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# Validating the Grit-S scale among postgraduate students in a South African distance education institution

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Grit has been associated with student success in a plethora of higher education (HE) studies. In order to measure and evaluate the predictive validity of grit in student success in a particular context, an appropriate, reliable and valid instrument is required. This paper examines the short grit scale's (Grit-S) psychometric properties among a sample of 837 postgraduate students enrolled at the University of South Africa (UNISA). This appears to be the first study to explore the psychometric rigour of the scale among postgraduates within a South African distance education (DE) setting. An exploratory factor analysis (EFA) followed by partial confirmatory factor analysis (PCFA) revealed that the same two factors commonly reported in the grit literature could be detected in the items tested (i.e. 'passion' and 'perseverance' for long-term goals), and in combination explained 57.22% of the variance. Model fit indices for the two-factor solution were satisfactory (NFI = 0.984; TLI = 0.981; CFI = 0.991; RMSEA = 0.038). Further results from the item analysis indicated that both factors (passion and perseverance) were soundly reliable, as was the overall Grit-S scale, yielding Cronbach Alpha values of  $\geq 0.77$ . Overall, the study provides promising evidence that the Grit-S scale can validly and reliably be used to operationalise grit (and the separate dimensions of perseverance and passion) among postgraduates pursuing their DE studies. Further theoretical and practical implications are discussed.

## KEYWORDS

psychological grit, psychometric properties, distance learning, postgraduates, South Africa

## 1. Introduction

Psychological grit has garnered much attention over the last 15 years and has widely been touted as the panacea to predicting student retention and success among traditional tertiary students (Duckworth et al., 2007; Wu et al., 2012; Cross, 2014; Salles et al., 2014; Reraki et al., 2015; Beyhan, 2016; Akos and Kretchmar, 2017; Broghammer, 2017; Lee and Sohn, 2017; Muenks et al., 2017; Pate et al., 2017; Salles et al., 2017; Mason, 2018; Rogalski, 2018; Terry and Peck, 2020; Sulla et al., 2022). In addition to this body of predictive validity, the Grit-S scale has demonstrated accepted construct validity and reliability levels among these student populations. Although noteworthy, the focus on traditional students precludes the generalizability of the psychometric properties of the Grit-S scale to other student populations (Xu et al., 2020). With the majority of the psychometric reports emanating from traditional, full-time students, or those enrolled in atypical educational settings (such

as Ivy-League institutions or military academies), the importance of examining grit's factorial stability in distance education (DE) cohorts cannot be overstated, especially considering the online impetus driven by COVID-19 (Karaman et al., 2019). Moreover, as Xu et al. (2020) rightly allude to, little is known about grit in DE and whether it can be reliably measured across culturally, ethnically and linguistically diverse student populations – characteristic of the South African DE student population. It is against this brief introduction that the current paper explores whether the Grit-S scale exhibits reasonable construct validity and reliability among postgraduate students in a diverse South African DE environment.

## 2. Defining and measuring psychological grit

It is essential to first define grit in the context of this paper and then outline how the conceptualization of grit can be measured. The following section deals with both the definition and measurement of grit.

### 2.1. Definition

Psychological grit was first coined by Duckworth et al. (2007) and is typically operationalised as a higher-order construct with two lower-order facets: consistency of interest (also referred to as passion) and perseverance (of effort). The first dimension, passion, measures an individual's self-reported tendency to pursue (and remain invested in) the same goal over a long period. In contrast, perseverance refers to an individual's propensity to maintain the energy and time needed to achieve this goal, despite potential distractions and setbacks (Mullen and Crowe, 2018).

### 2.2. Developing a measure of grit

Prompted by the absence of an adequate measure for grit, Duckworth and colleagues initially tested a pool of 27 Likert-scale items (believed to tap into the construct of grit) among 1,545 adults to explore hidden dimensions and reliability coefficients (Duckworth et al., 2007). Owing to poor item-total correlations, redundancy and complex vocabulary, these 27 items were reduced to 17. Next, using half of the sample chosen randomly ( $n = 772$ ), an exploratory factor analysis (EFA) was conducted on these 17 items to explore the underlying factor structure. While this analysis suggested removing five items, two dimensions emerged and were deemed valid and likely to produce consistent results over time. The resulting two-factor, correlated model ( $r = 0.45$ ) was retained and comprised the passion dimension (or consistency of interest; six items) and the perseverance (of effort) dimension (6 items).

