contexts. Uncovering the similarities or distinctions between resilience, hardiness, and grit within a variety of contexts will establish a greater understanding of how these traits operate collectively or with subtle differences to affect performance. This insight could enhance how we select, train, and develop high-performing individuals in business, sports, academics, and the military. In this study, we assess (1) whether the items in commonly used instruments for resilience, hardiness, and grit are reliable and valid in measuring each trait, (2) whether the instruments in fact reflect distinct traits, and (3) whether the measures—or a subset thereof—can be combined to reflect a single trait, rather than three distinct traits. The goals are to evaluate the measurement properties of some of the extant instruments in a unique population and to develop a parsimonious instrument or instruments that has/have strong predictive validity in terms of predicting performance. Our unique data come from a two-year study of students in three classes of the six-month Basic Underwater Demolition/SEAL (BUD/S) course that produces future U.S. Navy SEALs.

BACKGROUND

Resilience, hardiness, and grit are considered to be traits important for success in a variety of challenging and competitive settings ranging from business environments to sports, to academics, to military programs. Resilience is generally defined as the ability to adapt to adverse settings (Luthar et al., 2000; Britt et al., 2013). Hardiness is often defined as persistence, openness to challenge, and perceived control (Kobasa, 1979; Bartone et al., 2008). Finally, grit is defined as passion, perseverance, and consistency of interest in attempting to accomplish a long-term goal (Duckworth et al., 2007; Duckworth & Quinn, 2009). Both the common English understanding, as well as the academic understanding, of these terms that has arisen from decades of study, suggest that these three traits are interrelated. Indeed, "perseverance" and "persistence" are synonyms and are part of the common definitions of hardiness and grit.

However, despite widespread agreement about the general importance of these traits for performance (e.g., Duckworth et al., 2019; Dugan et al., 2018; Ledford et al., 2020; Loftus et al., 2020; Maddi et al., 2012, 2017; Sarkar & Fletcher, 2014; Sheard & Golby, 2010), there is less discussion regarding if they are indeed the same, distinct, or interrelated (Georgelous-Sherry & Kelly, 2019). The limited research (e.g., Georgelous-Sherry & Kelly, 2019) that investigated the distinctions among all three of these traits concluded that, while they are distinct, they are difficult to measure. Here, we describe each trait and discuss the relevant literature of each. We highlight the need for integrated study of these concepts, and we discuss the limitations of the extant literature in uniting them.

Resilience

Interest in the study of resilience began in the field psychology but was quickly adapted for a variety of other uses (Luthar et al., 2000). Since then, resilience has been researched in a variety of contexts including supply chains (Wieland & Durach, 2021), in entrepreneurial contexts, and in the context of human resources relative to how human resource practices contribute to the ability of a firm to bounce back from disaster (Inuaesiet et al., 2021). Although researchers differ in their definition of resilience, consensus has coalesced around the idea that it means "positive adaptation in the face of adversity" (Britt et al., 2013, p.

3). Research on resilience has expanded its scope over the past twenty years (Windle et al., 2011) to include numerous, different populations (Masten, 2018; Rutter, 1987). The concept of resilience is now ubiquitous in the scientific literature and is applied in numerous contexts (e.g., business, ecology, public policy, health and medicine). In this study, we focus on psychological resilience using a trait perspective within the field of positive psychology (Seligman, 2007, 2011). Many researchers consider resilience to be malleable and able to be developed over one's lifetime (e.g., Fletcher & Sarkar, 2016; Luthans et al., 2010; Youssef & Luthans, 2007).

There is a common belief that resilience can be improved through training (e.g., Arnetz et al., 2009; Joyce et al., 2018; Reivich et al., 2011; Robertson et al., 2015; Seligman, 2011). Businesses have attempted to train employees in the workplace for over a decade on how to be more resilient (Robertson et al., 2015). Resilience training is popular in various business areas from healthcare to small business management (e.g., Fatoki, 2018; Mealer et al., 2017). The military has historically placed high emphasis on building and training for resilience in military personnel and their families (e.g., Casey, 2011; Meredith et al., 2011; Palmer, 2008). The U.S. Army developed a resilience training program to teach non-commissioned officers to instruct their soldiers on how to be more resilient (Reivich et al., 2011). However, despite this emphasis on developing resilience in individuals that operate in or are impacted by high-stress environments, it remains unclear as to the best way to assess resilience, its subfactor structure - if any in fact exist, how resilience may be distinct in various contexts - specifically for high performing individuals in any context, and if it is related to other similar traits related to persistence and perseverance.

There are currently at least 19 measures of resilience (Windle et al., 2011). In a methodological review of resilience scales, Windle et al. (2011) identified three scales (CD-RISC 25-items, Resilience Scale for Adults 37-items, and Brief Resilience Scale) as best at measuring the trait, considering content validity, internal consistency, criterion validity, construct validity, reliability, responsiveness, and interpretability. However, the authors concluded that there is no 'gold standard' in terms of resilience measures.

The present study used the Connor-Davidson Resilience Scale (CD-RISC), a 25-item battery that is considered to represent resilience (Davidson, 2019). The seminal article developing the instrument (Connor & Davidson, 2003) indicated five subfactors of resilience in an adult U.S. population, (1) persistence and tenacity, (2) emotional and cognitive control under pressure, (3) adaptability or the ability to rebound from setbacks, (4) control, and (5) meaning. However, other research has called this into question. For example, Yu and Zhang (2007) studied Chinese adults and found a three-factor structure, (1) tenacity (which at times is relabeled as hardiness, see Davidson, 2019), (2) strength, and (3) optimism. Another study (Lamond et al., 2008) utilized a population of community-dwelling women over the age of 60 in the U.S., and identified four factors (1) personal control and goal orientation, (2) adaptation and tolerance of negative affect, (3) leadership and trust in instincts, and (4) spiritual coping. In a sample of post 9/11 U.S. military veterans, Green et al. (2014) revealed a two-factor model for resilience, which included (1) adaptability and (2) self-efficacy, dropping 11 items to develop the best fitting model.

