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Exploratory and Confirmatory Factor Analyses of the Short Grit Scale (Grit-S) for Malaysian Undergraduate Students

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Abstract

The 8-item Short Grit Scale (Grit-S; Duckworth & Quinn, 2009) is a measure of the two aspects of grit: consistency of interests and perseverance of effort. While the majority of the past studies supported the two-factor model, some found cultural differences. Two studies were carried out to test the factor structure of the Grit-S in a sample of Malaysian undergraduate students (total N = 1109). Exploratory factor analysis (Study 1) revealed two factors. Item 2 for perseverance subscale was removed due to unsatisfactory factor loading. Further analysis of the seven items supported the two-factor model. Confirmatory factor analyses (Study 2) supported the superiority of the two correlated-factor model with 7 items. Moreover, the consistency and perseverance scores showed acceptable internal consistency. The current research contributes to the literature by lending further support to the theoretical two-factor structure of the Grit-S and revealing potential cultural differences in the items. Future studies are thus recommended to address these cultural differences and confirm the usability of the 7-item Grit-S in the Malaysian context.

Analisis Faktor Eksplorasi dan Konfirmatori Skala Kegigihan (Grit-S) pada Mahasiswa Strata Satu Malaysia

Abstrak

Skala Kegigihan 8-aitem (Grit-S; Duckworth & Quinn, 2009) mengukur dua aspek: ketekunan upaya dan konsistensi minat. Sementara mayoritas penelitian mendukung model dua-faktor, beberapa peneliti menemukan perbedaan budaya pada penelitian Grit-S. Dua studi dilakukan untuk memeriksa struktur faktor Grit-S dalam sampel mahasiswa strata satu Malaysia (jumlah N = 1109). Teknik eksploratori analisis faktor (Studi 1) mengungkapkan dua faktor. Aitem 2 untuk dimensi ketekunan telah dihapus karena factor loading yang minim. Analisis lebih lanjut dari tujuh aitem mendukung model dua-faktor. Analisis Faktor Konfirmatori (Studi 2) mendukung keunggulan model grit dua faktor berkorelasi dengan 7 aitem. Selain itu, dimensi ketekunan upaya dan konsistensi minat menunjukkan reliabilitas konsistensi internal yang memadai. Penelitian ini memberikan sumbangsih pada literature grit dengan mendukung adanya struktur dua-faktor dari Grit-S dan potensi perbedaan budaya dalam tinjauan aitem. Penelitian selanjutnya direkomendasikan untuk menitikberatkan perbedaan budaya dan mendukung penggunaan 7-aitem Grit-S di Malaysia.

Keywords: short grit scale, exploratory factor analysis, confirmatory factor analysis, Malaysia, reliability

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1. Introduction

Psychological studies have revealed that a variety of factors such as intelligence and personality play a key

role in individuals' achievements (e.g., academic achievement) and behaviors (e.g., employees' retention) (Caprara, Vecchione, Alessandri, Gerbino, & Barbaranelli, 2011; Deary, Strand, Smith, & Fernandes, 2007). A new

aspect-grit has been recently introduced as a way of predicting scholastic performance and employee retention rates (Eskreis-Winkler, Shulman, Beal, & Duckworth, 2014). Grit is conceptualized as passion and perseverance towards long-term goals. In order to capture the essence of "grit," Duckworth, Peterson, Matthews, and Kelly (2007) developed a 12-item Grit Scale and further revised it into a 8-item Short Grit Scale (Grit-S; Duckworth & Quinn, 2009). Although Duckworth and colleagues found that the Grit Scale has satisfactory psychometric qualities, other researchers (e.g., Datu, Valdez, & King, 2016) found the opposite. The discrepancies suggest that there could be cultural differences in conceptualizing grit. Hence, the present study was undertaken to investigate the factorial structure of the Grit-S in a Malaysian sample.

Grit implies working laboriously towards obstacles, putting in prolonged effort and passion in defiance of hardships, difficulties, and challenges. Specifically, grit is composed of two factors namely consistency of interests and perseverance of effort. Perseverance of effort indicates the extent of dedication and work toward one's goals, while the consistency of interests indicates the tendency of attention and commitment to same crucial long-term goals (Duckworth et al., 2007).