To test the integrity of this two-factor solution, Duckworth and colleagues performed a confirmatory factor analysis (CFA) with the remaining 773 participants in the sample. Although the results demonstrated a relatively poor fit for the two-factor structure (Comparative Fit Index, CFI = 0.83; Root mean square error of approximation, RMSEA = 0.11), the overall scale demonstrated high

internal consistency ( $\alpha = 0.85$ ) and thus became known as the Grit-O scale.

A couple of years later, Duckworth and Quinn (2009) examined the performance of the Grit-O scale in four different samples. Owing to low item-level correlations, four items (i.e. two from each dimension) were removed from the Grit-O scale. The resulting 8-item survey<sup>1</sup> was labelled the Grit-S scale and exhibited more robust psychometric properties and better indices of fit when compared to its 12-item counterpart (Duckworth and Quinn, 2009). These findings, along with others from around the globe, are discussed next.

## 3. Scale validation from across the globe

The two-factor structure of grit is commonly cited in educational research (Duckworth and Quinn, 2009; Arslan et al., 2013; Christensen and Knezek, 2014; Meriac et al., 2015; Reraki et al., 2015; Rojas, 2015; Stewart, 2015; Datu et al., 2016; Broghammer, 2017; Pate et al., 2017; Arco-tirado et al., 2018; Collaço, 2018; Rojas and Tyler, 2018). In the earliest and perhaps most seminal of these studies, Duckworth and Quinn (2009) showed that the two-factor structure of the Grit-S scale held an acceptable level of model fit among two cohorts of West Point cadets<sup>2</sup> (CFI  $\geq 0.950$ , RMSEA  $< 0.07$ ). More importantly, these results revealed that the two-factor model fit the data significantly better (when compared to a single-factor solution) as indicated by a significant chi-square difference,  $\Delta\chi^2(1) = 191.93$ ,  $p < 0.001$ .

Within a HE setting, the two-factor solution exhibited good levels of fit among both traditional (CFI  $> 0.98$ , RMSEA  $< 0.05$ ; Pate et al., 2017; Rojas and Tyler, 2018) and non-traditional students in the United States (CFI = 0.98, RMSEA = 0.06; Meriac et al., 2015), as well as among Filipino students enrolled in a private higher education institution (CFI = 0.97, TLI = 96, RMSEA = 0.05; Datu et al., 2016). Further studies conducted in various countries including Spain, Turkey, Italy, Poland, and the Netherlands have also shown that the two-factor model demonstrates acceptable levels of fit in translated versions of the Grit-S scale among tertiary students. These studies have reported CFI indices of at least 0.920, RMSEA of no more than 0.08, and SRMR indices of less than 0.08 (Arslan et al., 2013; Reraki et al., 2015; Saricam et al., 2016; Wyszzyńska et al., 2017; Arco-tirado et al., 2018; Sulla et al., 2018; Xu et al., 2020).

Although limited, there is some support for the two-factor grit structure among DE students. Xu et al. (2020) compared one and

1 Although the responses to the eight items are Likert-scale in nature and thus categorical (ranging from *Very much like me* to *Not like me at all*), Duckworth and Quinn (2009) recommend calculating an average of these items to ascertain an individual's level of grit. To do so, the categorical responses of each item are assigned a corresponding value (from 1 to 5). These scores are then used to calculate an average grit score ranging from 1.00 (not at all gritty) to 5.00 (extremely gritty).

2 The United States Military Academy (USMA), commonly known as West Point, is a renowned institution for educating and training future military officers of the United States Army.

two-factor solutions (for both the Grit-O and Grit-S scales) among DE students in the Netherlands using an item response theory (IRT) CFA ( $n=2,027$ ). The first model assumed uni-dimensionality, whereas the second tested the two-factor structure with passion and perseverance as separate dimensions. Concurrent with other findings in the field, the two-factor model of grit fit the data significantly better than a one-factor solution for both scales (Xu et al., 2020). Moreover, the two-factor Grit-S model fitted the data better than the earlier two-factor Grit-O model.