However, other studies indicate a single factor structure for resilience. Dixon and Bares (2018) found a single factor structure of resilience in a sample of U.S. Airmen during a well-being survey in the Air Force Community; however, their research used the 10-item CD-RISC which constrains the number of items that can be used for meaningful factor analysis. Using the 25-item CD-RISC, Bezdjian et al.'s (2017) supported a single factor structure and retained all 25-items in their sample. Bezdjian et al.'s finding supports Davidson (2019) recommendation to avoid treating the battery as multidimensional, in part because there are and may be large discrepancies in subfactor structure based on regions and populations investigated. These discrepancies highlight the importance of careful scrutiny of the factor structure of resilience across distinct populations and underscore the need to further explore the relationship between resilience and other traits, such as hardiness.

Hardiness

Following the emergence of literature on resilience, interest in hardiness emerged in the late 1970's as a concept geared to reflect mental toughness or tenacity (e.g., Bartone, 1999, 2007; Bartone et al, 2002, 2008; Kelly et al, 2014; Maddi et al., 2012). Kobasa (1979) introduced the trait in her seminal study on

stress in middle and upper-level executives and their susceptibility to illness based on their sense of control of the events in their life, commitment from their sense of meaning and purpose, and openness to challenge. In general, a hardy individual displays a high sense of control, a high sense of commitment, and in difficult situations an openness to grow (Kobasa, 1979; Bartone, 2007; Bartone et al., 2008; Maddi et al., 2012). Hardiness, in contrast to resilience, is consistently recognized as a personality trait, whereas resilience is considered a trait, a process, or an outcome. Moreover, in contrast to grit, with its focus on a higher-order end goal (Duckworth & Gross, 2014) as discussed below, hardiness is a more generalized state of being rather than centered on a specific long-term goal. In general, hardiness is theoretically centered on the idea of endurance through both relatively stable moments, as well as those of challenge.

Hardiness has been studied across several business frontiers. For example, hardiness was found to be a critical component in human resource systems (Pritvorava et al., 2018), a similarly critical component in an organizational context (Ferreira et al., 2013), as well in the healthcare industry (Judkins et al., 2006). Of note, one study focused on middle managers revealing how hardiness moderates the relationship between structural empowerment, psychological empowerment, and burnout (Calvo & Garcia, 2017); the authors concluded that organizations should focus on hardiness training. In a study of nurse managers, those with higher levels of hardiness had lower levels of stress in their jobs (Bueno de Freitas et al., 2017). Broadly, researchers seem to suggest that an emphasis on hardiness can play an important role in enabling individuals to be more resilient in high-stress environments (e.g., Bartone, 2006; Beasley et al., 2013; Maddi, 2013).

Beyond the study of hardiness in the context of business, it has also been studied at length in various military contexts. Hardiness was a central component in studying high-stress environments, such as in assessment training in the U.S. Military Academy (Maddi et al., 2012) and in rigorous combat situations (Bartone, 1999; Bartone et al., 1989). Further, hardiness has been studied in international militaries (Bartone et al., 2002; Florian et al., 1995); it was tested as a predictive measure of mental health and commitment in Israeli military recruits (Florian et al., 1995). Hardiness was studied in POWs from the Yom Kippur War compared to non-POWs who fought in the war (Zakin et al., 2003). The study indicated that hardiness and secure attachment style mitigated the negative effects of stressors. More recent studies also highlight the value of hardiness for those operating in high-stress environments. A study of U.S. Army combat medics indicated that at least one aspect of hardiness--commitment--plays a role helping U.S. soldiers succeed (Krauss et al. 2019). Another study indicated hardiness may also moderate the impact of depression on soldiers in combat situations (Bartone & Homish, 2020). Holistically, these studies suggest the value in generating a better understanding of the trait of hardiness.

Bartone et al.'s (1989) 15-item Dispositional Resilience Scale (DRS-15) is an instrument that has been widely used in such hardiness studies. This short hardiness scale consists of an equal number of items for three subscales (commitment, control, and openness to challenge). In a study of 525 collegiate athletes, the whole instrument was found to have good internal consistency (Madrigal et al., 2016). The DRS-15 scale has been used across a broad range of samples and conditions over the past two decades (e.g., Bartone, 2007; Kelly et al, 2014; Madrigal et al., 2016; Picardi et al., 2012; Wong et al., 2014), establishing it as a widely used instrument to measure hardiness.

Grit

Since its introduction in 2007, the trait of grit has been both lauded (e.g., Eskreis-Winkler et al., 2014; Duckworth & Gross, 2014; Duckworth et al., 2011) and critiqued (e.g., Credé, 2018, Credé et al., 2017, Ion et al., 2017; Schmidt et al., 2020) within the fields of psychology, business, education, and other social sciences. Other researchers argue that the trait is relevant for understanding human performance but acknowledge the measurement is plagued by theoretical, construct, and predictive validity issues (e.g., Jachimowicz et al., 2018; Jordan et al., 2019; Luthans et al., 2019).

Grit is defined as a passion and perseverance towards a long-term goal (Duckworth et al., 2007; Duckworth & Quinn, 2009). The instrument for measuring grit consisted of two subscales capturing (1) consistency of interest - a focus on a long-term goal over years and decades, and (2) perseverance of effort - representing one's ability to persist toward the long-term goal despite setbacks and failures. The initial

grit studies were performed with cadets in the U.S. Military Academy (USMA) and they found grit was a more accurate predictor of successful completion of the rigorous cadet basic training than West Point's whole candidate score (a compilation academic ability, leadership potential, and physical aptitude) (Duckworth et al., 2007; Duckworth & Quinn, 2009).

Yet, one issue that persists with the measurement of grit (The Grit Scale and The Short Grit Scale) is that neither the consistency of interest nor perseverance of effort subscales seems to capture "passion" that was part of Duckworth et al.'s (2007) definition of grit (Jachimowicz et al., 2018). Duckworth (2016) explained that the passion aspect of grit is encompassed within the consistency of interest subscale. However, Jordan et al. (2019) argued that this explanation fails to capture the emotional component of passion. Overall, there appears to be a lack of alignment between the initial definition of grit and the subscales of the instrument developed to measure grit (Jachimowicz et al., 2018; Jordan et al., 2019).