A gritty individual performs energetically, besides sustaining effort and interest towards their long-term goals despite disappointments, adversities, and trials (Duckworth et al., 2007). Studies found that grit plays a role in estimating the accomplishment of a person in challenging circumstances (Eskreis-Winkler et al., 2014), success in diversity of challenging domains (including retention of cadets at West Point Military Academy and final rankings in National Spelling Bees) (Duckworth et al., 2007; Duckworth & Quinn, 2009) as well as Grade Point Average (GPA) among adolescents (Duckworth & Quinn, 2009). Furthermore, grit was linked to positive teaching performance and persistence when considering the challenges associated with teaching, particularly during the first few years of teaching (Duckworth, Quinn, & Seligman, 2009). There is also evidence showing that grittier people inclined to experience greater life satisfaction and subjective well-being (Singh & Jha, 2008).

To develop a measurement of the concept of grit, Duckworth and colleagues (2007) identified 27 items and then removed 10 items due to low internal consistency and redundancy. After that, the remaining 17 items were submitted to an exploratory factor analysis. Five items with factor loading lower than 0.40 were deleted and 12 items were retained and submitted to the confirmatory factor analysis. The results indicated that the two-factor solution is acceptable. Moreover, the original Grit Scale (Grit-O) with 12 items showed good reliability ($\alpha = 0.85$). The Grit-O is a bi-faceted model

comprising two dimensions: consistency of interests and perseverance of effort.

Duckworth et al. (2007) found a positive association between Grit-O score and GPAs achievement, retention of an army, and attainment in National Spelling Bee competition. Besides, the Grit-O has been translated into different languages. Tyumeneva, Kuzmina, and Kardanova (2014), for instance, translated the Grit-O into Russian and changed some items (e.g., Setbacks don't discourage me) to avoid double negative wordings together with words which might create ironic meanings for Russian participants. Analysis of the Russian version using Item Response Theory lent support to the two-factor structure. However, the modified item, "As a rule, setbacks do discourage me" of perseverance of effort loaded on the consistency-of-interests subscale. Similarly, Areepattamannil and Khine's (2018) study on 777 Arab adolescents found that the item "I become interested in new pursuits every few months" demonstrated a misfit with the Rasch model. Moreover, Duckworth and colleagues' (2007) results (CFA = 0.83, RMSEA = 0.11) revealed that the model fit of the Grit-O was unsatisfactory, indicated a need for further improvement.

With the intention of enhancing the psychometric qualities of the grit measure, Duckworth and Quinn (2009) re-analyzed the data from Duckworth and colleagues' (2007) study and developed a Short Grit Scale (Grit-S). Specifically, the researchers computed item-level correlation for the four samples (i.e., cadets from West Point Class of 2008 and 2010, participants of 2005 National Spelling Bee final round, and Ivy League undergraduates) respectively and used Spearman's rho correlation coefficient to rank the items and retain items that were above the median. As a result, two items were eliminated from the two subscales respectively. The Grit-S demonstrated acceptable internal consistency with a Cronbach alpha coefficient (α) ranging from 0.73 to 0.83 across the four samples. Moreover, in Study 3, the researchers asked participants and their family members and friends to evaluate the participant's grit level using the Grit-S. They found that Grit-S demonstrated favorable internal consistency: $\alpha = 0.83$, 0.84, and 0.83 for self, family, and friend.

Other studies also supported that idea Grit-S is a good measurement for predicting: retention and performance of trainee teachers (Robertson-Kraft & Duckworth, 2014); retention in both workplace and school and also longevity of marriages (Eskreis-Winkler et al., 2014); motivational orientation in looking for happiness in life (Von Culin, Tsukayama, & Duckworth, 2014); risks of burnouts (Salles, Cohen, & Mueller, 2014); life satisfaction (Khan & Khan, 2017); job satisfaction of doctors (Reed, Schmitz, Baker, Nukui, & Epperly, 2012); and, metacognition of students (Arslan, Akin, & Çitemel, 2013). The Grit-S was also found to predict:

university staff's utilization of emotion and perception of mutual obligations in exchanging resources with employers (Ramasamy & Yu, 2017); undergraduates' academic performance (Siah, Ong, Ngiam, & Tan, 2018); and, adolescents' addiction to mobile phone use (Siah, 2016) in the Malaysian context.

