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Psychometric Assessment and Cross-Cultural Adaptation of the Grit-S Scale among Omani and American Universities' Students

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Abstract: The current study aimed to adopt and assess the psychometric properties and measurement invariance of Grit-S among Omani and American students (N = 487) using Exploratory Factor Analysis (EFA) and Multi-Group Confirmatory Factor Analysis (CFA). The scale's construct validity was estimated by investigating its associations with achievement goal orientations (AGOs). EFA results suggested that a two-factor solution (i.e., perseverance of effort [G_PE] and consistency of interest [G_CI]) was the best factorial structure, explaining 47.74% and 51.02% of the variance in the Omani and American samples, respectively. The factors had good reliability coefficients in the two samples. Related to the intercultural differences, G_PE explained more variance among Omanis (31.02%) relative to American sample, whereas G_CI explained a larger proportion of variance among Americans (36.86%) compared with Omani sample. The first level of measurement invariance, configural invariance, was not supported, necessitating the investigation of the other levels of measurement invariance using a new sample. Grit correlated positively with mastery and performance-approach goals ($r = .29$ and $.12$, respectively) and negatively with avoidance goals ($r = -.25$), supporting the scale's construct validity. These findings showed that Grit-S scale can be used as valid and reliable assessment tool to assess student interest and perseverance in the academic context in Arabic/Omani and American cultures.

Keywords: *Grit, psychometric properties, achievement goal orientations, cross-cultural study.*

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Introduction

Undergraduates' academic achievement is shaped by students' cognitive abilities (e.g., intelligence, long term memory, and abstract thinking), along with their affective qualities (e.g., personality, interests, self-efficacy, and motivations). A recently established psychological concept, grit, is one of the motivational qualities that partially determine undergraduates' academic path, approaches and strategies toward the academic tasks (e.g., Arslan, Akin & Citemel, 2013; Duckworth, Peterson, Matthews & Kelly, 2007). Grit is defined as behaving passionately and assiduously to achieve long-term goals despite difficulties (Duckworth et al., 2007). For example, Wolter and Hussain (2015) found that grit positively associated with self-regulated learning dimensions (i.e., including content value, self-efficacy, cognitive and motivational study strategies) and negatively related to procrastination. The grit's influences are not limited to the academic context, but also is associated with well-being (Datu, Vadez, & King, 2016; Eskreis-Winkler, Shulman, Beal & Duckworth, 2014). This concept can be assessed using the abbreviated Grit-S scale (i.e., eight items; Duckworth & Quinn, 2009). This version has been shown as having solid psychometric properties, which are: two-factor structure (i.e., perseverance of effort and consistency of interest), internal consistency reliability, and construct validity.

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After a thorough review of the psychometric studies, several key findings were noted. First, three versions of grit scale were developed (i.e., 27-item initial scale, 12-items Grit-O, and 8-items Grit-S). That is, the initial version of the scale was developed and validated using several populations in the United States (U.S.), including: (a) Individuals older than 25 years ($N = 1,545$ and $N = 706$), (b) University undergraduates ($N = 139$), (c) West Point cadets ($N = 1,218$ and $N = 1,308$), and (d) Children who were participants in Spelling Bee Championship contests ($N = 175$; Duckworth et al., 2007). After conducting EFA and examining item-total correlations, reliabilities, and the overlap between items, a 12-item scale (Grit-O) was obtained. Findings of Grit-O supported a two-factor solution and each factor had six items. However, the differential predictive validity of Grit-O was unclear (Duckworth & Quinn, 2009). This means that the scale had different validity coefficients across different groups of examinees. Therefore, Grit-S was developed by eliminating four items. The reliability of Grit-S was assessed using internal consistency reliability and test-retest reliability. Alpha coefficients ranged from .73 to .83. Moreover, two types of validity were checked (i.e., consensual validity and predictive validity), supporting the inferences that have to be made from the test scores (Crocker & Algina, 2008).

Second, the Grit-S was adopted and its psychometric properties were examined in various cultures. This resulted in many versions, including: Turkish (Akin, Abaci, Arici, Uysal & Uysal, 2011), Japanese (Nishikawa, Okuyami & Amermiya, 2015), Filipino (Datu et al., 2016), and German (Fleckenstein, Schmidt & Moller, 2014). None of these versions examined the scale in an Arabic context, particularly in Middle East countries. Third, the majority of the reviewed psychometric studies indicated that Grit-S is an adequate tool in terms of internal consistency, language equivalency, and test-retest reliability. Fourth, the scale retained the two-factor solution, which loaded onto a second higher latent factor (i.e., grit; Akin et al., 2011; Fleckenstein et al., 2014; Nishikawa et al., 2015). Though, one study revealed an interesting cross-cultural difference in term of the factorial structure (Datu et al., 2016). That is, perseverance of effort dimension explained more variance in collectivist communities. Correspondingly, perseverance of effort was more salient in predicting the psychological outcomes (i.e. academic engagement and subjective well-being) in collectivist cultures relative to consistency of interest.

Clearly, culture has a fundamental influence on grit scale's structure. The literature has demonstrated cross-cultural differences between the individualistic context (e.g. western countries) and the collectivist context (eastern countries, including Arabic, African, and Asian communities; Akin et al., 2011; Datu et al., 2016; Fleckenstein et al., 2014; Nishikawa et al., 2015). In individualistic countries (i.e., cultures that stress the need of individual over the group), there is a strong emphasis on personal autonomy and the self-first approach, whereas people in collectivistic countries (i.e., cultures that focus on achieving the group's goals over the individual) tend to focus more on interpersonal harmony and pursuing family/group and personal goals interchangeably (Ting-Toomey & Chung, 2012). These differences could directly affect grit's dimensions. For example, individualistic students may show great consistency of interest to achieve certain goals in a shorter period of time, while the students in the collectivistic countries, may show less consistency in an attempt to balance between their personal and family goals. Yet, they still persevere more to actualize their goals and dreams even if it takes a longer time (Datu et al., 2016). Furthermore, Grit-S scale has been developed in an individualistic culture, particularly the U.S. population. Though, this scale has not yet been adopted and assessed in the Omani/Arabic collectivistic culture, necessitating the psychometric assessment of Grit-S.