Aside from disagreement over the measurement of particular aspects of grit, some researchers argue that grit is not distinct from other personality measurements, most specifically conscientiousness (e.g., Credé et al., 2017; Ivcevic & Brackett, 2014; Rimfeld et al., 2016; Schmidt et al., 2020). Additionally, in a meta-analytic review of the grit literature, Credé et al. (2017) indicated that the perseverance subcomponent of grit may be the only facet of grit that provides any utility beyond conscientiousness of personality and that the construct validity of grit should be further questioned and analyzed. These researchers (e.g., Credé et al., 2017; Ivcevic & Brackett, 2014; Rimfeld et al., 2016; Schmidt et al., 2020) concluded that without improvement both theoretically and methodologically, grit provides little value to understanding human performance.

Despite the seeming limitations of extant grit measures, some researchers argue that the concept provides value for understanding human performance, and the problems with extant measures can be resolved with additional research (e.g., Cormier et al., 2019; Jachimowicz et al., 2018; Jordan et al., 2019). From a theoretical standpoint, gritty individuals use a hierarchical goal framework to achieve their long-term goal (Duckworth & Gross, 2014), using specific actions to achieve lower-order goals as a means to reach the ultimate higher-order focal goal. This goal framework and goal process is a central tenet to the concept of grit (Jordan et al., 2019). Thus, the hierarchical goal framework that is used by gritty individuals may be an important differentiating aspect of the concept which helps an individual to persevere and remain consistently focused on a singular long-term end goal, such as completion of rigorous training or even successful completion of a mission.

Despite the inconsistencies within the empirical research, grit continues to be used to explain leadership performance (e.g., Caza & Posner, 2019), academic performance (e.g., Duckworth et al., 2011; Luthans et al., 2019), entrepreneurial performance (e.g., Mooradian et al., 2016), and military performance (e.g., Eskreis-Winkler et al., 2014; Kelly et al., 2014; Maddi et al. 2012). As such, examining grit and differentiating it from similar character traits, such as resilience and hardiness, begins to clarify both the theoretical and methodological issues with the construct.

Trait Distinction

Despite the abundance of research on the singular concepts of resilience, hardiness, and grit as predictors of performance, and despite their seeming similarities, there is little research that investigates the distinctions between these constructs (Georgoulas-Sherry & Kelly, 2019). After reviewing the literature on grit and resilience in health professions education, Stoffel and Cain (2018) concluded that the terms of grit and resilience "are nuanced, complex, and difficult to measure and understand" (p. 124). In a conceptual paper, Raver Luning and Ledford (2020) argued that grit and hardiness are necessary character traits for those within the military. They theorized that the traits are distinct yet operate symbiotically to help an individual excel both with the day-to-day "grind" of the military and the more challenging events that one must overcome within any military setting.

Studies have found positive correlations between grit and resilience (e.g., Shakir et al., 2020; Shrivastava & Mishra, 2016), between grit and hardiness (e.g., Maddi et al., 2013; Matthews et al., 2019), between resilience and hardiness (e.g., Nezhada & Besharatb, 2010) and between all three traits (e.g., Georgoulas-Sherry & Kelly, 2019; Martin et al., 2015). In one of the few studies that examined all three

concepts, Georgoulas-Sherry and Kelly (2019) found, using data from a sample of cadets in the USMA, that the three concepts are distinct. However, the authors state that one of the primary limitations of their study was low levels of reliability, suggesting that the results may not be reproducible, even under similar circumstances. This may limit the applicability of their conclusions and provides fertile ground for additional research to better understand the similarities and distinctions between the concepts. Essentially, more empirical research is necessary to distinguish these traits or discover their overlap to combine them into a single measure representative of "persistence" and "perseverance."

RESEARCH QUESTIONS

In this study, we examined the intersection of the concepts of resilience, hardiness, and grit. We address the following questions:

1. What are the most reliable and parsimonious measures of resilience, hardiness, and grit?
2. Do standard measures of resilience, hardiness, and grit enable distinguishing between these concepts?
3. Because previous research suggests resilience, hardiness, and grit are positively correlated, is it possible to create one, more parsimonious construct from items contained in standard measures of the three concepts?

We address these questions using the data obtained from the individuals during the training and selection for Navy Sea, Air, and Land Teams, SEALs, during the BUD/S course. They are a distinct population who have chosen to be in the U.S. Navy. SEAL candidates undergo an extensive selection process involving physical and mental performance assessments. Individuals earning a spot at BUD/S have previously demonstrated stamina through arduous physical and mental tasks. However, selection to attend BUD/S is far from a guarantee to selection into the SEAL community where the BUD/S pass rate is approximately 20% (Taylor et al., 2006). Persistence and perseverance through the mental and physical assessments over a six-month period during the BUD/S course are necessary. Due to the intense focus on stamina, persistence, and perseverance in order to complete BUD/S, this group provides an extremely unique window into a special population to understand how resilience, hardiness, and grit may represent distinct traits or overlap. This sample provides an unprecedented view into a group of some of the most motivated individuals in the country. A population like this enables us to closely examine the constructs in question and later extrapolate our findings to other populations.

METHOD

Sample, Recruitment, and Data Collection

The present study used data from 353 students from three classes in BUD/S training, a six-month course of instruction with attrition rates historically up to 80% (Taylor et al., 2006). The physical and mental training regime identifies candidates who can tolerate a variety of stressors while maintaining consistently high performance. We assessed candidates' resilience, hardiness, and grit within the first few days of training. IRB approval and informed consent was obtained after the BUD/s candidates were given a consent document in writing, and a verbal description of the study. The candidates were also made aware that the study was voluntary, they could withdraw at any time and their participation was completely confidential. Of the 418-total number of possible participants, 368 agreed to participate in the study, for an 88% response rate which led to usable data for 353 of those participants.

Sample Characteristics

All participants (n=353) were male and currently on active duty in the Navy. As shown in Table 1, 315 were enlisted and 38 were officers. The average age of participants in this study was 23.4 years, with a range from 18.3 to 35.6 years, skewing negative, with the majority of candidates being less than 30. The

majority of candidates did not have partners (88%), were predominately white (85%), and were college educated (50%).