The two-factor structure of Grit-S was also supported in different cultural contexts. Li and colleagues (2018) indicated that the Chinese version of Grit-S is suitable for adolescents in China. In addition, the German version (Schmidt, Fleckenstein, Retelsdorf, Eskreis-Winkler, & Möller, 2017), Japanese version (Nishikawa, Okugami, & Amemiya, 2015), and Polish version (Wyszyńska, Ponikiewska, Karaś, Najderska, & Rogoza, 2017) of Grit-S also supported by the two-factor model.

Datu et al. (2016) carried out a study to validate the Grit-S among college and high school students in the Philippines. Although the results supported that grit can be conceptualized by two factors, the correlation between the two factors was found to be weak ($r = 0.15$) for college students and not significant for high school students. Moreover, Datu and colleagues found that the consistency-of-interests factor did not load on the higher-order grit factor. In other words, the hierarchical structure of grit was not supported in their samples. The inconsistent findings of the Grit-S thus call attention for examining psychometric qualities of the Grit-S before using it in the Malaysian context.

Previous researches (e.g., Datu et al., 2016; Muenks, Wigfield, Yang, & O'Neil, 2017) had found discrepancies in the factor structure of Grit-S. The present study aimed to investigate the factorial structure of the Grit-S in the Malaysian context in two studies. The potential factorial structure was first examined in Study 1 using exploratory factor analysis (EFA). Confirmatory factor analysis (CFA) was then carried out in Study 2 to further investigate the model revealed by EFA and compare with other competing models to identify the best fit model. Besides, the reliability of the Grit-S was examined.

2. Methods

2.1. Study 1: Exploratory Factor Analysis

Participants. A total of 396 undergraduate students in Malaysia participated in the study. The sample comprised of 132 males and 264 females. Their ages ranged from 19 to 41 years old ($M = 21.45$, $SD = 1.70$). The majority (84.1%) of them were Chinese, followed by 51 Indians, 5 Malays, and 7 others. The participants were recruited using snowball sampling. Specifically, the researchers created an online questionnaire and posted the link on a social networking site. The online questionnaire was first circulated and promoted to potential respondents. Participants were then asked to promote the survey to

their friends. Consent was obtained from participants before they responded to the survey.

Instruments. The English version of the Short Grit Scale (Grit-S; Duckworth & Quinn, 2009) was employed in the present study. Composed of eight items, Grit-S taps into the perseverance and consistency for long-term goals respectively. Participants indicated the extent to which the items described them on a 5-point Likert scale ranging from 1 (not at all like me) to 5 (very much like me). Reverse coding was done for four items from the consistency of interest subscale. Then, a mean score was calculated through averaging the score of the eight items. Individuals who report higher score tend to endure longer for long-term goals.

2.2. Study 2: Confirmatory Factor Analysis

Participants and Procedure. A recruitment of 769 undergraduate students at two different universities was done for a larger project. To fit the purpose of the present study, 56 foreign students were removed from further analysis resulting in 713 students. The sample comprised of 297 males and 416 females. Their age ranged from 18 to 44 years old ($M = 21.45$, $SD = 1.78$). The majority of them were Chinese (82.3%), followed by 58 Indians, 35 Malays, 4 others, and 29 of them did not report ethnicity. Upon the approval from the university ethical and scientific review committee, students at different locations of the university were approached. Students who agreed to participate were then informed of their rights and the confidentiality of data they provided. Data was collected utilizing either a paper-and-pencil questionnaire or an online survey. Participants in the latter condition were provided with a QR code containing a link for the questionnaire. Regardless of the data collection methods, participants were requested to read the aims of the study and informed consent form and further indicated their consent to be involved in the study. Then, participants were given 20 minutes to complete the questionnaires.

Instruments. The same 8-item Grit-S tested in Study 1 was applied in Study 2.

Analytical Approach. CFA using AMOS 22 was carried out to compare competing models and identify the best fit model. Specifically, three models (one-factor model, two correlated-factor model, and bifactor model) were tested for the Grit-S with 8 and 7 items respectively. Note that the higher order model in which consistency of interests and perseverance of effort subscales as first-order factors and grit a second-order factor was not tested because it is mathematically correspondent with the two correlated-factor model (Muenks et al., 2017). As a result, we tested a bifactor model composed of one general factor of grit and two specific factors of consistency and perseverance. Missing values (0.18 %) were replaced by series mean. Several indices such as ratio of chi-square values to

degrees of freedom (χ^2/df), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and standardized root mean square residual (SRMR) were used to assess model fit. A good fit model shall be $\chi^2/df < 3$, CFI and TLI > 0.95 , RMSEA ≤ 0.05 (reasonable fit = 0.05 to 0.08), and SRMR < 0.08 (Hu & Bentler, 1999; Steiger, 2000; Tabachnick & Fidell, 2007).