The primary objectives of the current research, therefore, were: (1) Adopting and assessing the psychometric properties of Grit-S among collectivistic and individualistic samples (i.e., Omani and American universities students), (2) Examining the cultural differences that could affect grit factorial structure using EFA and measurement invariance, and lastly, (3) Estimating the construct validity by investigating grit's association with achievement goal orientations (AGOs). Such endeavor can be informative and valuable, adding new psychometric evidences regarding the Arabic Grit-S version and highlighting the expected cross-cultural differences. The next section reviews grit, AGOs, and intercultural variations between individualistic and collectivist cultures.

Literature Review

Grit

Duckworth and colleagues (2007) defined grit as passionate and assiduous pursuing of long-term targets regardless of hardships and difficulties. That is, people with high level of grit are more assiduous in overcoming obstacles and maintaining interest to accomplish their goals despite failure, difficulties, and lack of support (Arslan et al., 2013). Empirical research showed that gritty cadets are less likely to withdraw from their academic program than their less gritty peers, after controlling for personality (i.e., particularly conscientiousness), SAT scores, and school rank (Duckworth et al., 2007). Grit has two factors: (1) Perseverance of effort (G-PE), and (2) Consistency of interest (G-CI; Duckworth & Quinn, 2009). G-PE refers to the extent to which individuals exert durable effort when facing challenges and hardships. Whereas, G-CI reflects the tendency to espouse a similar array of interests toward the target for a long period of time.

A more recent research has articulated the grit's associations with a range of academic and personal outcomes among university students. In respect with academic context, previous studies have shown that grit positively correlated with

multiple outcomes, for example, freshman retention (Arouty, 2015), metacognition (Arslan et al., 2013), academic engagement (Datu et al., 2016), self-reported grades and post-secondary aspirations (Gorman, 2015), first year GPA (Chang, 2014), graduation rate (Eskreis-Winker et al., 2014), and academic achievement (Duckworth et al., 2007). Furthermore, Akin and Arslan (2014) found that grit associated with approach goal orientation and negatively with avoidance goal orientations.

Related to the personal outcomes, the literature has found that grit predicted several variables. For instance, grit positively correlated with physical exercises (Reed, 2014), meaning in life (Kleiman, Adams, Kashdan, & Riskind, 2013), higher levels of well-being (Datu et al., 2016; Salles, Cohen, & Mueller, 2014), resilience and constructive coping mechanism (Fillmore, 2015), fewer career changes and a lower rate of watching television (Duckworth & Quinn, 2009), lower odds of alcohol use, marijuana use, fighting level and lower involvement in delinquent behavior (Guerrero, Chung, Dosanjh, & Wong, 2016). Furthermore, grit correlated with participants' profile of mood states, self-control and the personality (Nishikawa et al., 2015). Moreover, grit associated with attachment and parenting styles. For instance, Havewala (2012) showed that group which perceived their parents as authoritative had higher grit compared to the group that perceived their parents as authoritarian or permissive.

Achievement Goal Orientations (AGOs)

AGOs is defined as an individual's beliefs that reveals the reasons why he/she approaches and engages in academic tasks. Also, goals are defined as the cognitive representation of different purposes that individuals may adopt in academic situations (Elliot & Church, 1997; Al-Harthy, 2016; Al-Harthy & Was, 2013). In addition, it outlines the specific types of goals that students adopt when they perform their achievement pursuits. Consequently, it predicts the quality of learning (i.e., deep or surface learning, Soyer & Kirikkanant, 2018). The AGOs literature has evolved over time (Adesope, Gress, & Nesbit, 2008). An initial dichotomous framework (Dweck & Leggett, 1988) was expanded to a trichotomous framework that includes mastery, performance-approach, and performance-avoidance goals (Elliot, 1999; Elliot & Church, 1997). An additional four-factor model emerged consisting of two types of mastery goals (i.e., mastery-approach and mastery-avoidance) and two of performance goals (i.e., performance-approach and performance-avoidance; Pintrich, 2000; for review, see Al-Harthy, 2016). Recently, a five-factor model has been developed in attempt to explain the variability in the students' mastery behavior (i.e., mastery intrinsic, mastery-extrinsic, performance-approach, performance-avoidance, and avoidance goals; Niemivirta, 2002).

The present study adopted the trichotomous framework for the following reasons. A meta-analysis ($N = 125$ studies examining AGOs) revealed that the majority of existing research has adopted the three-factor model ($n = 72$ studies), whereas a smaller number of studies investigated the two-factor model ($n = 52$) and the four-factor model ($n = 24$) (Huang, 2016). More critically, literature has demonstrated clear conceptual distinctions between three models. Haung (2016) has argued that empirical differentiations among these models had not been fully supported (i.e., discriminant validity). However, a more recent line of research has illustrated that an individual can embrace diverse goals simultaneously (Luo, Paris, Hogan & Luo, 2011), making it less plausible and practical to investigate the four-factor model in the current study.

Mastery goal (MGs) orientation is defined as a desire to develop competence, master a skill, and understand the learning material. Individuals who are mastery goal oriented usually show persistence even in failure and have high task enjoyment (Elliot & Church, 1997). Studies have shown that mastery goals correlated positively with an intrinsic motivation to learn, an adaptive pattern of attribution, and deep cognitive engagement (Lau & Lee, 2008). Other research has revealed that MGs positively influence enjoyment and negatively relate to anxiety and boredom throughout the academic year (Ranellucci, Hall, & Goetz, 2015). A recently published study supported the association between the MGs and the academic achievement (Uyar, Genc, & Yasar, 2018). They found that high achieving students adopted a more learning approach (i.e., MGs) relative to those with medium and low level of academic achievement. As well, these students demonstrated more critical thinking and practiced more self-regulation skills.

