EDUCATIONAL PSYCHOLOGY | RESEARCH ARTICLE

Development and validation of multi-dimensional scale of grit

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Abstract: Positive psychology nurtures the potent qualities of individuals and aids them in carving a niche for themselves. Based on this theoretical foundation, a non-cognitive trait-like grit plays an imperative role in attaining high achievement. Previous studies have identified three dimensions of grit: perseverance of effort, consistency of interest and adaptability to situations. Recent research has criticized the dimension consistency of interest in a collectivist context. The present study provides an account of grit in view of eastern perspectives to check the suitability of the construct in India. Current findings provide a framework for the development and validation of Multi-Dimensional Scale of Grit reveals four dimensions of grit, namely, adaptability to situation, perseverance of effort, spirited initiative and steadfastness in adverse situations. It also provides an insight regarding the duration of goal attainment with respect to grit. The research conducted over three studies included Indian university students to develop and examine the psychometric properties of grit. Study 1 focused on item analysis and development of the factor structure through exploratory factor analysis. Study 2 confirmed the previously obtained factor structure through confirmatory factor analysis. In study 3, the psychometric properties of the scale were measured through test-retest reliability and validity, criterion, convergent and divergent. Results indicated that Multi-

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PUBLIC INTEREST STATEMENT

In the upcoming trend of Positive Psychology, it is noticed that the focus is now transcending towards character strengths. There is a shift from the disease model. The present researches are enunciating the growth of Positive Psychology and interventions for the same. This has been leading to cultivation of character strengths and values in all age groups. For the same, the present research aims to develop a tool on grit, a character strength that is about reaching the goal no matter what. It is an imperative strength which if inculcated would lead to success. The tool has been developed in the West and has had great utility; however, the point of it not being suitable for all cultures has been raised. For the same, the present tool has been developed.
Dimensional Scale of Grit is a reliable and valid measure. It also indicated that the obtained 12 items and four dimensions were in synchronization with the relevant eastern perspective.

**Subjects:** Psychological Science; Applied Social Psychology; Positive Psychology

**Keywords:** grit; non-cognitive trait; perseverance; spirited initiative; steadfastness; adaptability

1. **Introduction**

Contemporary advances in technology and global culture have led to profound changes in the lifestyle of individuals and placed increasing demands to be successful in life. The traditional exclusive focus of education on cognitive abilities did not prepare individuals for future challenges (Bowles et al., 2001; Heckman & Rubinstein, 2001). Researchers acknowledge the significance of non-cognitive skills towards positive psychological health and character development (Farrington et al., 2012; Jones et al., 2015; Kautz et al., 2014; Kautz & Zanoni, 2014). These factors are critical to an individual’s ability to overcome challenges through life (Shechtman et al., 2013). It is imperative to look at the Non-cognitive skills overlooked by a traditional educational system in the context. While cognitive ability or alternatively referred to as hard skills encapsulate formal conceptual understanding (Garcia, 2016), non-cognitive skills are identified as socio-emotional, behavioural traits (Garcia, 2016) and soft skills (Gutman & Schoon, 2013). Developing non-cognitive skills along with cognitive skills provide students with the tools to work towards success and enable them to resolve the complex challenges in life (Gutman & Schoon, 2013). Twenty-first century educationists presently focus on enabling conditions and resources at both individual and community levels to foster a state of being where people can actively flourish.

Grit is considered as a non-cognitive skill encompassing perseverance and passion for long-term goals and academic research on grit was pioneered by Duckworth et al. (2007). The construct was also popularized by the movie True Grit, released in the year 1969 (Hoerr, 2013). A person is not born with grit, rather the character strength can be learned. Development of grit is steady and is nurtured with training, experiences and practice (Duckworth et al., 2007). Gritty individuals are those who remain focussed on a task and work towards its completion or achievement. They strive towards achieving a certain level of mastery through intentional practice and sustained interest despite initial failures (Hokanson & Karlson, 2013). Grit is identified as a better predictor for academic achievement than intelligence or talent and is considered essential for future success (Duckworth et al., 2011, 2007; Duckworth & Quinn, 2009). Studies investigating grit among students reveal the evidence of higher persistence and academic success among grittier students (Duckworth et al., 2007; Cross, 2013; Strayhorn, 2014; Bowman et al., 2015; Fillmore, 2015; Wolf & Jia, 2015; Hwang et al., 2018; Hodge et al., 2018). An fMRI study exploring the neural processes underlying grit and its relationship with academic performance was conducted by Wang et al. (2017). Grit was related to spontaneous activity in the dorsomedial prefrontal cortex which acts as a neural link with academic performance.