3. Results

Study 1: Exploratory Factor analysis. To investigate if the conceptual two-factor structure of the Grit-S holds in the Malaysian context, an EFA was conducted to examine the factor structure underlying the 8-item Grit-S. Following the suggestion of parallel analysis, we examined a two-factor solution using maximum likelihood and Promax rotation. The result of the sampling adequacy measure reported a Kaiser-Meyer-Olkin (KMO) value of 0.71. Bartlett's test of sphericity was statistically significant, $\chi^2(28) = 589.84$, $p < 0.001$, supporting the suitability for factor analysis. The two-factor solution explained 53.05% of the total variance. All factor loadings were higher than 0.40 except item 2 ("Setbacks don't discourage me."). Following Muenks and colleagues' suggestion, item 2 was removed and another EFA of the 7 items found that KMO = 0.70 and Bartlett's test, $\chi^2(21) = 545.01$, $p < 0.001$, supporting the factorability of the items. The first factor (consistency of interests) consisted of items 1, 3, 5, and 6 accounted for 32.52% of the variance (eigenvalue = 2.28), and the second factor (perseverance of effort) explaining 25.74% of the variance (eigenvalue = 1.80). Overall, the two-factor model with seven items accounted for 58.26% of the total variance (see **Appendix Table 1**).

The α for the overall scale was 0.64 (McDonald's Omega = 0.65). The consistency and perseverance subscales demonstrated acceptable internal consistency with values of 0.66 ($\omega = 0.66$) and 0.75 ($\omega = 0.76$) respectively. Pearson correlation analysis showed that there was a positive relationship between the two subscales, $r(394) = 0.18$, $p = 0.02$.

Study 2: Confirmatory Factor analysis. In total, six models were compared (see **Appendix Table 2**). Results showed that both one-factor model with 8 items (Model 1) and 7 items (Model 2) were poor fit. On the contrary, the two correlated-factor models with 8 items (Model 3) showed a good fit to the data. However, all the indices signaled that the two correlated-factor models with 7 items (Model 4) yielded a better fit than Model 3. On the other hand, the bifactor model with 8 items (Model 5) was overfitting as the TLI values exceeded 1.0. For the bifactor model with 7 items (Model 6), a negative variance value was observed for item 1. To remedy the issue, the variance was set to zero and the iteration limit was increased to 5000. All the

indices except CFI and SRMR indicated that Model 6 was not fit to the data. Taken together, it is concluded that the two correlated-factor model with 7 items (Model 4) fit best for the sample.

The standardized factor loadings for Model 4 were all significant ($ps < .001$) and they ranged from 0.34 (item 1) to 0.85 (item 8). The two subscales were positively correlated, $r = 0.13$, $p < 0.001$. Cronbach's alpha for the overall scale was 0.66 ($\omega = 0.67$). The consistency and perseverance subscales demonstrated acceptable internal consistency with values of 0.65 ($\omega = 0.66$) and 0.75 ($\omega = 0.77$) respectively.

4. Discussion

The Grit-S was developed to assess the trait-level perseverance and passion for long-term goals. While most of the past studies supported the two-factor structure, some studies found cultural differences in the items. Thus, the present study was conducted to examine the factorial structure of the Grit-S in a Malaysian sample.

The EFA revealed a two-factor structure of the Grit-S: consistency of interests and perseverance of effort. The result is in line with previous findings (e.g., Duckworth et al., 2009). The consistency implies the structure of the Grit-S holds across different cultures. In other words, respondents from different cultural backgrounds generally perceive that the eight items explain two different constructs. Moreover, the consistency lends further support to the factorial validity of the Grit-S.