Performance-approach goals (PAGs) imply attaining favorable judgments of competence. That is, individuals who are performance goal-oriented focus on demonstrating competence by attempting to accomplish tasks better than others. As indicated by Dull, Schleifer, and McMillan (2015), individuals with PAGs adopt both learning processes and activities (Duff, 2004) including surface and strategic learning (i.e., related to rote learning and memorization that aim at maximizing academic performance). In addition, individuals with PAGs reduce effort in the face of failure and have low task enjoyment (Bodmann, 2008). This substantiates the positive correlation between performance-approach and avoidance goals (Linnenbrink-Garcia et al., 2012; Ranellucci et al., 2015).

By contrast, performance-avoidance goals (AGs) are centered on evading unfavorable competency judgments. AGs are characterized by fears of failure and expectations of low competence, which leads to self-protective behaviors, feelings of helplessness, and poor academic outcomes (Lau & Lee, 2008). Thus, the literature favors a negative correlation between performance-avoidance goals and academic performance (Ranellucci et al., 2015). A more recent study demonstrated that performance-avoidance a significant predictor of surface learning among junior and senior undergraduates (Soyer & Kirikkanant, 2018).

The selection of AGOs to investigate the construct validity of Grit-S scale has been supported by previous research. Akin and Arslan (2014) showed that students who adopt mastery/learning-approach goals orientation were more likely to have higher level of grit. Conversely, AGs correlated negatively with grit. Thus, it is hypothesized that the construct validity of Grit-S scale is substantiated by: (1) Positive and stronger associations between grit dimensions and MGs relative to PAGs and (2) Negative association between grit and AGs.

Intercultural Variations between Individualistic and Collectivist Cultures

Culture is a set of norms and standards that characterize a specific nation in terms of the apparent features (e.g., language and costumes) to more obscure values and beliefs. Intercultural literature provides many theoretical frameworks to identify these differences (Ting-Toomey & Chung, 2012). Hofstede (2001) presented a multi-dimensional classification, explaining wide range of apparent differences between nations. It includes six dimensions, which are: (1) Power distance, (2) Uncertainty avoidance, (3) Individualism versus collectivism, (4) Masculinity versus femininity, (5) Long term versus short term orientations, and (5) Indulgence versus restraint (Hofstede Insights, 2017). Despite the fact that this model is comprehensive and actually has been cited a lot by many researchers, several recent critiques were highlighted, implying the importance of creating a revised and more accurate model (Nakata, 2009). One of the attempts is the model of negotiation culture (Brannen, 2009).

Nevertheless, only one dimension (i.e., individualism versus collectivism) may seem more relevant with the current study's objectives (Gorodnichenko & Roland, 2012). Given that, it may explain any underlying differences in the grit level between individualistic (e.g., American students) and collectivistic cultures (e.g., Omani students). Individualistic students tend to aggrandize the self, because individualist cultures award personal accomplishments that enable the person to stand out. Thus, it is expected that the degree of interest to achieve personal goals would be higher among these students. For instance, American students pay more attention to sport and artistic talents. To be a great musician or a successful football player, it needs continuous interest and persistence over a long period of time. In comparison, students from collectivist culture tend to focus on achieving the goals of the group (e.g., family, friends, school or the nation), in order to create a sense of harmony and fitting in with group. The relationship with others is highly valued (Hofstede, 2001). Given that, students in such cultures may delay the achievement of personal goals, rather serving the benefit of the group. For instance, the convenience of the family is a priority in such cultures, thus, the oldest member in the collectivistic family might sacrifice or delays the achievement of personal goals until the family status improves. Balancing between the group and personal purists requires a perseverance of effort. Overall, cultural differences affect the majority of psychological concepts and grit is not an exception.

Study Aim

The aim of the current study was to adopt and assess the psychometric properties (e.g., factorial structure and reliability) of Grit-S scale among Omani and American universities students using EFA. Additionally, it purposed to assess items' measurement invariance and investigate any cultural differences that would affect the factorial structure. As well, it aimed to investigate the construct validity by estimating grit dimensions' relationships with AGOs.

Method

Participants

After Institutional Review Board's (IRB) approval, university students in two countries (i.e., Sultanate of Oman and the U.S.) were invited to participate via emails and social media posts. A sample of 287 students from one large main university in Oman was obtained. There were 70 males (24.2%) and 219 females (75.8%). The sample covered diverse majors, which were: scientific majors ($n = 149$, 51.6%) and art/humanities majors ($n = 140$, 48.4%). Majority of students were undergraduates ($n = 245$, 85.4%), 37 were master students (12.9%), and 5 were doctoral students (1.7%). The second sample contained 199 students from one, large, public Midwestern university in the U.S. There were 52 males (26.1%) and 147 females (73.9%). These students studied diverse majors (e.g., Sociology, Nutrition, Accounting, Aeronautics, Art, History, Chemistry, Communication Studies, Computer Science, Psychology, Geology, etc.). Additionally, 137 of students were undergraduate (68.8%), 39 were master students, and 23 were doctoral students (11.6%).

Measures

The current study administered an online survey that consisted of three sections including: (1) Demographic information, (2) Grit-S scale (Duckworth & Quinn, 2009), and (3) The Modified AGOs questionnaire that was originally developed by Elliot and Church (1997). Demographic information included gender, age, major, nationality, and study level (i.e., undergraduate study versus graduate study).

The second measure, Grit-S scale, consists of eight items reflecting a range of grit features. The scale contains two dimensions: Consistency of Interest (G-CI; i.e., four items reversely coded; e.g., "I have been obsessed with a certain idea or project for a short time but latter lost interest") and Perseverance of Effort (G-PE; i.e., four items positively coded; e.g., "I finish whatever I begin"). The scale uses a 5-point Likert scale ranging from "Not Like Me at All" (Coded 1) to

“Very Much Like Me” (Coded 5). It also has a good internal consistency reliability based on previous studies (Cronbach’s α from .73 to .83; Crocker & Algina, 2008).