Grit is predominantly discussed in the context of academic outcomes, but lately its relevance towards work outcomes, wellbeing, and quality of life is also receiving considerable attention (Datu et al., 2018; Goodman et al., 2017; Kleiman et al., 2013; Musumari et al., 2018; Tiittinen, 2014). It is associated with greater life course achievements (Abuhassan & Bates, 2015) and better health care management (Sharkey et al., 2018). Increasing evidence considers grit as a protective factor against negative mental health outcomes such as learned helplessness (Arya & Lal, 2018) and procrastination (Schmidt et al., 2017; Wolters & Hussain, 2015). Grit is future-oriented and evidence indicates that it can be associated with a stronger sense of purpose in life. It has shown positive associations with happiness (Singh & Jha, 2008); self-esteem (Weisskirch, 2018); subjective well being through mindful persuasion (Li et al., 2018) and emotional stability in stressful situations (Blalock et al., 2015). It is also associated with positive affect and purpose commitment (Datu et al., 2016; Singh & Jha, 2008; Zhang et al., 2018).
The construct of grit consists of two important dimensions: consistency of interest and perseverance. The first dimension involves enduring focus on well-defined long-term goals while the second dimension emphasises overcoming difficulties and persistence in working with challenges along the way (Duckworth et al., 2007). Li et al. (2018) provide evidence that free will is an important predictor of perseverance for long term goals.

It is important to differentiate grit from other related non-cognitive skills. Resilience is considered a positive adaptation in the face of adversity. Duckworth states that grit is related to resilience. Being gritty entails being not just resilient in the face of challenges or difficult situations, but also displays a commitment to goals over longer periods of time. Resilience does not involve goal-setting (Perkins-Gough, 2013). Tenacity in the educational setting is defined by Dweck et al. (2014) as mindset and skills, which facilitate students to move beyond short-term goals to long-term goals. To work hard and smart for a longer time scale is the essence of tenacity. The relationship of grit and growth mindset (Galla et al., 2014) has been explored with neuro-anatomical-based evidence (Wang et al., 2018). A “growth mindset,” unlike fixed mindset, prospers on challenges and considers failure as a nurturing ground for growth and development. Grit is related to optimism (Duckworth & Quinn, 2009). Grit is considered distinct from intrinsic motivation. The emphasis of intrinsic motivation is on personal fulfilment whereas grit stresses on the commitment to achieve long-term goals (Datu et al., 2017b). Similarly, hardness, a protective factor, is defined quite similarly to grit, yet distinct with respect to certain abilities (Block, 2014). Conscientiousness, which is one of the important big five factors, is differentiated from grit by Duckworth et al. (2007). The focus of the former is proposed to be on self-regulation and dependability while the latter emphasizes on consistent effort and motivation.

1.1. Review of grit measures
The non-cognitive skill is measured on two dimensions: perseverance of effort and consistency of interest. Duckworth et al. (2007) constructed Grit-O, 12-item scale and then later revised it to Grit-S, 8-item scale (Duckworth & Quinn, 2009). Adaptation of Grit-S among Chinese adolescents was perceived to be a sound measure (Li et al., 2018). However, Credé et al. (2017) criticized the consistency of interest dimension and its applicability to measure grit. Perseverance of effort is a reliable indicator of academic achievement and consistency of interest did not relate. Credé (2018) pointed out that grit literature lacked construct, discriminant and predictive validity and pressed on the need to improve measurement of grit and its facets for empirical investigations. Datu et al. (2017a) while measuring grit on Filipinos’ samples considered perseverance of effort and consistency of interest as two interdependent yet distinct traits. The former dimension predicted academic engagement and well being while the latter did not. The applicability of consistency of interest in the Filipino collectivistic culture was questioned and a new dimension called adaptability to situations was introduced. Datu et al. (2017a) constructed a measure called Triarchic Model of Grit Scale which consisted of three dimensions: perseverance of effort, consistency of interest and adaptability to situations. The additional dimension provided a flexibility element to grit (Jordan et al., 2019).

Grit has been extensively researched on the American sample thereby limiting its applicability in the interdependent contexts (Datu et al., 2017a). A collectivist culture differs from the independent culture in behavioural consistency (Suh, 2007). The people in the interdependent context are deeply woven into the social fabric and would prioritize goals as per others, which makes them inconsistent and flexible in their approach. Therefore, the dimension consistency of interest may be debatable in these contexts; however, the importance of adaptability to situations is validated. With the present background, the current study aims to integrate eastern perspectives on grit and explore its conceptualization.