There are however more recent studies which have favoured a unidimensional structure of grit (Gonzalez et al., 2020; Postigo et al., 2021). These studies have reported model fit indices ranging between 0.89 and 0.98 (CFI) and RMSEA values between 0.12 and 0.05, respectively. Regardless of whether commonly-accepted thresholds have been met (CFI > 0.95 and RMSEA < 0.06; Hu and Bentler, 1999), the findings by Gonzalez et al. (2020) emanate from samples outside of a HE setting (as do those by Postigo et al., 2021). Moreover, Postigo et al. (2021) developed a new measure of grit (i.e. the Oviedo Grit Scale / escala grit de Oviedo; EGO) and did not validate either of the grit scales by Duckworth et al. (2007) and Duckworth and Quinn (2009). As such, although these results highlight a lack of clarity which still exists on the dimensional aspect of the construct, their applicability in the current paper is limited.

### 3.1. A notable (validity) gap

While worthy of comparison, particularly due to the shared tertiary setting, most of the studies mentioned above focused on undergraduate students in traditional, face-to-face HEIs abroad, thus limiting the generalisability to other contexts. In addition, although grit has been explored among postgraduate students (Burkhart et al., 2014; Salles et al., 2014; Aswini and Deb, 2017; Palisoc et al., 2017; Kannangara et al., 2018) and South African students (Urban and Pendame, 2015; Mason, 2018), the psychometric analyses in these studies are either non-existent or focus only on the reliability of the scale. More importantly, although reported among DE students (Xu et al., 2020), the psychometric properties relate solely to a sample of students in the Netherlands (whose grit scales were translated into Dutch). As such, the absence of comparable findings suggests that this paper is one of the first to explore the factor structure of the English version of the Grit-S scale using a sample of South African postgraduate DE students.

## 4. Reliability indices from across the globe

Spanning over a decade, grit and its dimensions have shown to be reliable across a range of student populations. In the earliest of these studies, Duckworth and Quinn (2009) reported an overall reliability estimate of 0.83 for the Grit-S scale among Ivy League undergraduates in the United States ( $n=139$ ). Further analyses revealed reliability coefficients of 0.79 and 0.78 for the passion and perseverance domains, respectively. Additional research emanating from contact-based institutions in the United States

has attested to the reliability of the Grit-S scale among undergraduates, with Cronbach's alpha coefficients ranging from 0.73 to 0.84 (Akos and Kretchmar, 2017; Rojas and Tyler, 2018; Luthans et al., 2019).

Reraki et al. (2015) conducted a study with undergraduate students in Turkey and found similar results, reporting an overall Cronbach's alpha of 0.88 for the Grit-S scale. More recently, Arcotirado et al. (2018) and Sulla et al. (2018) conducted studies with undergraduate students in Spain and Italy, respectively, and found that the Grit-S scale also produced reliable results, with Cronbach's alpha coefficients of 0.75 and 0.76. In addition to these European statistics, research emanating from Korea has attested to the reliability of the Grit-O scale among a sample of undergraduates ( $\alpha=0.75$ ; Hwang et al., 2017).

From a global south perspective, the Grit-S and Grit-O scales have also shown to produce reliable results among undergraduate students in contact-based universities in South Africa (Urban and Pendame, 2015; Mason, 2018). In the most recent of these South African studies, Mason (2018) revealed that the Grit-O scale, along with its subscales of passion and perseverance, exhibited good reliability among first-year students in undergraduate programmes at a university of technology ( $\alpha=0.81$ ,  $\alpha=0.80$ , and  $\alpha=0.78$ , respectively). The Grit-S scale, by similar token, demonstrated acceptable levels of reliability among final-year undergraduates enrolled in a traditional university in South Africa, producing a reliability coefficient of 0.71 (Urban and Pendame, 2015). Clearly, there is substantial evidence to support the reliability of the grit scales among various undergraduate cohorts (see Table 1 for a chronological record of the reliability coefficients derived from previous research in the higher education sector).

### 4.1. A notable (reliability) gap

Lamentably though, there is a paucity of research on the topic among postgraduate students. Only a handful of studies have examined the reliability of the grit scales among postgraduates, and these remain confined to contact-based settings. For instance, Aswini and Deb (2017) found that the Grit-O scale (and each of its dimensions) produced reliable results among 101 master's and doctoral students in India, with Cronbach's alpha coefficients ranging from 0.70 to 0.83. Most recently, Kannangara et al. (2018) revealed that the same scale exhibited high levels of reliability among 39 postgraduate students in the United Kingdom, with an overall coefficient of 0.85.