This scale was adopted and implemented in Arabic. International Test Commission’s (ITC) guidelines were followed to ensure the quality of adaptation (Hambleton, 2005; International Test Commission, 2017). The forward translation (i.e., English to Arabic) of the scale was conducted by an expert committee. The committee consisted of members from the Psychology Department in the College of Education, and English instructors in the Language Centre and Ministry of Education). The multiple translations were analyzed, aiming to identify the functional equivalence and not the literal equivalence. It was decided that the translation would be accepted if the committee agreement percentage was above 60%. Correspondingly, an Arabic version of Grit-S was prepared that suited Omani culture without eliminating any items, allowing for future cross-cultural studies. A backward translation to English was conducted by one of the English instructors to compare it with the original Grit-S scale. No major differences were identified. Thus, it was considered that the adopted version was appropriate for data collection.

The third measure, the modified AGO scale, consists of 18 items and three dimensions: (1) Performance-Approach Goals (e.g., PAGs; “My goal in my courses is to get a better grade than most of the students”), (2) Mastery Goals (MGs; “I want to learn as much as possible from my courses”), and (3) Performance-Avoidance Goals (e.g., AGs; “My fear of performing poorly in my courses is often what motivates me”). Items are rated on a 7-point Likert scale ranging from “Not Like Me at All” (Coded 1) to “Very True of Me” (Coded 7). In the current study, the response structure for the items was modified from a 7-point to a 5-point Likert scale. Previous studies using the 5-point Likert scale had higher response rates and quality, which was attributed to reduce respondents’ frustration with the online-format survey (Buttle, 1996; Elliot & Murayama, 2008). In the current study, internal consistency reliability coefficients were high for the three dimensions of MG, PAG, and AG (Cronbach’s $\alpha = .87, .84, \text{ and } .75$, respectively).

Data Analysis

The two data sets were cleaned using the Statistical Package for Social Sciences (SPSS) for Windows Version 24.0 before conducting the analyses (e.g., missing data, normality, outliers). EFA, particularly Principal Axis Factoring (PAF) was used. To identify the type of rotation to use, large inter-correlation coefficients between factors (i.e., $r > .32$) suggested the use of an oblique rotation (Costello & Osborne, 2005). Otherwise, Varimax rotation is used when the inter-correlation coefficients between factors is relatively small.

Multiple assumptions were assessed, which included: multicollinearity, singularity, sampling adequacy and presence of identity matrix. A correlation matrix should reflect appropriate correlation coefficients (i.e., $.08 > r > .03$) to ensure no concern about multicollinearity. Additionally, the determinant should be small (i.e., > 0) to avoid singularity. Furthermore, KMO values of .80 and above reflect “Good” to “Great” sampling adequacy, values of .70 suggest fair sample adequacy, values of .60 to .50 implies moderate to bad sample adequacy (Pett, Lackey, & Sullivan, 2003). Lastly, a significant p -value for Bartlett’s Test indicates that the correlation matrix is not an identity matrix (Thompson, 2004). Multiple criteria were examined to determine the number of extracted factors including: Kaiser’s rule of eigenvalues greater than one, scree plots, and the Parallel Test (Patil, Singh, Mishra, & Donovan, 2008). Also, items should preferably load greater than .40 on the relevant factor (Field, 2009). Though, a minimum value of factor loading (.32) were acceptable as well (Costello & Osborne, 2005). Coefficient (Cronbach’s) Alpha was used to estimate internal consistency reliability. Criterion validity was examined by investigated Pearson correlation coefficient between grit dimensions and three achievement orientation goals.

In addition, item discrimination coefficients (i.e., a correlation between an item’s score and the total score of a test) were examined (McGahee & Ball, 2009; Office of Educational Assessment, 2019). In other words, these coefficients identify the items ability to differentiate between persons who have low and high scores in a test. According to McGahee and Ball (2009), discrimination values of .4 to .7 reflect “Very Good” items, values of .30-.39 identifies “Good” items, values of .2 to .29 implies “Fair” items, and values below .2 suggests “Poor” items, necessitating the revision or elimination of these items. Office of Educational Assessment (2019) presents another set of criteria. That is, discrimination values above .30 reflect “Good” items, values of .30 - .10 show “Fair” items, and values below .10 suggest “Poor” items.

Measurement invariance was assessed using several Multi-Group CFA models (Schumacker & Lomax, 2016). Four levels of measurement invariance were examined in a sequential order (i.e., configural, metric, scalar, and strict invariance; Putnick & Bornstein, 2016). That is, configural invariance was established when the items loaded into same factors in both samples. Metric invariance is established by having similar factors loadings for the two groups. Equal factor loadings and items’ intercepts supported the scalar invariance. Lastly, strict invariance is substantiated by equal factor loadings, items’ intercepts and measurement errors. The gradual testing of the successive levels of invariance depends on the results of the formal level. For instance, failing to support measurement invariance in configural model results in stopping the process of examining higher levels (e.g., metric; Milfont & Fischer, 2010).

At each level of measurement invariance testing, a chi-square differences test is estimated to identify whether the higher level of measurement invariance is attained. In addition, several GoF indices were examined to evaluate the fit

for each model of measurement invariance. These indices included Chi-Square, Root-Mean-Square-Error of Approximation (RMSEA), Standardized Root-Mean-Residual (SRMR), Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), and Normed Fit Index (NFI). According to Kremelberg (2009), a significant χ^2 (i.e., divided by the *df*) is indicative of poor model fit. For the RMSEA, if values are $\leq .05$, then the model fit is considered good. Above .05, RMSEA values ranging to .08 are considered acceptable. The model is considered to be marginal if the RMSEA is from .08 to .10 (Schumacker & Lomax, 2016). For the RMSEA and SRMR, values $\leq .05$ indicate good model fit. Models with GFI, AGFI, and NFI values $\geq .90$ are considered acceptable and values $\geq .95$ are good (Hu & Bentler, 1999). Furthermore, statistically significant direct and indirect effects ($p < .05$) were interpreted.