1.2. Eastern perspectives on grit
Grit has been widely prevalent in the Indian and overall Eastern perspectives much before its inception in the West. The term has been widely acknowledged in the Indian religious script of Holy
Bhagavad Gita, which focuses on the conversations of Lord Krishna and Arjuna about accentuating the importance of work without paying attention to the gain per se. The Bhagavad Gita emphasizes the capability of developing “titiksha” or the strength of the mind as a first step to being tough and not giving up in the midst of difficult situations (Marballi, 2017). The positive message included in the religious script is about finding one’s inner potential by pushing aside a negativist mind-set and moving towards greater achievements (Chakrabarti, 2010). The holy book provides an understanding of imbibing a sense of purpose and the importance of maintaining parity of mind in times of success and failure. The equilibrium hence assists the individual in becoming aware of the correction of the wrongdoings to avoid the same next time (Satsangee, 2012). Another source of Indian literature, The Upanishads threw light on “gumption” of Lord Vishnu that is explained in terms of an increase in vigour, which assisted him in fighting the demons and achieving his boon (Sharma et al., 2005).

Taoist literature interprets grit as the yang in dualistic cosmology yin-yang that denotes the masculine, hard, penetrating principle of persevering and achieving by taking action (Rose, 2013). Grit is also acknowledged by Buddhist literature which provides an account of the term Dukkha and puts forth the viewpoint of the individual not contemplating the suffering or coping through distraction in such situations, rather striving to work through the situation with caution and being steadfast (Thanissara, 2014). The Islamic perspective articulates grit as strength of character, constancy, steadfast, showing devotion in work and being determined (Qamar, 2016). Grit research in India is very nascent. There has been no attempt so far to design and review grit tools relevant in Indian context. Singh et al. (2018) translated and validated Grit-S (Duckworth & Quinn, 2009) in Hindi language. However, the authors could not replicate the factor structure in the original scale and suggested to re-examine the internal consistency of the construct.

Summing up the eastern perspectives, the essential elements which contribute to grit are guts, which is courage to walk on in spite of challenges and not succumb to adversity, dealing with problems by bouncing back, ability to initiate action and ability to persistently focus on the goal (Thaler & Koval, 2015).

The present study aims to incorporate the various elements of grit identified from eastern literature and to develop a new scale of grit relevant for the eastern societies as well. The present research is centred on the development and validation of the Multi-Dimensional Scale of Grit (MDSG) over three studies. Study 1 focuses on item development and exploratory factor analysis while study 2 focuses on confirming the factor structure identified. The Cronbach alpha was also measured. Study 3 focuses on the validity and test-retest reliability of the developed tool.

2. Study 1
The objective of study 1 was to explore the factor structure of the Multi-Dimensional Scale of Grit using exploratory factor analysis. Items were generated through item writing and item analysis.

3. Method

3.1. Participants
A total of 297 undergraduate students pursuing social sciences (age: $M = 18$ years, $SD = 1.27$) from a private Indian University in an urban setting were part of this study. 71.2% of the sample was women ($n = 208$). Classes were randomly selected to sample among various classes in the university.

3.2. Procedure and material
Necessary Permissions for concerned authorities was taken before initiating the administration of the scale. The participants were approached through classroom announcements and the new Multi-Dimensional Scale of Grit was administered after seeking their consent. Participation in the study was purely voluntary and the participants were oriented about the time required to complete the questionnaire, the confidentiality of the data and the process of withdrawal from the study.
The participants were asked to give their responses on a 5-point scale on items such as “Rejection at any point does not deter me from achieving my goal.” The scale ranged from 1 (strongly disagree) to 5 (strongly agree). A higher score on the scale indicates greater levels of grit.