TABLE 1
DEMOGRAPHIC TABLE OF PARTICIPANT CHARACTERISTICS

Participant Characteristics	Number	Percentage
Rank		
Enlisted	315	89.49%
Officer	38	10.76%
Race		
White	301	85.51%
Nonwhite	52	14.73%
Marital Status		
Partner	42	11.93%
No Partner	311	88.10%
Regions of the United States		
South	128	36.26%
Other than South	225	63.74%
Family Income (Parents)		
$0 - $50,000	50	14.16%
$51,000 - $100,000	83	23.51%
$100,000 - $150,000	88	24.93%
$151,000 or greater	87	24.65%
Prefer not to answer	45	12.75%
Average Family Income	**$115,999[a]**	
Education Level		
GED or High School	89	25.21%
Some College	87	24.65%
College Degree	162	45.89%
Graduate School or Degree	11	3.12%
Missing	6	0.01%
Average Education	**College Degree**	
Age		
17 – 23	196	55.52%
24 – 26	94	26.63%
27 – 35	61	17.28%
Average Age	**23.44**	

[a] Average Family Income was computed as the average of the midpoint of the income brackets.

Key Measures

Resilience

Resilience was measured with the 25-item Connor-Davidson Resilience Scale (CD-RISC) (Connor & Davidson, 2003). While numerous studies (e.g., Connor & Davidson, 2003; Green et al., 2014; Lamond et al., 2008; Yu & Zhang, 2007) have indicated that resilience, as measured with the CD-RISC has subfactors, the originating author (Davidson, 2019) recommends using the CD-RISC as a single factor construct. Thus, we began our analyses following that approach. Sample items in the battery include, "I adapt when changes occur" and "I have a strong sense of purpose in life." Each item is measured on a five-point Likert scale ranging from "not true at all" to "true nearly all the time."

Hardiness

Hardiness was measured with the 15-item Dispositional Resilience Scale (DRS-15) (Bartone et al., 1989). Hardiness, as measured by the DRS-15, is considered a superordinate factor with three subfactors (commitment, control, and challenge). An example measure of commitment is "Most of my life gets spent doing things that are meaningful." An example measure of control is "By working hard you can nearly always achieve your goals." Finally, an example measure of challenge is "Changes in routine are interesting to me." The items are measured on a four-point Likert scale with categories ranging from "not at all true" to "completely true." Six of the items are negatively worded (i.e., agreement with the item indicates lowers levels of the trait).

Grit

Grit was measured using the 12-item Grit Scale (Duckworth et al., 2007). The 12-item Grit Scale is typically considered to consist of two subfactors: perseverance of effort and consistency of interest. Perseverance items include questions such as, "I have overcome setbacks to conquer an important challenge." Consistency items include questions such as, "I often set a goal but later choose to pursue a different one." Items are measured on a five-point Likert scale, with categories ranging from "not like me at all" to "very much like me." All six items measuring consistency of interest are negatively worded.

Analytic Strategy

We estimated a series of confirmatory factor analyses (CFA) to investigate the reliability and validity of the latent constructs of resilience, hardiness, and grit in our data (Bollen, 1989). In the first stage of our analyses, for each construct, we estimated a CFA in which all items associated with it were treated as loading on a single factor. In each model, overall model fit was assessed using the Root Mean Squared Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI), all of which are standard measures of model fit and reported by our software package (MPlus version 8; Muthen & Muthen, 1998-2017), with RMSEA<.05 and CFI>.95 and TLI>.95 indicating good fit.

Most initial models for each construct did not fit particularly well. We revised initial models for each construct by examining standardized factor loadings and explained variances (R-squares) as measures of validity and reliability, respectively (Bollen, 1989), as well as modification indices, to guide us in (1) dropping particularly poorly fitting items and/or (2) introducing additional latent variables representing different but related subfactors. The latter type of modification was conducted by grouping items with standardized factor loadings and R-squares of similar magnitudes, as discussed in the results section. Given the number of models estimated, we show only model fit indices in the table summarizing this stage of the analyses. Full model results are available from the authors.

In the second stage of our analyses, we constructed models that incorporated all three traits using the final models for each trait obtained in the first stage. The purpose of this second stage was to determine the extent to which the three traits are distinct.

Because our data were all measured on ordinal scales, we estimated all models using the default probit specification with ML estimation in MPlus. Further, as noted above, several items were negatively worded. These items were reverse-coded prior to analyses. In order to compensate for potential effects on response of negative wording of items, we include a latent variable indicating negative wording where appropriate. Factor loadings for this "wording" latent variable were set to 1, and the latent variable was forced to have a 0 covariance with the substantive factors. This strategy is akin to including sets of error correlations between items worded similarly to capture additional covariance between them not accounted for by the primary factor, but the approach costs fewer degrees of freedom than a set of (unrestricted) error correlations and it explicitly acknowledges the effect of wording similarities in potentially affecting the response (Agarwala & Lynch, 2006).

RESULTS

Resilience

The initial resilience model consisted of a single latent factor with all items loading on it. This model did not fit well, (Table 2, Res 1; RMSEA=.079; TLI=.89; CFI=.90). Inspection of standardized factor loadings and reliabilities showed that the items cluster into four groups. One group had factor loadings above .74; a second had factor loadings ranging from .61 to .70; a third had factor loadings ranging from .48 to .52; and a fourth had factor loadings ranging from .28 to .34. Based on these results, we estimated a second model with four factors, with items 11, 12, 17, and 24 loading on the first factor; with items 1, 4, 5, 7, 8, 10, 14, 16, 19, 21, 22, and 23 loading on the second factor; with items 6, 13, 15, 18, and 25 loading on the third; and with items 2, 3, 9, and 20 loading on the fourth. The model fit better than the first model (Table 2, Res 2; RMSEA=.061; TLI=.93; CFI=.94), but still not well. Further, the covariance matrix of the latent variables was not positive definite, indicating that the matrix may contain a negative variance or imply a correlation of greater than one between latent variables. In fact, the correlation between the first and second latent variable in this model was .97, and the correlation between the second and third was .92.