Results

Descriptive Statistics and Correlations Descriptive statistics (see Table 1) were examined as well as outliers ($z \pm 2.58$) on the scale items. Findings showed that normality was met after eliminating three outliers. Also, no concern about the ceiling and floor effect was identified.

Table 1. Descriptive Statistics for the Grit-S Scale Items

Variables	Omani Sample				American Sample			
	M	SD	Max	Min	M	SD	Max	Min
1. I often set a goal but choose to pursue a different one.	3.04	1.01	5.00	1.00	3.57	.87	5.00	1.00
2. New ideas and projects sometimes distract from previous once.	3.23	1.05	5.00	1.00	2.90	1.00	5.00	1.00
3. I have been obsessed with a certain idea or project for a short time but latter lost interest.	2.89	1.18	5.00	1.00	3.09	1.05	5.00	1.00
4. I have difficulty maintaining my focus on projects that take more than a few months to complete.	3.08	1.16	5.00	1.00	3.23	1.19	5.00	1.00
5. I finish whatever I begin.	3.46	1.00	5.00	1.00	3.78	.98	5.00	1.00
6. Setbacks don't discourage me.	3.41	1.03	5.00	1.00	3.28	1.02	5.00	1.00
7. I am a hard worker.	3.86	.98	5.00	1.00	4.43	.73	5.00	2.00
8. I am diligent.	3.86	.94	5.00	1.00	4.22	.82	5.00	2.00

Furthermore, the results indicated all EFA assumptions were met in the two groups. That is, the inter-items correlations were below .80, meaning no multicollinearity (see Table 2). Furthermore, singularity was not problematic because the determinant values were .07 and .06 among the Omani and American samples, respectively. The KMO tests for the two samples (.70 and .79 respectively) were "fair" pertaining to sample adequacy (Pett et al., 2003). Bartlett's Tests of Sphericity were significant, indicating that the correlation matrix was not an identity matrix $\chi^2[28] = 761.52, p < .01$ and $\chi^2[28] = 537.55, p < .01$ for the Omani and American samples, respectively).

Table 2. Inter-item Correlation Matrix for the Grit-S Scale among Omani and American Samples (N = 8)

	Omani Sample								Item-total correlation	American Sample								Item-total correlation
	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8	
1	-	.42	.39	.32	.11	-.04	.05	.03	.31	-	.47	.44	.51	.28	.14	.27	.28	.53
2		-	.41	.38	.08	.05	.11	.10	.37		-	.51	.53	.22	.16	.11	.18	.49
3			-	.63	.29	.16	.19	.25	.57			-	.60	.21	.25	.14	.17	.53
4				-	.30	.14	.19	.20	.53				-	.40	.27	.26	.35	.66
5					-	.36	.35	.39	.44					-	.44	.53	.49	.54
6						-	.37	.37	.32						-	.30	.40	.41
7							-	.80	.47							-	.66	.46
8								-	.50								-	.53

In addition, item-total correlations were examined to identify items discrimination (i.e., to what degree items differentiate between those who have high and low level of grit). Findings of Omani sample showed that three items' discrimination were good (i.e., Items 1, 2 and 6 with correlation coefficients ranging between .03 and .39; McGahee & Ball, 2009; Office of Educational Assessment, 2019). The discrimination of the other five items were very good (Items 3, 4, 5, 7, and 8 with $r > .40$). In the American sample, the item discrimination was very good for all items ($r > .40$).

EFA Results. Initially, Principle Axis Factoring (PAF) with Direct Oblimin rotation was conducted to examine the primary items structure and the correlation between the extracted factors. Results of inter-correlation coefficients between factors showed small correlation (i.e., $< .32$). Therefore, Principle Axis Factoring (PAF) with Varimax rotation was used as recommended by Thompson (2004).

For the Omani sample, the eigenvalues' criterion, scree plot and Parallel Test demonstrated a two-factor solution. Rotated factor matrix showed no cross loading between items and all factors loading were greater than .40. Factor 1 accounted for 31.02% of the variance and consisted of four items (see Table 3.A). The most two significant items loading on this factor include: "I am diligent" and "I am a hard worker". This factor was consistent with "G-PE" because it describes students' reactions toward difficulties (Duckworth et al., 2007). Factor 2 accounted for 16.27% of the variance. Four items loaded in this factor (i.e., Items 1, 2, 3, and 4). This factor aligns with "G-CI", reflecting students' interest in achieving goals over a long period of time (Duckworth & Quinn, 2009). The reliability coefficients for the two factors were good in the Omani sample.

In comparison, two-factor solution was supported by the eigenvalues' criterion, scree plot and Parallel Test in the American sample (See Table 3.B). No cross loadings were shown. Factor 1 accounted for 36.86% of the variance and align with "G-CI", containing four items (i.e., Items 1, 2, 3, and 4). In contrast, Factor 2 consisted of four items that reflect the features "G-PE", accounting for 14.16% of the variance. Two examples of items that loaded in this factor were: "I am a hard worker" and "I am diligent." Comparatively, reliability coefficients for the two factors were good in the American sample.

One major observation related to EFA findings was that items 5, 6, 7 and 8 loaded in the factor named as "G-PE", which explained the largest proportion of variance (31.02%) in the Omani sample, whereas, items 1,2,3 and 4 loaded in "G-CI" factor, which accounted for the larger amount of variance (36.86%) in the American sample. In other words, items that explained more variance in the two samples were different. Accordingly, factors that explained the greatest extent of variance in both samples were different. Overall, the researcher concluded that two-factor solution with total eight items was the best structure in both samples.