To date, the absence of psychometric analyses to directly compare findings is apparent. Although South African studies have explored certain psychometric properties of the grit scales (Urban and Pendame, 2015; Mason, 2018), the research findings are limited to contact-based undergraduate samples. And while assessed among distance learning students (Hwang et al., 2017; Xu et al., 2020), the findings relate specifically to Korean and Dutch versions of the scale, respectively. Against this deficit, the current paper aims to contribute by reporting on the psychometric properties of the English version of the Grit-S scale among a South African sample of DE students. This aim, along with the research questions, is outlined below.

TABLE 1 Reliability coefficients derived from a decade of research in higher education (2009–2022; Young, 2020).

Year	Study	Sample	Scale	Grit ( $\alpha$ )	Passion ( $\alpha$ )	Perseverance ( $\alpha$ )
2009	Duckworth & Quinn	UG	Grit-S	0.83	0.79	0.78
2013	Arslan, Akin & Çitemel	UG	Grit-S	Not reported	0.91	0.87
2015	Reraki et al.	UG	Grit-S	0.88	Not reported	Not reported
2015	Bowman et al. (Sample 1)	UG	Grit-S	Not reported	0.71	0.73
2015	Bowman et al. (Sample 2)	UG	Grit-S	Not reported	0.70	0.75
2015	Urban & Pendame	UG <sup>b</sup>	Grit-S	0.71	0.75	0.73
2015	Stewart	UG	Grit-O	0.75	0.72	0.77
2015	Meriac et al.	Unknown	Grit-S	0.75	0.75	0.65
2015	Lucas et al.	UG	Grit-S	0.73	Not reported	Not reported
2015	Vela et al.	UG	Grit-S	0.73	Not reported	Not reported
2016	Datu, Valdez & King	UG	Grit-S	Not reported	0.61	0.61
2016	Hill, Burrow & Bronk	UG	Grit-S	0.71	Not reported	Not reported
2017	Lee & Sohn	UG	Grit-O	Not reported	0.79	0.67
2017	Akos & Kretchmar	UG	Grit-S	0.77	0.67	0.70
2017	Broghammer	UG	Grit-S	0.75	0.66	0.65
2017	Hwang et al.	UG <sup>a</sup>	Grit-O	0.75	0.68	0.70
2017	Aswini & Deb	PG	Grit-O	0.82	0.83	0.70
2018	Hodge, Wright & Bennett	UG	Grit-S	Not reported	0.80	0.71
2018	Rojas & Tyler (Sample 1)	UG	Grit-O	0.84	0.85	0.83
2018	Rojas & Tyler (Sample 2)	UG	Grit-O	0.84	0.86	0.82
2018	Luthans, Luthans & Chaffin	UG	Grit-S	0.73	Not reported	Not reported
2018	Mason	UG <sup>b</sup>	Grit-O	0.81	0.80	0.78
2018	Sulla et al.	UG	Grit-S	0.76	0.76	0.61
2018	Kannangara et al.	UG & PG	Grit-O	0.85	Not reported	Not reported
2018	Brooks & Seipel	UG & PG	Grit-S	0.71	0.61	0.63
2018	Collaço	UG & PG	Grit-O	0.73	0.72	0.66
2020	Xu et al. (Original scale)	UG & PG <sup>a</sup>	Grit-O	0.79	0.82	0.67
2020	Xu et al. (Short scale)	UG & PG <sup>a</sup>	Grit-S	0.76	0.76	0.62
2023	Current study	PG <sup>a,b</sup>	Grit-S	0.72	0.77	0.62

UG, Undergraduate; PG, Postgraduate; <sup>a</sup> Distance education sample; <sup>b</sup> South African study.

## 5. Aims and research questions

Given the paucity highlighted above, the need to investigate the psychometric rigour among distance learning students is evident. The current paper aims to psychometrically evaluate the Grit-S scale among a sample of postgraduate distance learning students in South Africa by examining the inherent factor structure and the derived reliability coefficients. The following question prompted the current analysis;

1. To what extent is the Grit-S scale valid and reliable among postgraduate students in a DE institution?
2. To what extent is the two-factor solution proposed by Duckworth et al. (2007) an acceptable fit to the data?