Thus, a third model was created combining the items from factor 1 and 2 into a single factor, resulting in a three-factor model. This model (Table 2, Res 3; RMSEA = .061; TLI = .93; CFI = .94) had nearly identical fit to that of the second, but the covariance matrix of the factors was positive definite. However, inspection of factor loadings, reliabilities, correlation between the first and (new) second factor, and modification indices suggested several ways to improve the model's fit. First, both the factor loading and reliability for item 20 indicated that this item does not fit well with the other items in the battery (loading =.45 vs. .59 or higher for other items on factor 4; reliability =.20 vs. .30 or higher for all other items except 15). Second, the correlation between the first and third factors was .88, which is large enough to question whether it is substantively meaningful to treat them as separate factors. Third, modification indices suggested that allowing the items associated with the third factor to load on factors 1 and 2 would improve model fit. Taken together, these results point to a single latent factor that excludes item 20, and possibly 2, 3, and 9.

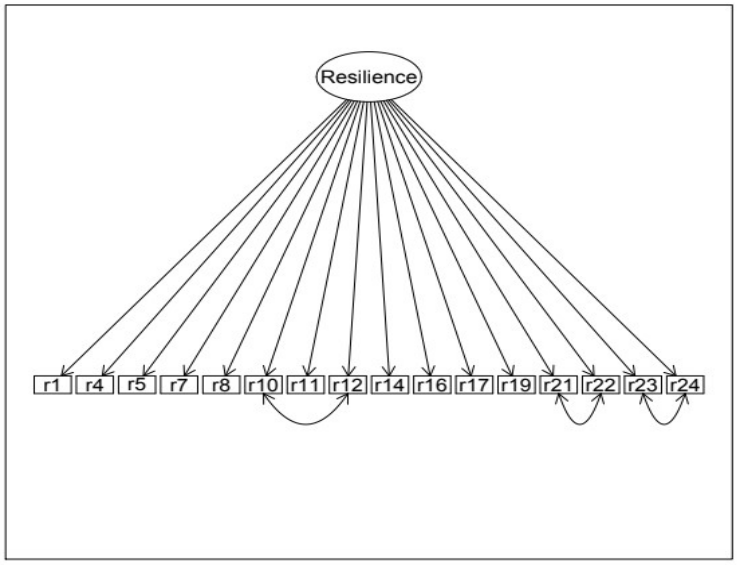
Thus, we estimated a fourth model consisting of a single factor and excluding these four items. This model fit better than previous models but still not well (Table 2, Res 4; RMSEA=.057; .TLI=.96; CFI=.96). Inspection of the item reliabilities showed that items 6, 13, 15, 18, and 25 had very low reliabilities (all below .28). Further examination of these items indicated that they appear to capture the extent to which the respondent is willing to take on leadership roles and perceives that social support is available in times of need. One of the authors of this paper, a member of the SEAL community, suggested perhaps these items may not be clear measures of resilience in this population during BUD/S selection and assessment, thus they were excluded from the fifth model. These adjustments enhanced the comparative fit indices, but not the absolute fit index (Res 5; RMSEA=.058; TLI=.97; CFI=.97).

Inspection of the remaining 16 items suggested that these items are distinct from the dropped items: the remaining items appear to capture the extent to which individuals feel they are able to handle difficult situations, while the dropped items ask respondents about (1) the extent to which they cope with situations via particular approaches (e.g., by turning to a higher power, turning to friends, seeing humor in difficult situations) and (2) the extent to which they are willing to take on leadership roles in such situations. Further inspection of the remaining items and modification indices led us to incorporate three error correlations (first, between items 21 and 22, and later, between items 10 and 12, and 23 and 24). These correlations improved the model fit substantially (Res 6; RMSEA=.035; TLI=.99; CFI=.99) but do not change the overall substantive conclusions. The final factor structure for resilience is shown in Figure 1.

TABLE 2
RESULTS OF CONFIRMATORY FACTOR ANALYSIS FOR RESILIENCE, HARDINESS, AND GRIT

Model	Description	RMSEA	TLI	CFI	Chi-Squ/df
Res 1	Single Factor	.079	.89	.90	888.8/275
Res 2	Four factor structure	.061	.93	.94	617.9/269
Res 3	Three factor structure	.061	.93	.94	630.6/272
Res 4	One factor minus items 2, 3, 9, 20	.057	.96	.96	403.9/189
Res 5	Res 4 minus items 6, 13, 15, 18, 25	.058	.97	.97	227.1/104
Res 6	**One factor, Res 5 + error correlations**	**.035**	**.99**	**.99**	**145.4/101**
Hard 1	Single Factor	.129	.61	.67	622.0/90
Hard 2	Single Factor w/ negative wording (neg. word) factor	.118	.67	.72	529.9/89
Hard 3	Single Factor w/ neg. word minus 3 and 14	.095	.80	.84	268.0/64
Hard 4	Three Factor structure	.072	.88	.90	247.4/87
Hard 5	Three Factor structure w/ neg. word	.069	.89	.91	231.5/86
Hard 6	**Three Factor structure w/ neg. word minus drs9**	**.052**	**.94**	**.95**	**142.6/73**
Hard 7	Three Factor structure w/ neg. word minus drs9 and drs8	.058	.94	.95	132.7/61
Grit 1	Single Factor	.097	.88	.90	232.9/54
Grit 2	Single Factor w/ neg. word factor	.061	.95	.96	122.2/53
Grit 3	**Single Factor w/ neg. word minus g3 and g11**	**.050**	**.97**	**.98**	**64.2/34**
Grit 4	Single Factor w/ neg. word minus g4 and g10	.061	.97	.98	44.1/19
Grit 5	Two Factor from literature	.077	.93	.94	163.7/53
Grit 6	Two Factor + corr=1 constraint (i.e., Grit)	.097	.88	.90	232.9/54
All	**Grit 3, Hard 6, Res 6 final (bold) models**	**.037**	**.96**	**.96**	**1066.7/724**

FIGURE 1
FACTOR STRUCTURE OF FINAL RESILIENCE MODEL (RES 6)