Measurement invariance Findings. In a preliminary step, three CFA models were fit to the individual samples and the combined sample. Initial investigation of CFA for the individual samples and the global sample showed poor model fit (see Table 4.A). The Chi-square tests were significant. The RMSEA values ranged between .08 to .09, reflecting a marginal model fit. SRMR values were $\geq .05$, showing an unacceptable fit. GFI and NFI were relatively acceptable (i.e., $\geq .90$). These findings implied conducting some modifications. The model fit for individual and combined samples were good after adding multiple error covariance terms (see Table 4.B). Though, these terms differed across the three samples. As shown in Figure 1, two error covariance terms between different items were added for the Omani (i.e., G_PE_7 with G_PE_8 and G_CI_1 with G_CI_2) and American samples (i.e., G_PE_7 with G_PE_8 and G_PE_5 with G_PE_7). As well, three error covariance were added to the combined sample. These differences imply some preliminary concerns about the measurement invariance.

Table 3. Loading Factor with PAF with Varimax Rotation for Grit-S among the Two Groups

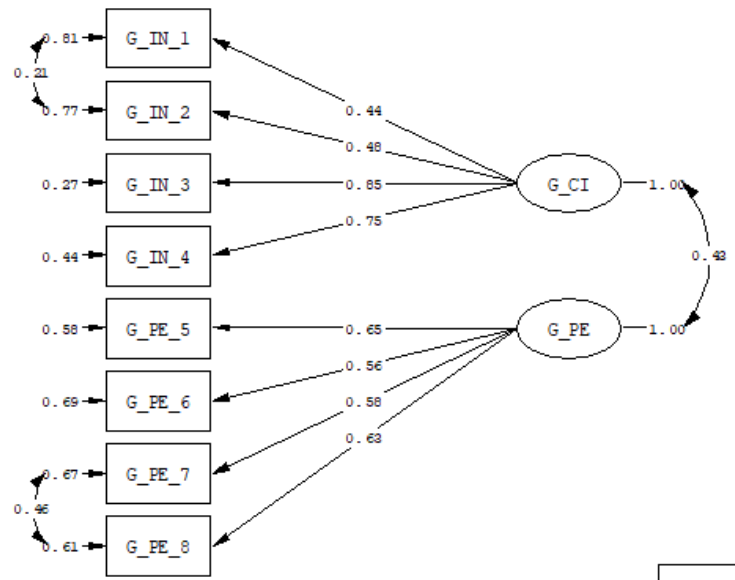
A. Omani Sample		Factor1: G-PE	Factor2: G-CI
Items			
8	I am diligent.	.91	
7	I am a hard worker.	.85	
6	Setbacks don't discourage me.	.46	
5	I finish whatever I begin.	.45	
3	I have been obsessed with a certain idea or project for a short time but latter lost interest.		.77
4	I have difficulty maintaining my focus on projects that take more than a few months to complete.		.70
2	New ideas and projects sometimes distract from previous once.		.56
1	I often set a goal but choose to pursue a different one.		.54
Cronbach's alpha		.76	.75
Eigenvalue		2.48	1.34
Variance explained		31.02%	16.72%

Table 3. Continued

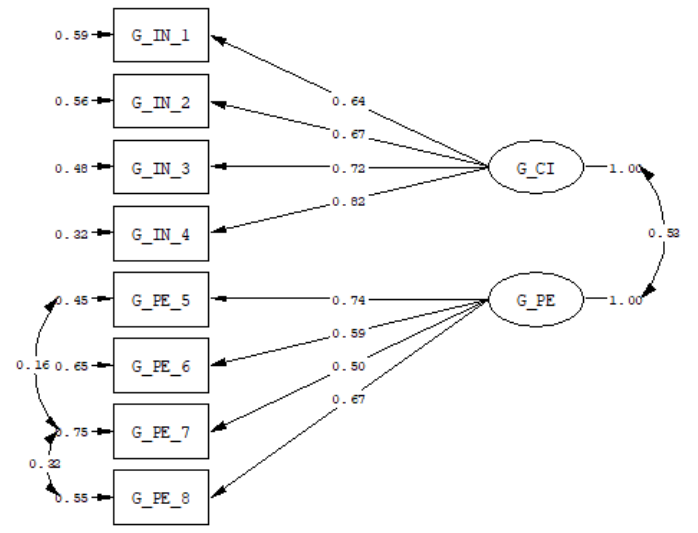
A. American Sample		
Items	Factor1: G-CI	Factor2: G-PE
4 I have difficulty maintaining my focus on projects that take more than a few months to complete.	.75	
3 I have been obsessed with a certain idea or project for a short time but latter lost interest.	.74	
2 New ideas and projects sometimes distract from previous once.	.69	
1 I often set a goal but choose to pursue a different one.	.59	
8 I am diligent.		.79
7 I am a hard worker.		.77
5 I finish whatever I begin.		.66
6 Setbacks don't discourage me.		.46
Cronbach's alpha	.81	.77
Eigenvalue	2.95	1.13
Variance explained	36.86%	14.16%

Table 4. Comparison of Global, Omani and American Samples.