## 6. Materials and methods

An English survey consisting of two sections (i.e. the Grit-S scale and a demographic section) was administered online during the 2017 academic year. Of the 8,689 potential participants in the target population (i.e. postgraduate students who enrolled for their qualification for the first time in 2017), 837 students submitted complete responses. A final response rate of 9.63% was calculated.

The majority of the research participants were female ( $n=587$ ; 70.1%) and between the ages of 25–29 years ( $n=203$ ; 24.3%). This was followed by 18.6% of the sample who indicated that they were between the ages of 30–34 years ( $n=156$ ). Regarding the ethnicities of the research sample, over half was African ( $n=495$ ; 59.1%), while over a quarter was white ( $n=228$ ; 27.2%). A fair majority of the research

participants were first-language English-speakers ( $n=237$ ; 28.3%).<sup>3</sup> Afrikaans and isiZulu were also prominent among the sample, comprising 14.9% ( $n=125$ ) and 14.5% ( $n=121$ ), respectively. These were followed by Setswana- ( $n=62$ ) and Northern Sotho-speaking participants ( $n=59$ ). A detailed description of the sample can be found in Young (2020).

Subsequent to analysing the demographic attributes, the Grit-S scale's factorability was assessed (using the KMO statistic and Bartlett's test of sphericity) followed by an exploration of the underlying dimensions in the scale (using exploratory factor analysis; EFA). This underlying structure was then supplemented using a partial confirmatory factor analysis (PCFA; Gignac, 2009) and the factors tested for internal consistency using Cronbach's alpha coefficients. All analyses were performed in SPSS (version 28) and are presented below.

## 7. Analysis and results

### 7.1. Pre-validity testing

As mentioned, prior to performing any factor analyses, the scale's factorability was assessed. The analysis yielded a KMO value of 0.78, attesting to the appropriateness of a factor analysis. In addition to the sampling adequacy, the chi-square derived from Bartlett's sphericity test indicated that there was a significantly strong enough relationship among the items to conduct a factor analysis,  $\chi^2(28)=1758.98$ ,  $p<0.001$ . Based on these indices, factor analysis was deemed suitable and likely to produce satisfactory results.

### 7.2. Validity testing

#### 7.2.1. Exploratory factor analysis (EFA)

After conducting factorability tests and obtaining satisfactory results, an EFA with an oblique rotation (i.e. oblimin) was performed and eigenvalues obtained. According to Kaiser's rule, which suggests retaining components with eigenvalues greater than one (Kaiser, 1960), two factors were retained. In addition to Kaiser's criterion, a parallel analysis was conducted (Patil et al., 2017) which verified the retention of two factors.<sup>4</sup> These two factors accounted for a total of 57.22% of the variance in the data, as shown in Table 2.

Upon reviewing the eigenvalues and variance explained by the two factors, the factor loadings were analysed in the pattern matrix. The analysis showed that questions 1, 3, 5, and 6 were associated with component 1 and produced factor loadings that ranged from 0.73 to 0.78 and, while questions 2, 4, 7, and 8 were linked with component 2 and exhibited factor loadings that ranged from 0.41 to 0.83. Further scrutiny of these loadings indicated that

factor 1 represented the passion subscale, while factor 2 reflected the perseverance subscale. This is shown in Table 3.

#### 7.2.2. Partial confirmatory factor analysis (PCFA)

In order to verify the two-factor structure of the Grit-S scale as proposed by Duckworth et al. (2007) and supplement the findings from the EFA, a PCFA was conducted using the approach described by Gignac (2009). It must be noted that, although a CFA appears most conventional at this stage, Gignac (2009, p. 40) argues that 'the recommendation of CFA would be more justifiable if the EFA were (first) supplemented with more relevant information as to whether the exploratively-derived factor solution is associated with a reasonable chance of being confirmed via CFA'. As such, Gignac (2009) suggests first conducting a PCFA.

Since the factorability of the Grit-S scale had already been established, a maximum likelihood estimation (MLE) with an oblimin rotation was utilised in the PCFA. The initial outcomes from the pattern matrix indicated that the results were consistent with those reported from the EFA above. See Table 4.