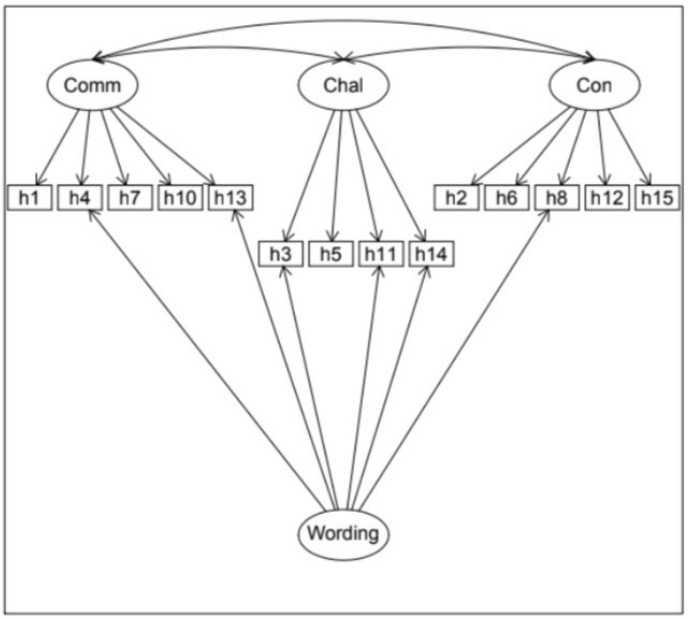


Hardiness

Similar to our approach with resilience, our initial model for hardiness consisted of a single latent factor with all items loading on it. This model did not fit well (Table 2, Hard 1; RMSEA=.129; TLI=.61; CFI=.67). The second hardiness model included a latent factor capturing possible question wording effects. This model fit the data only marginally better but not well (Table 2, Hard 2; RMSEA=.118; TLI=.67; CFI=.72). Inspection of the standardized factor loadings showed that items 3 and 14 had particularly low loadings (.29 and .25, respectively) compared to the loadings of the other items (ranging from .36 to .78). Thus, we estimated a third model that excluded these items. This model fit better but still not acceptably well (Table 2, Hard 3; RMSEA=.095; TLI=.80; CFI=.84). Subsequent iterations of inspection of standardized coefficients and reliabilities and dropping items (11, 9, and 5) worsened model fit.

Prior literature (Bartone et al., 1989) suggests a three factor structure for the hardiness instrument, with items 1, 4, 7, 10, and 13 comprising a "commitment" factor; items 2, 6, 8, 12, and 15 comprising a "control" factor; and items 3, 5, 11, and 14 comprising a "challenge" factor. We estimated this model and obtained a very poor initial fit, albeit better than our single factor models (Table 2, Hard 4; RMSEA=.072; TLI=.88; CFI=.90). In our fifth hardiness model, a latent factor was incorporated capturing the negative wording of some items. The model fit better, but still not acceptably well (Table 2, Hard 5; RMSEA=.069; TLI=.89; CFI=.91). Finally, inspection of standardized coefficients and reliabilities suggested that item 9 loaded poorly and had poor reliability. Thus, we estimated a model excluding that item. This model had reasonable fit (Table 2, Hard 6; RMSEA=.052; TLI=.94; CFI=.95). Further inspection of standardized loadings and reliabilities suggested the fit may be improved by dropping item 8. However, as Table 2 indicates, dropping that item lowered the overall fit indices. Thus, item 8 was retained. Our final model, therefore, consisted of a three factor structure with a latent factor capturing negative wording, as shown in Figure 2.

FIGURE 2
FACTOR STRUCTURE OF FINAL HARDINESS MODEL (HARD 6)



Grit

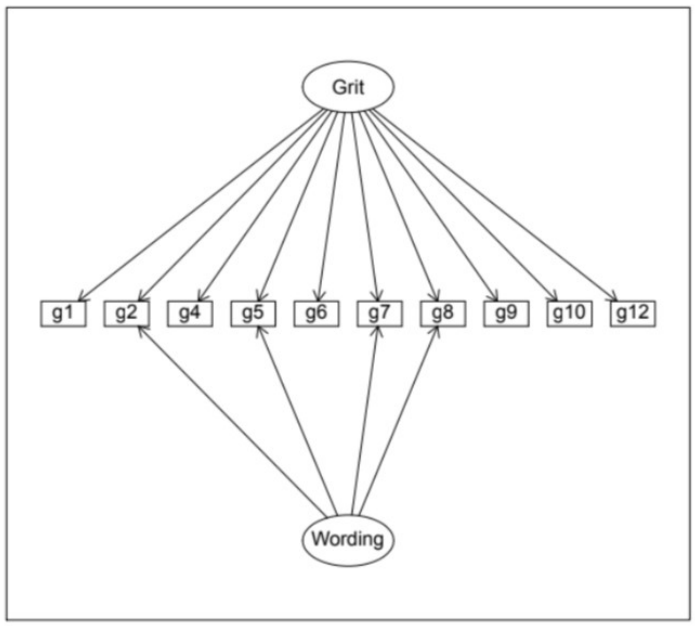
As with the previous traits, our first grit model included all items loading on a single grit factor. As Table 2 shows, this model did not fit the data well (Table 2, Grit 1; RMSEA=.097; TLI=.88; CFI=.90). A second model was estimated with a latent factor capturing the negative wording of items 2, 3, 5, 7, 8, and 11. This model fit substantially better but was still unsatisfactory based on the standard measures of model

fit (Table 2, Grit 2; RMSEA=.061; TLI=.95; CFI=.96). Inspection of the standardized factor loadings and item reliabilities suggested that items 3 and 11 did not load well on the single grit factor. The standardized factor loading for items 3 and 11 were .31 and .21, respectively, while the loadings for the other variables ranged from .39 (item 2) to .81 (item 9). The reliabilities for these items were .33 (item 3) and .28 (item 11), respectively, while the reliabilities for the other items ranged from .22 (item 4) to .65, with most above .40. We estimated a third model that excluded items 3 and 11. This model fit well (Table 2, Grit 3; RMSEA=.05; TLI=.97; CFI=.98). All factor loadings were above .4, ranging from .40 to .79, and all item reliabilities were .35 or higher, except for those of items 4 and 10. Items 4 and 10 had reliabilities of .23 and .29, respectively. A fourth model that excluded these items did not fit quite as well (Grit 4; RMSEA=.061; TLI=.97; CFI=.98). Further, given the low factor loadings and the face validity of items 3 and 11 we opted to exclude them. However, upon further inspection items 4 and 10 appear to be clear measures of grit despite their low reliability in this sample; thus, we retained them, especially given that excluding them hurt overall model fit.