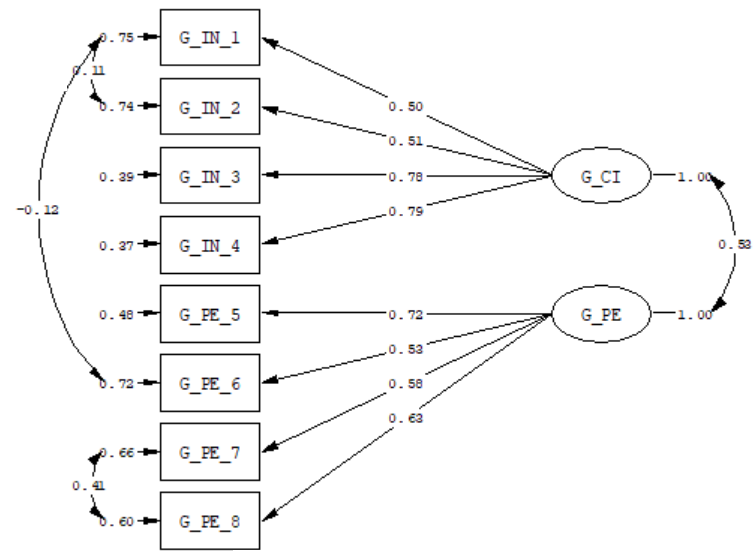
A. Initial Models						
Fit Statistics	Global Model		Omani Sample		American Sample	
	Factor1: G_CI	Factor2: G_PE	Factor1: G_CI	Factor2: G_PE	Factor1: G_CI	Factor2: G_PE
Factor loadings						
G_CI_1	.51		.48		.65	
G_CI_2	.55		.52		.67	
G_CI_3	.88		.83		.72	
G_CI_4	.91		.75		.82	
G_PE_5		.52		.42		.68
G_PE_6		.41		.42		.50
G_PE_7		.79		.88		.77
G_PE_8		.81		.93		.80
Fit Indices						
$\chi^2(df)$	92.04(19)		65.39(19)		45.33(19)	
p value	.00		.00		.00	
RMSEA	.09		.09		.08	
SRMR	.06		.06		.06	
GFI	.96		.96		.95	
NFI	.93		.93		.92	
B. The modified Models						
Fit Statistics	G_CI	G_PE	G_CI	G_PE	G_CI	G_PE
Factor loadings						
G_CI_1	.50		.44		.64	
G_CI_2	.51		.48		.67	
G_CI_3	.78		.85		.72	
G_CI_4	.79		.75		.82	
G_PE_5		.72		.65		.74
G_PE_6		.53		.56		.59
G_PE_7		.58		.58		.50
G_PE_8		.63		.63		.67
Error covariance						
G_PE_7 & G_PE_8	.41		.46		.32	
G_CI_1 & G_CI_2	.11		.21			
G_CI_1 & G_PE_6	-.12					
G_PE_5 & G_PE_7					.16	
Fit Indices						
$\chi^2(df)$	23.13(16)		21.86(17)		23.59(17)	
p value	.11		.19		.13	
RMSEA	.03		.03		.04	
SRMR	.03		.04		.04	
GFI	.99		.98		.97	
NFI	.98		.97		.96	



A. Omani sample



B. American sample



C. The combined sample

Figure 1. CFA models for the individual and the combined sample.

In respect to measurement invariance, configural invariance only was examined by fitting the Multi-Group CFA model (see Table 5). The Chi-square tests was significant. The RMSEA value was .09, reflecting a marginal model fit. SRMR was $\geq .05$, showing unacceptable fit. GFI and NFI suggested good and acceptable model fit, respectively. Though, items loaded in the same factors in both the Omani and American samples. Overall, measurement configural invariance was not supported leading to discontinuity of measurement invariance assessment as suggested by Putnick and Bornstein (2016).

Table 5. Model Fit Indices for Configural Invariance only Model

Models	Model 1: Configural invariance only
$\chi^2(df), p$ value	145.80(46), $p < .001$
$\Delta\chi^2(\Delta df)$	-
RMSEA (90%CI)	.09 (.08-.11)
SRMR	.07
GFI (Δ GFI)	1.00(-)
NFI (Δ NFI)	.91(-)
BIC	2891.68
Comparison	-
Decision	Reject

Construct Validity. Construct Validity is defined as “postulating of specific relationships between measure of a construct and measures of a specific real-world criterion, and measures of other constructs in a theoretical system” (Crocker & Algina, 2008, p. 230). Empirical research had shown significant correlations between AGOs and grit (Akin & Arslan, 2014; AL-Baddareen, Ghaith, & Akour, 2015). Therefore, there is a strong likelihood of having positive correlations between MGs, PAGs and grit’s factors. Though, a negative association between AGs and grit was expected. Pearson correlation coefficients (see Table 6) showed that grit has a significant positive relationship with MGs ($r = .29, p < .01$), a weak correlation with PAGs ($r = .12, p < .01$), and a negative correlation with AGs ($r = -.25, p < .01$).

Table 6. Correlation Coefficients between Grit factors and the AGOs (N = 6)

	G-CI	G-PE	PAGs	AGs	MGs
G-CI	-	.31**	-.05	-.30**	.10*
G-PE		-	.27**	-.09*	.39**
Grit			.12**	-.25**	.29**

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

Grit is one of the non-cognitive characteristics that identifies the quality of students’ outcomes academically and personally. Grit-S Scale has been constructed in the American context and was adopted by multiple cultures. However, this scale has not been adopted to Arabic-Omani culture. In addition, previous psychometric studies reflected inconsistency between cultures in term of the grit factorial structure (Datu et al., 2016). Thus, the current study had a three-fold aim: (1) Adopting Grit-S Scale and assessing its psychometric properties among Omani and American universities’ students, (2) Examining Grit-S measurement invariance and investigating cross-cultural differences, and (3) Establishing evidence of construct validity. Multiple analyses were conducted, including: EFA, Multi-group CFA and Pearson correlation.

EFA findings supported a two-factor solution (i.e., G-PE and G-CI) in the Omani and American samples. Each factor had four items, consistent with the structure presented by Duckworth and Quinn (2009). Reliability coefficients of the factors were good in the two samples. These findings are compatible with many empirical results (Akin et al., 2011; Datu et al., 2016; Fleckenstein et al., 2014; Nishikawa et al., 2015) regarding the Grit-S scale’s factorial structure (i.e., two-factor solution), advocating the use of this scale to assess grit among university students. Further investigation of the influences of this concept among university students would provide deeper understanding about how it relates to productive academic outcomes. A mixed-method comprehensive project investigated grit among university students (N = 790), resulting in three studies (Kannangara et al., 2018). The quantitative studies of this project showed that gritty

undergraduates had higher levels of self-control, resilience, mental well-being and were more likely to adopt a growth mindset. Simultaneously, the qualitative investigation of ten graduates input revealed three themes, which were: (1) Passion and perseverance, (2) Self-control, and (3) Positive mindset.