Next, the null model chi-square and the implied model chi-square were calculated using Bartlett's test of sphericity and the goodness-of-fit test, respectively (Gignac, 2009). Results from the current analysis revealed a null model chi-square of  $\chi^2(28)=1758.98$ ,  $p<0.001$ ; and an implied model chi-square of  $\chi^2(13)=28.42$ ,  $p<0.01$ . Although the goodness-of-fit test (i.e. the implied model chi-square) is the most commonly used test to determine model accuracy, this test is highly sensitive to the sample size, with large samples generally giving rise to results that lead to the rejection of the null hypothesis, when in fact, the factor solution is appropriate (DeCoster, 1998; Gignac, 2009). As a result of the large sample size, this statistic has been abandoned in PCFA in favour of examining multiple fit indices together with the pattern matrix. As a result, in addition to assessing the pattern matrix, five close-fit indices were calculated using the null model chi-square, the implied model chi-square, and in some instances, the sample size (Gignac, 2009). These indices included the RMSEA; standardised root mean residual (SRMR); normed fit index (NFI); Tucker-Lewis Index (TLI); and the CFI.

Based on the preceding two chi-square values, the close-fit indices were calculated. These calculations revealed an NFI of 0.984, a TLI of 0.981, a CFI of 0.991, and an RMSEA of 0.038. Based on the corresponding residual correlation matrix, SRMR was calculated at 0.020. As reported by Hooper et al. (2008) and Kline (2016), the NFI and TLI should exhibit an index value  $\geq 0.950$  (for good fit), while the cut-off for the CFI is slightly lower, suggested at 0.900. As for the other two close-fit indices, the index value for both RMSEA and SRMR should be smaller than 0.08, with values closer to 0 indicative of a progressively better-fitting model (Hu and Bentler, 1999; Hooper et al., 2008; Kline, 2016). Thus, if one were to consider the close-fit indexes collectively, as commonly recommended by Hu and Bentler (1999), and the other outputs from the PCFA and the former EFA, the two-factor solution would be considered an acceptable fit to the data in the current paper.

### 7.3. Reliability testing

To evaluate the reliability of the two dimensions in the Grit-S scale, an item analysis was conducted, and Cronbach's alpha coefficients were calculated. As a general rule of thumb, a

<sup>3</sup> The most commonly-spoken language in South Africa is isiZulu (25%). English is the sixth most common language spoken *inside* of South African households (8.1%) and the second-most prevalent language spoken *outside* of the household (16.6%; Statistics South Africa, 2020).

<sup>4</sup> 1,000 random correlation matrices generated; 95th percentile of eigenvalues.

TABLE 2 Total variance explained by the components.

Factor	Eigenvalues			
	Parallel analysis (Random Eigenvalues)	EFA (Initial Eigenvalues)	% of Variance	Cumulative %
1	1.146	2.993	37.411	37.411
2	1.092	1.585	19.813	57.224
3	1.051	0.936	11.698	68.922
4	1.015	0.647	8.082	77.004
5	0.981	0.537	6.707	83.711
6	0.946	0.512	6.398	90.109
7	0.907	0.452	5.650	95.759
8	0.862	0.339	4.241	100.000

TABLE 3 Pattern matrix from EFA.

Item	Factor 1 Passion	Factor 2 Perseverance
I have been obsessed with a certain idea or project for a short time but later lost interest (Q3)	0.781	-0.007
I often set a goal but later choose to pursue a different one (Q5)	0.778	0.030
I have difficulty maintaining my focus on projects that take more than a few months to complete (Q6)	0.760	0.113
New ideas and projects sometimes distract me from previous ones (Q1)	0.729	-0.061
I am diligent (Q8)	0.145	0.825
I am a hard worker (Q4)	0.037	0.801
I finish whatever I begin (Q7)	0.225	0.742
Setbacks do not discourage me (Q2)	-0.154	0.406

Extraction method: principal component analysis with oblimin rotation. Rotation converged in five iterations.

TABLE 4 Pattern matrix from PCFA.