In the literature, the 12-item grit battery has been argued to measure two grit factors—perseverance of effort and consistency of interest (e.g. Duckworth et al., 2007). Thus, our fifth model modeled this two-factor structure. This model did not fit our data well (Grit 5; RMSEA=.077; TLI=.93; CFI=.94). Inspection of the items showed that the two-factor structure most likely results from the negative wording of the items. That is, the two-factor model consists of one factor with entirely positively worded items, while the other factor consists of all of the negatively worded items. We estimated a sixth model that consisted of two factors, with the correlation between factors set to 1 in order to determine whether the two-factor model could be viewed as a single factor model (without wording effects). The fit of this model is necessarily equivalent to that of Model 1, which posited a single grit factor with all items loading on it, and the fit is poor (Grit 6; RMSEA=.097; TLI=.88; CFI=.90).

In conclusion, our results indicate that items 3 ('My interests change from year to year') and 11 ('I become interested in new pursuits every few months') may not be important in our population for a single underlying grit factor, and that a single underlying grit factor with 10 measures is reasonable once the negative wording of some of the items is considered. This final factor structure is shown in Figure 3.

FIGURE 3
FACTOR STRUCTURE FOR FINAL GRIT MODEL (GRIT 3)



Resilience, Hardiness, and Grit

After obtaining final factors for resilience, hardiness, and grit as shown in the figures, we estimated a final model that included final factors for all concepts. The last line in Table 2 shows that this model fits the data quite well, with an RMSEA of .037, a TLI of .96 and a CFI of .96. Results from this final model can be found in Table 3. The top half of the table reports the standardized factor loadings and reliabilities for all items included in the final model. As the table shows, factor loadings are largely of similar magnitude within factors, and reliabilities are generally well above .3 or .4, with some exceptions. Specifically, grit 10 has a reliability of .22, and hardiness item 6 has a reliability of .27. However, as noted above, removing grit item 10 hurt the model fit significantly, and there was no indication in the models for hardiness that item 6 should be excluded.

The bottom half of Table 3 shows the correlation matrix of the latent variables. The results reveal that grit and resilience are very highly correlated (.86), and that hardiness-commitment is highly correlated with both grit and resilience (.70 and .79, respectively). Although these correlations suggest that these concepts may be combined into a single concept, further investigation showed that doing so worsened model fit.

TABLE 3
STANDARDIZED FACTOR LOADINGS AND RELIABILITIES OF ITEMS CORRESPONDING TO RESPECTIVE LATENT FACTORS AND CORRELATION MATRIX OF FACTORS

Item	Resilience	Hardiness	Grit
1	.70/.50	(1).69/.48	.69/.47
2	--	(2).76/.58	.42/.39
3	--	(3).55/.40	--
4	.68/.46	(1).65/.53	.57/.33
5	.64/.41	(3).69/.47	.44/.41
6	--	(2).52/.27	.68/.46
7	.59/.35	(1).71/.51	.63/.61
8	.68/.47	(2).55/.41	.60/.57
9	--	--	.72/.52
10	.65/.42	(1).70/.49	.47/.22
11	.79/.63	(3).87/.86	--
12	.74/.54	(2).83/.69	.64/.40
13	--	(1).52/.38	na
14	.63/.40	(3).54/.40	na
15	--	(2).81/.65	na
16	.62/.38	na	na
17	.81/.66	na	na
18	--	na	na
19	.66/.44	na	na
20	--	na	na
21	.72/.52	na	na
22	.71/.51	na	na
23	.60/.36	na	na
24	.81/.65	na	na
25	--	na	na

Correlation Matrix of Factors

		(Hardiness Factors)					
	Resilience	(1)Commitment	(2)Control	(3)Challenge	Grit	Hardiness Wording	Grit Wording
Resilience	1						
Commitment	.79	1					
Control	.68	.58	1				
Challenge	.37	.35	.21	1			
Grit	.86	.70	.47	.19	1		
Hardiness Word.	0	0	0	0	0	1	
Grit Word.	0	0	0	0	0	.17	1

Note. Item numbering refers to within-battery numbering (i.e., item 1 is grit1, resilience1, or hardiness1). "na" means there is no such item in a battery, while "—" means the item exists but was excluded from the model.

DISCUSSION

This study addressed theoretical, reliability, and validity issues of previous research through a unique sample especially suited for the analysis of the concepts of resilience, hardiness, and grit. The present study, to address limitations of other resilience research (e.g., Dixon & Bares, 2018), utilized the full 25-item CD-RISC (Connor & Davidson, 2003) which enables more robust analysis, versus the 10-item scale used in other construct assessment papers of resilience. We take initial steps in addressing some of the limitations with grit (Credé, 2018; Credé et al., 2017), by examining grit's construct validity. Further, this research addressed the low levels of reliability reported as a limitation in Georgelous-Sherry and Kelly's (2019) study examining resilience, hardiness, and grit in two ways. First, we applied confirmatory factor analysis methods that explicitly accounted for the categorical nature of the variables. Second, through the use of statistical models, the research focused on defining a more parsimonious measure of each concept as well as the three concepts together.

The present research developed a more parsimonious measure of resilience. While the model fit is specific to this sample, studies in other samples of individuals in arduous training environments or those who work in high-stress environments may benefit from testing this model to see if similar fit indices emerge. These findings are distinct from previous studies (e.g., Dixon & Bares, 2018; Lamond et al., 2008; Yu & Zhang, 2007). This study's 16-item solution is somewhat similar to Green et al.'s (2014) findings; yet, there are clear distinctions in the items retained and the single factor structure indicated in this sample of SEAL candidates. This finding could highlight how resilience is distinct in differing contexts, specifically contexts where an individual is operating in a high-stress environment such as during military training or deployments, intense business and occupational environments, and/or sports.

Further, our results differ from Bezdjian et al.'s (2017) findings which suggest resilience could be reliably measured by retaining all 25-items of the CD-RISC. Perhaps most importantly, the present study indicates that it may be important to consider the demography and unique situation of the sample, and the related utility of items based on their wording. For example, by dropping items that focused on external factors that may contribute to resilience and leadership, model fit was substantially improved in this group of individuals that was persisting through an arduous training environment.