3.3. Development of MDSG
We generated potential items for the Multi-Dimensional Scale of Grit by reviewing the existing literature on Grit. Both western and eastern perspectives of grit were appraised and items from existing scales both in western and eastern countries were also reviewed. Gender-neutral statements were carefully included. An initial item pool of 77 statements exploring the passion for goals and long term commitment along with the situational determinants were written. The central goal of developing a new scale was to incorporate the elements of adaptability of situations identified by Datu et al. (2016) (eg I learn from my mistakes and incorporate them to work towards my goal.), the essence of grit as identified from eastern perspectives consisting of ancient literature and its emphasis on spirited initiative (eg I embrace the frustration I feel during difficult situations and move forward to achieve my goals.) and steadfastness (eg Rejection at any point does not deter me from achieving my goal.). The project team screened the items for redundancy and repetition. Items that were vague and long were also eliminated. 30 items were deleted and eleven academic experts with the background of Psychology for content validity reviewed the remaining items. A four point evaluation criteria wherein 1 was least relevant and 4 was highly relevant was used to rate the statements. The experts were encouraged to give feedback or remarks for each item. Items with greater than 80% agreement among the reviewers were retained. 18 statements were deleted at the end of this stage and led to a pool of 29 items. A pilot study (N = 30) was done for increasing comprehensibility of items and validating instructions. Consequently for item analysis (N = 100), we scrutinized the 29 items by asking the participants to give their responses for each statement on the scale. Six items were deleted based on mean, item discrimination and item total reliability. The final scale constituted 23 statements on a five-point Likert scale ranging from strongly agree to strongly disagree (Figure 1).

4. Results
Results of exploratory factor analysis using principal component analysis through promax rotation indicated 5 factors for 23 items. A χ2 value of 1859.861 on Bartlett’s test of Sphericity indicated the suitability of correlations for factor analysis. Kaiser-Meyer-Olkin value was 0.904 indicating adequacy of sample (Worthington & Whittaker, 2006).

Factors with eigen-value greater than 1 were considered and resulted in a five-factor solution explaining 50.9 % variance which is within the acceptable proportions (Samuels, 2017). Items with factor loadings greater than 0.4 are considered stable (Guadagnoli & Velicer, 1988). An optimal scale consists of less items but also retains its reliability and validity. It was decided to extract the top three items with loadings greater than 0.50 that did not cross load on any other factor were considered for retention (Samuels, 2017). This resulted in the deletion of fifth factor as the items did not meet the above criteria. The final scale consisted of 12 items with four factors (Table 1).

The first dimension identified is adaptability to situations (α =.63) and reflects items which estimate the individuals ability to adapt effectively to changing circumstances. The second dimension is perseverance of effort (α =.54) and reflects determination to achieve the goals through consistent effort in times of adversity. Spirited initiative (α =.50) is the third dimension and indicates ability to embrace situations with positive energy and initiate action through resourcefulness. The last dimension is steadfastness (α =.57) and it denotes unwavering focus on the path to goal accomplishment. The internal consistency of the overall scale is 0.78 which is indicative of acceptable levels (Tavakol & Dennick, 2011). Although the α for the dimensions is 0.50 and above, it is common for dimensions with fewer items to have lower internal consistencies (Pallant, 2001). Table 1 demonstrates the item analysis and exploratory factor analysis results. All the items have item-total reliability within suggested limits.
Figure 1. Flow chart of development of items for MDSG.

**Review of literature for item pool**
Reviewing existing scale items for clarity of factors.
Reviewing literature from Western and Eastern perspectives:
Relevant research articles and books

**Item pool**
77 statements centering on perseverance, passion, adaptability to situations, steadfastness in adverse situations and spirited initiative

**Item Screening**
Items screened by project team and 30 items deleted on the basis of redundancy and repetition

**Expert Validation**
11 experts validated the item pool on a 4-point scale based on relevance and provided feedback for the same. 18 items deleted on the basis of the validation. Final pool of 29 items retained.

**Pilot Study**
Sample Size: 30. Validating instructions and comprehensibility of the scale by participants. No items were deleted.

**Item Analysis**
Sample Size: 100. Six items were deleted on the basis of mean, item discrimination and item total reliability leading to a total of 23 items on a 5-point likert scale (Strongly agree and strongly disagree)