Item	Factor 1	Factor 2
I am diligent (Q8)	0.848	0.075
I finish whatever I begin (Q7)	0.654	0.184
I am a hard worker (Q4)	0.653	0.034
Setbacks do not discourage me (Q2)	0.191	-0.045
I often set a goal but later choose to pursue a different one (Q5)	0.010	0.710
I have difficulty maintaining my focus on projects that take more than a few months to complete (Q6)	0.069	0.697
I have been obsessed with a certain idea or project for a short time but later lost interest (Q3)	-0.010	0.694
New ideas and projects sometimes distract me from previous ones (Q1)	-0.028	0.589

Factor 1 and Factor 2 are in opposite order to that reported in the EFA. Extraction method: MLE with oblimin rotation. Rotation converged in four iterations. Although the analysis appears to suggest the removal of Question 2 (a possible consequence of the negatively-phrased content), this item is intraneous to the core concept of grit. In Duckworth and Quinn (2009) psychometric analysis of the Grit-S scale, item two (i.e. *Setbacks do not discourage me*) exhibited a factor loading of 0.37. As a result, its inclusion may be necessary to avoid construct under-representation (Furr and Bacharach, 2014).

Cronbach’s alpha value above 0.80 is considered good; a value between 0.60 and 0.80 is acceptable; and a value below 0.60 is considered unacceptable (Field, 2009). The item analyses yielded acceptable Cronbach alpha values: 0.77 for consistency of interest (four items), 0.62 for perseverance of effort (four items), and 0.72 for the Grit-S scale.

## 8. Discussion

The findings of the EFA showed that the same two factors (i.e. passion and perseverance), previously identified by Duckworth and colleagues (Duckworth et al., 2007; Duckworth and Quinn 2009), were evident in the Grit-S scale when applied to a sample of postgraduate, DE students in South Africa. These two factors, consistency of interest and perseverance of effort, collectively explained

TABLE 5 Reliability of the Grit-S scale.

	No. of items	$\bar{x}$ (SD)	$\alpha$
Passion (Q1, Q3, Q5, Q6)	4	3.55 (0.88)	0.77
Perseverance (Q2, Q4, Q7, Q8)	4/3*	4.09 (0.67)	0.62/0.79*
Grit-S (Q1-Q8)	8/7*	3.82 (0.62)	0.72/0.77*

\*Cronbach alpha/scale if item deleted.

57.2% of the variance. Although typical of social science research where extracted factors usually explain between 50 and 60% (Peterson, 2000), these results are slightly higher than those reported in the current discourse. Alhadabi et al. (2019) indicated that 47.7 and 51.0% of the total variance in the data could be explained by the same two-factor structure among Omani and American students, respectively. Collaço (2018) results, on the other hand, indicated that the two-factor solution explained only 42.84% of the total variance among a sample of college students, almost 15% less than that reported in the current paper. Overall, the higher percentage of total variance explained in the current paper may suggest that the two factors are more meaningful and useful in explaining the relationships among the variables among a sample of postgraduate, DE students in South Africa.

Results further revealed that the two-factor solution proposed by Duckworth et al. (2007) and Duckworth and Quinn (2009) demonstrated good levels of fit among the postgraduate DE sample. Index calculations revealed an NFI of 0.98, a TLI of 0.98, a CFI of 0.99, and an RMSEA of 0.04. Based on the corresponding residual correlation matrix, SRMR was calculated at 0.02. Support for this two-factor solution among tertiary students is not novel, with concurrent results emanating from around the globe. Most recently, Schmidt et al. (2021) reported adequate fit of the two-factor solution<sup>5</sup> among university students in the Czech Republic; CFI = 0.94, TLI = 0.91, RMSEA = 0.08, SRMR = 0.05. Broghammer (2017); Karaman et al. (2019); and Meriac et al. (2015) also reported satisfactory indices for the two-factor solution among undergraduate students in the United States: GFI  $\geq$  0.96; CFI  $\geq$  0.96; TLI  $\geq$  0.94; RMSEA = 0.06; SRMR = 0.04. Interestingly, Fosnacht et al. (2018) only achieved adequate fit for the two-factor model when Item 2 (*Setbacks do not discourage me*; CFI = 0.97, TLI = 0.95, RMSEA = 0.06) was removed, somewhat consonant with that discussed next.