Consequently, these practices can explain the positive associations between grit and other academic outcomes that have been documented in the literature. That is, grit significantly associated with academic achievement (Chang, 2014), academic engagement (Datu et al., 2016), aspirations (Gorman, 2015), and higher graduation rate (Eskreis-Winker et al., 2014). The grit's promising influences are not limited to academic context among university students. An ample body of empirical evidences articulated that grit positively correlated with meaning in life (Kleiman et al., 2013), higher levels of well-being (Salles et al., 2014), constructive coping mechanisms (Fillmore, 2015), and lower odds of delinquent behavior (e.g., alcohol use, marijuana use, and fighting level; Guerrero et al., 2016).

One of the interesting findings in the current study showed that the role of the two factors varied across Omani and American cultures. Given that, G-PE explained more variance (i.e., 31.02%) in the Omani sample, whereas, G-CI accounted for a larger extent of variability (i.e., 36.86%) in the American sample. These results align with Datu and colleagues (2016) findings, implying that culture does play a role in the structure of grit. One of cultural difference that can explain such difference is the individualism versus collectivism dimension (Hofstede, 2001). Students in individualistic cultures (i.e., American sample) have stronger interest to achieve their goals and stand out by accomplishing big. In contrast, students' consistency of interest in collectivistic cultures (i.e., Omani sample) might be affected by other priorities that relate to the family or the group. Nevertheless, accomplishing of their personal goals is empowered by their tendency to preserve the effort, in order to create a balance between the need of the self (i.e., I's goals) and the group (i.e., we's goals). For instance, two of significant items that capture the perseverance of effort to achieve their goals are: "I finish whatever I begin" and "Setbacks don't discourage me". Overall, this finding is inconsistent with previous psychometric studies about the influence culture in the factorial structure, only aligning with Datu and colleagues (2016). This finding necessitated further investigation of the intercultural differences in the grit.

Nevertheless, meaningful intercultural differences in the grit should be estimated after establishing evidence of measurement invariance (Putnick & Bornstein, 2016). Findings of basic CFA for the individual samples showed poor model fit. Adding different error covariance terms in the two samples led to good model fit. Furthermore, results of multi-group CFA indicated that configural invariance was not supported. Meaning, the scale has significant differences between the two samples. Consequently, additional measurement invariance levels were not assessed as suggested by Milfont and Fischer (2010). Alternatively, Putnick and Bornstein (2016) recommended the redefining of the construct by omitting some items and retesting the model. As such, future studies should retest a modified Multi-Group CFA after collecting new samples to estimate more meaningful intercultural differences in grit-factorial structure.

Construct validity was supported by significant associations between grit, MGs, PAGs, and AGs ($r = .29, .12, -.25$, respectively, $p < .01$). Results are consistent with Akin and Arslan (2014) findings, which add more evidence about the grit's construct validity. Given that, students who adopt MGs have higher level of grit compared to PAGs. As suggested by Uyar et al. (2018), this resulted in better academic achievement. They revealed that students who adopted more learning approach (i.e., MGs) were more likely to be classified among the high achieving students. Furthermore, these students practiced more self-regulated strategies and critical thinking. In the current study, grit had a weaker association with PAGs compared to the association with MGs. This result aligns with Dull and colleagues' (2015) findings. That is, students who adopt PAGs were more likely to involve in a surface and strategic learning (i.e., related to rote learning and memorization) that can be combined with low engagement, especially in case of hardship/difficulties (Bodmann, 2008). Such behavior conflict with one main grit's factor (i.e., perseverance of effort). One of the remarkable findings in the current study highlighted the negative association between grit and AGs. In a similar research conducted by Soyer and Kirikkanant (2019) emphasized that AGs was a significant predictor of surface learning among junior and senior undergraduates. Therefore, strengthening students' grit would decrease the likelihood of adapting AGs, which can reduce the likelihood of surface learning.

Implications and Limitations

The current study resulted in several conceptual important findings. First, it adopted Grit-S scale to the Arabic context that can be used in other Middle East countries. It showed that Grit-S has a good factorial structure. This scale can be a baseline for upcoming studies, which can flourish the understanding of the association between youth's grit and other academic and psychological outcomes. Furthermore, the current study highlighted concerns related to the Grit-S scale measurement invariance, encouraging future psychometric studies to construct more solid version of Grit-S. The present study findings have practical applications as well. Majority of educators in the higher education context experience overwhelming workloads. These faculty members seek to ensure better academic outcomes for their students. Though, they find difficulty in term of assessing students' traits that may associate with better learning outcomes. Having a short version of grit scale with solid psychometric properties would be a useful addition to these instructors' teaching toolboxes. It reduces any considerations that prevent instructors or student themselves from completing the scale due to the scale's length (Burisch, 1984). Gaining clear understanding of students' grit would

enable teachers to visualize students' performance and thus identifying several interventions to ensure the optimal performance. Furthermore, this scale can be used as an accurate assessment tool in collectivistic cultures.

Though, this study also has limitations. The study sample was traditional colleges' students from two public universities in the two countries (Oman and U.S.), which limits generalizability to other environments. The measurement invariance analysis covered only one level (i.e., configural invariance).

For further studies, the following is a list of recommendations: (1) Re-test psychometric properties of adopted Arabic Grit-S scale using different samples covering different students' demographic information (i.e., gender, public and private universities); (2) Retesting other levels of measurement invariance by redefining the Multi-Group CFA model (i.e., eliminating or constructing new items that can be applicable to different cultures and assessing higher levels of measurement invariance, particularly metric, scalar and strong invariance), (3) Modelling the associations between grit, academic and personal outcomes among university students, and (4) Run experimental studies in order to examine the effects of training courses specialized to strengthen students' grit in student academic achievement and well-being.

When results of this study were addressed as a whole, it was concluded that Grit-S scale is considered to be a reliable and valid assessment tool to measure student persistence and interest in Arabic cultures. By adopting Grit-S scale, this study contributes to the educational and psychological field by providing a baseline for many psychological prospective researches in the Middle East related to a recently developed motivational concept (i.e., grit). Though, cross-cultural differences influence the scale's factorial structure to some extent. Thus, further investigation of the scale's psychometric properties across cultures is necessitated. Finally, grit's construct validity was supported by significant association with AGOs, signifying the importance of great in shaping students' academic/personal path.

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