Findings for the hardiness concept closely aligned the seminal authors' (Bartone et al., 1989) indication of a construct composed of three factors (commitment, control, and challenge). However, in this sample, model fit was improved by dropping an item and considering the negatively worded items. Negatively worded items can be a challenge because of the changes in item polarity (DeVellis, 2017); thus, this approach accounts for potential issues that arise with negatively worded items.

While this study does not address the concerns with the measurement of grit lacking a passion component (e.g., Jachimowicz et al., 2018; Jordan et al, 2019) or the concerns regarding its distinction from conscientiousness (e.g., Credé et al., 2017; Ivcevic & Brackett, 2014; Rimfeld et al., 2016; Schmidt et al.,

2020), it does address Credé et al.'s (2017) call for more robust analysis of the concept. One critical contribution is the development of a more parsimonious measure of grit, which includes consideration of the negatively worded items. In this sample, the best fitting model was one that dropped two items and considered the negative wording. While these two items are dropped in the Short Grit Scale (Grit-S, Duckworth & Quinn, 2009), dropping the additional two items (which do not appear in the Grit-S) did not improve model fit.

While previous research (e.g., Abuhassàn & Bates, 2015, Credé et al., 2017) indicates that the perseverance of effort subfactor of grit may have more utility than the consistency factor, much of the grit research does not consider the negative wording (agreement with the item indicating lower levels of the trait) of the items that are indicated to align with the consistency of interest subfactor of grit. All six original items of the Grit Scale that Duckworth et al. (2007) indicated should fall under the consistency of interest subfactor are negatively worded items; this same pattern emerges with the Grit-S Scale (Duckworth & Quinn, 2009) with all four items that align with the consistency of interest factor negatively worded items. The negative wording alone could be a contributing aspect to why other studies have found those items to be part of a distinct subfactor (e.g., Abuhassàn & Bates, 2015; Duckworth et al., 2007; Duckworth & Quinn, 2009). While many scales use both negatively and positively worded items, the reversals in item polarity can pose an issue (DeVellis, 2017). As such, it is important to consider the effects of the negatively worded items, which this study found was an important consideration for model fit in this sample. This consideration of the negatively worded items in both the hardiness and grit measures highlights the importance of accounting for the item polarity that can emerge with negatively worded items in future studies that use these instruments.

Beyond analyzing each concept individually, this study assessed the distinctions between resilience, hardiness, and grit. Similar to Georgelous-Sherry and Kelly (2019), this study revealed that the three concepts were distinct from each other in this sample of SEAL candidates. Due to the high correlations between grit and resilience (.86) and hardiness-commitment and grit (.70) and resilience (.79), we tested a model in which all measures were combined into a single construct. However, model fit was significantly diminished with such a model; supporting the notion that each concept is accounting for unique variance in our sample.

Resilience, with its emphasis on positive adaptation and adjustment in the face of challenge (Luthar et al., 2000), hardiness's emphasis on one's ability to endure over time with a sense of control and openness (Kobasa, 1979; Bartone et al., 1989), and grit, with its focus on preserving toward a long-term goal (Duckworth et al., 2007), potentially all provide a unique insight into individual "persistence" and "perseverance." Our research seems to suggest that each concept measures a slightly different theoretical component of persistence and perseverance. The persistence and perseverance toward long-term goal aspect of grit may be what distinguishes it from the measures of resilience and hardiness. The measure of resilience may be capturing one's adaptability in the face of major obstacles, which is less focused on a goal, but rather driven by one's adjustment capabilities and underlying purpose. Hardiness may be capturing aspects of endurance through life more generally which too may be driven by an underlying purpose. However, unlike resilience with its focus on overcoming grand challenges, hardiness captures persistence through daily challenges.

This study empirically supported the conceptual distinctions between grit and hardiness presented by Raver Luning and Ledford (2020). Hardiness's focus on a generalized persistence through life seems to separate it from grit, where individuals persevere due to their desire to achieve a specific long-term goal. Due to these nuanced differences between resilience, hardiness, and grit, it is important to generate a greater understanding of how each plays a role in operating in high-stress environments. For example, business managers and leaders may need to focus on how to adapt in the face of challenge (resilience), endure the daily obstacles of a complex organization or environment (hardiness), and maintain a long-term focus on a goal and the ability to persist toward that goal despite obstacles (grit). Further, focus on developing and using all three nuanced aspects of "persistence" and "perseverance" may serve an important role in human performance. Moreover, those leading in high-stress environments (military, business, sports) may need to understand how to develop all three in the individuals in which they are leading to ensure their teams can

persist through the challenges in their respective organizational environments. Ultimately, this study highlights the importance of considering all three traits in research examining human performance.

CONCLUSION

This study provides a concise analysis of the concepts of resilience, hardiness, and grit. It provides a method to discern between similar ideas, while providing ample explanation of the distinctions between items and constructs. The research supports and extends Georgelous-Sherry and Kelly's (2019) research. The present research finds the traits to be distinct and unique, and provides a more parsimonious measure of resilience, hardiness, and grit. This parsimony is extremely useful in a variety of contexts, but perhaps most useful in the business setting. Further, the research utilized a uniquely assembled sample, one that enables researchers to access a large sample of resilient, hardy, and gritty participants who help to illuminate the measures in ways not previously measured.

As with most research, there are limitations, the most significant in this study are from the self-assessed instruments and the sample population. Given the self-report nature of the study whereby the subjects filled out the surveys, there was no external validation of responses. Another limitation stems from the homogeneity of the sample. Individuals attending BUD/S training are extremely fit, predominantly between 18 to 27 years old, and at the time of this research all male. While this homogeneity is understandable, it is unlikely that this data is a perfect representation of the entire SOF or military population, much less the general public. However, this research does provide implications for the traits of resilience, hardiness, and grit in individuals who operate in high-stress environments.

Future research focused on a more heterogeneous sample may provide additional support for these findings or potentially indicate less construct distinction between resilience, hardiness, and grit. In either case, future research examining the distinctions or similarities between resilience, hardiness, and grit will provide insight into the underlying characteristics and traits that contribute to "persistence" and "perseverance," which ultimately will contribute to the scientific knowledge regarding human performance.

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