The reliability analysis indicated that the two dimensions as well as the Grit-S scale in its entirety demonstrated acceptable levels of reliability among the sample ( $\alpha > 0.62$ ). However, as seen in Table 5 above, the analysis suggested the removal of Question 2 (*Setbacks do not discourage me*), resulting in a Cronbach's Alpha coefficient of 0.79 for the perseverance domain and an overall Cronbach's Alpha of 0.77. Interestingly, this finding is not isolated; a number of studies have noted concerns with this item among different student populations (Tyumeneva et al., 2014; Bowman et al., 2015; Li, 2015; Broghammer,

2017; Wyszynska et al., 2017; Arco-tirado et al., 2018; Fosnacht et al., 2018). In the earliest of these studies, Bowman et al. (2015) revealed that '*Setbacks do not discourage me*' reduces the internal consistency of the perseverance domain among a population of undergraduates in the United States ( $n = 417$ ). According to these authors (preliminary) analyses showed that the removal of this item does not affect subsequent results. Broghammer (2017) also reported a reduction in reliability with the inclusion of this item among first-time entering students in the United States ( $n = 544$ ).

Although it is unclear whether the lower reliability coefficient is an artefact of the negatively-phrased item, the substantial gain in reliability cannot be ignored. This may be due, in part, to the cognitively laborious nature of these types of items which require additional mental resources to process, often cause confusion, and do not perform as intended (Chyung et al., 2018). There also remains the possibility that this item is irrelevant to the construct being measured (i.e. perseverance of effort) among the South African sample of postgraduate DE students, despite its face validity. Resultantly, regardless of the suggestions by Furr and Bacharach (2014) to retain items that are intraneous to the core construct (so as to avoid construct under-representation), its exclusion could be warranted in this setting and others which explore grit among postgraduate students studying at a distance in South Africa. However, this is stated tentatively and requires further exploration.

## 9. Implications, limitations and future directions

A number of implications, limitations and future directions are inherent in the findings above. Firstly, the results imply that grit (and its two inherent dimensions) can be measured accurately within DE settings, across a diverse population of postgraduate students in South Africa (i.e. in terms of ethnicities, home languages and cultures). However, the measure has yet to be validated among an undergraduate DE population in South Africa. Considering the sheer size of the undergraduate population at UNISA which accounts for approximately 30% of the entire student body in the public HE system (i.e. 316,000 students; Department of Higher Education and Training, 2023), results from such a study may yield fruitful insights into the scale (and the construct) from a national perspective. Secondly, the survey was administered and validated in English, undoubtedly adding to the plethora of psychometric evidence on the English Grit-S scale. However, considering that English is only the sixth most common home language spoken inside South African households, future studies should explore the psychometric rigour of translated versions of the Grit-S scale - paying particular attention to the official languages of the country. Moreover, the measurement invariance across these languages should be explored. With so few studies reporting the measurement invariance of grit across different language and cultural groups (Li et al., 2023), future endeavours in this regard may suggest (or refute the idea) that the theoretical understanding of grit is limited to a single culture. Thirdly, having partially established the *construct* validity of the scale among postgraduate DE students in the country, future research endeavours should seek to confirm this two-factor solution using a confirmatory approach (i.e. using CFA), as suggested by Gignac (2009). And lastly, educational practitioners should explore grit's *predictive* validity in the same domain. Initiatives

<sup>5</sup> However, to achieve adequate fit, the authors had to make provision for a correlation between item residuals of two items. Without such, the two-factor model did not exhibit acceptable fit; CFI=0.89, TLI=0.84, RMSEA=0.10, SRMR=0.06.

in this area may yield interesting findings into grit's role in determining retention and success among DE students in the country.

## 10. Conclusion

Although there is much debate regarding the factor structure of grit – a critique recognised by the developers themselves (Duckworth et al., 2021) – the current paper provided novel insight into how the Grit-S scale and its intransigent dimensions perform among a sample of postgraduate distance education students in South Africa. Following the suggested criteria (Hu and Bentler, 1999) and acceptable thresholds (Field, 2009), it seems reasonable to conclude that the Grit-S scale is a valid tool and can reliably measure passion and perseverance among postgraduate students at a South African DE institution.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

This study, involving humans, was approved by the University of South Africa's (UNISA) Research Permission Sub-committee (RPSC) and the Department of Psychology's Ethics Review Committee. The study was conducted in accordance with the local legislation and

institutional requirements. The participants provided their informed consent to participate in this study.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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