It is noteworthy that item 2 ("Setbacks don't discourage me") which showed a factor loading lower than 0.40 was removed. The removal of item 2 is in line with Muenks and colleagues' suggestion and supported by the CFA results. The two correlated-factor model with 7 items were superior to alternative models. Although the two correlated-factor model with 8 items also showed a good fit to the data, eliminating item 2 improved the model fit. The result implies that our participants may perceive item 2 differently from Western individuals. One possible explanation is that item 2 contains double negative words (e.g., don't discourage) thus difficult for non-native English speakers to comprehend the meaning of the item (Lavrakas, 2008). In line with this assumption, item 2 was found acceptable in the translated versions of Grit-S (e.g., Li et al., 2018; Nishikawa et al., 2015; Schmidt et al., 2017; Wyszynska et al., 2017). Moreover, Muenks et al (2017) found that item 2 was found acceptable for American college students but not high school students. Taken together, the findings lead us to suggest either modifying item 2 to facilitate respondents' understanding, or translating the Grit-S into the native language of respondents. Similarly, as the consistency of interests subscale reported a Cronbach

alpha coefficient slightly lower than 0.70, all the items may require modification to avoid reverse-scoring.

In addition, both Study 1 and Study 2 showed the two factors positively correlated with each other. The finding is consistent with Duckworth and Quinn's (2009) result but contradicts with Datu and colleagues' (2016) result. The discrepancies imply that the concept of grit may vary from one culture to another. Further explorations are required to investigate the sources of cultural differences.

Several limitations of this study are worth noting as well. First, the validity of the Grit-S was not thoroughly examined in the current study. Thus, future works are recommended to examine the construct validity and predictive validity to shed light on the usefulness of the Grit-S. Second, unlike Muenkes and colleagues' findings, our results preferred the (7-item) two correlated-factor model to the bifactor model for undergraduate students. Due to the scope of interest, the present study was not able to offer an explanation to the difference. Finally, the sample mainly consisted of Chinese and does not reflect the proportion of the Malaysia population. Future studies are recommended to replicate our findings on a sample of an equal number of the three main ethnic groups (i.e., Malay, Chinese, and Indian) in Malaysia. Moreover, a measurement invariance test shall be conducted to understand if the model holds across different ethnic groups.

5. Conclusion

In conclusion, the present study shows that the two-factor structure of the Grit-S is both tenable and applicable in the Malaysian context. The findings provide additional cross-cultural evidence to the theoretical structure of the Grit-S. However, cultural or language differences were observed in the understanding of the items. When using the Grit-S, researchers should take caution to ensure that respondents do not face difficulty in comprehending meanings of the items.

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Appendices

Appendix 1. Summary of Factor Loading by Maximum Likelihood for the 7-item Short Grit Scale (N = 396)

No.	Item	Consistency	Perseverance
1	New ideas and projects sometimes distract me from previous ones.	0.520	-0.193
2	I have been obsessed with a certain idea or project for a short time but later lost interest.	0.599	-0.024
3	I am a hard worker.	-0.040	0.755
4	I often set a goal but later choose to pursue a different one.	0.553	-0.096
5	I have difficulty maintaining my focus on projects that take more than a few months to complete.	0.641	0.106
6	I finish whatever I begin.	0.063	0.631
7	I am diligent.	-0.030	0.757

Note. Consistency = consistency of interests subscale; Perseverance Boldface factor loadings are greater than 0.40. Item 2 was removed due to low factor loading.

Appendix 2. Model Fit Indices From Confirmatory Factor Analysis (N = 713)

Model	χ^2	df	<i>p</i>	χ^2/df	CFI	TLI	RMSEA [90% CI]	SRMR
1 1-Factor (8 items)	372.3	20	< 0.001	18.62	0.645	0.503	0.157 [0.144, 0.171]	0.122
2 1-Factor (7 items)	361.83	14	< 0.001	25.85	0.634	0.452	0.187 [0.170, 0.204]	0.137
3 2-Factor (8 items)	30.79	19	0.04	1.62	0.988	0.982	0.03 [0.006, 0.048]	0.034
4 2-Factor (7 items)	17.38	13	0.18	1.34	0.995	0.993	0.022 [0.000, 0.046]	0.027
5 Bifactor (8 items)	10.3	12	0.59	0.86	1.000	1.004	0.000 [0.000, 0.034]	0.015
6 Bifactor (7 items)	52.51	9	< 0.001	5.83	0.954	0.893	0.082 [0.062, 0.105]	0.073

Note. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; CI = confidence interval; SRMR = standardized root mean square residual.