**Exploratory Factor Analysis**
Sample Size: 297. Top three items extracted with factor loadings above 0.5.
Final scale: 12 items and 4 factors.
| Item                                                                 | Factor Loading 1 | Factor Loading 2 | Factor Loading 3 | Factor Loading 4 |
|----------------------------------------------------------------------|------------------|------------------|------------------|------------------|
| I am able to monitor and control myself to achieve my goals.         | 3.53             | 0.68             | 0.61             | 0.71             |
| I learn from my mistakes and incorporate them to work towards my goal.| 3.96             | 0.71             | 0.69             | 0.61             |
| I work hard to achieve my goals.                                    | 3.93             | 0.56             | 0.64             | 0.60             |
| I move out of my comfort zone to achieve my goal.                   | 3.53             | 0.56             | 0.54             | 0.68             |
| I take in, blend and construct new ideas to achieve my goals.       | 3.82             | 0.55             | 0.51             | 0.58             |
| I am willing to complete an important journey despite the obstacles I may face. | 3.88             | 0.53             | 0.57             | 0.64             |
| I am alert and adaptable in situations of distress.                 | 3.74             | 0.54             | 0.52             | 0.61             |
| Item                                                                 | Mean | Item discrimination | Item Total Reliability | Factor Loading |
|---------------------------------------------------------------------|------|----------------------|------------------------|----------------|
| I embrace the frustration I feel during difficult situations and move forward to achieve my goal. | 3.37 | 0.62                 | 0.53                   | 0.57           |
| I am able to handle whatever comes my way.                         | 3.67 | 0.58                 | 0.55                   | 0.52           |
| Rejection at any point does not deter me from achieving my goal.   | 3.32 | 0.75                 | 0.53                   | 0.74           |
| I have a sense of purpose in life.                                 | 3.8  | 0.56                 | 0.48                   | 0.58           |
| No matter how hopeless the situation is, I don’t give up.          | 3.54 | 0.63                 | 0.51                   | 0.56           |
Gender differences were calculated for the four factors. The results reported a significant difference between men and women on perseverance of effort dimension ($t = -2.338, p < 0.05$). The other dimensions did not report significant differences between men and women.

5. Discussion
The findings from study 1 demonstrated empirical evidence for a new measure of grit. The 12-item Multi-Dimensional Scale of Grit is a brief measure to assess grit which can be administered in collectivist cultures. The scale is developed to overcome the critique of the model put forth by Duckworth et al. (2007) which is not completely relevant in collectivist societies (Datu et al., 2016) and arrive at a new measure based on indigenous eastern perspectives of the construct of grit. The dimension of “perseverance of effort” was consistent with prior conceptualizations in western literature and is relevant in eastern cultures as well. It is about working vigorously towards obstacles and sustenance of effort. The dimension of “adaptability to situations” is similar to the framework given by Datu et al. (2017a) of viewing individuals’ skill to adapt efficiently. The third and fourth dimensions are based on the essence of the concept of grit from ancient Indian literature which was in existence long before the western perspectives. The dimensions of spirited initiative is reflected in the concept of “titiksha” as an enthusiastic resourceful approach towards facing challenges (Srivastva & Cooperrider, 1998). Steadfastness in adverse situations is being dutiful in the face of goal achievement. It denotes that an individual has the skill to stay put even when the situation gets tough (Scarre, 2012) and reflects firmness of character (Kelly et al., 2014). The next stage was to validate the proposed factor structure among new participants.

6. Study 2
The purpose of the study 2 was to corroborate the four-factor structure of MDSG developed in study 1 by using confirmatory factor analysis.

7. Method

7.1. Participants
Necessary Permissions from the concerned authorities was taken before initiating the administration of the scale. One hundred and twenty postgraduate students pursuing social sciences (age: $M = 21$ years, $SD = 2.07$) from the same university as study 1 participated. Participants were from urban settings and about 103 of them were women.

7.2. Procedure and material
The new 12-item MDSG developed in the previous phase was administered to confirm its factor structure. Participants were recruited for research through announcements. Participation was solely voluntary and guidelines related to consent was elicited before the grit scale was administered. Instructions for giving their responses on a 5-point Likert scale similar to study 1 were given.

8. Results
Confirmatory factor analysis to evaluate the 12-item MDSG factor structure from EFA was done using Amos twentieth version (Figure 2). The first model tested the 12 items mapped on to a single latent grit factor. Next, we tested the four factors as independent non-hierarchical factors. A $\chi^2$ value of 1872.502 on Bartlett's test of Sphericity indicated the suitability of correlations for factor analysis. Kaiser-Meyer-Olkin value was 0.874, indicating the adequacy of the sample (Worthington & Whittaker, 2006).

Results from Table 2 demonstrated a support for the hierarchical model wherein all four factors loaded on higher order grit factor. The factor loadings were significant and in between 0.20 and 0.96 ($M = 0.69$, $SD = 0.18$). The model demonstrated adequate fit (RMSEA = 0.08, CFI = 0.921, SRMR = 0.067, BIC = 253.563 and TLI = 0.88). The hierarchical model was deemed acceptable based on cut-offs suggested by Byrne (2012) and recommended values by Schermelleh-Engel et al. (2003). Based on the cut off, Root mean square error of approximation (RMSEA) index between .05 and .08 is considered a good fit and Standardized Root Mean Square Residual (SRMR) index
between .05 and .10 as an acceptable fit. Based on all the above indices the model explored in CFA is considered a better fit than the single-factor model.

The Cronbach alpha for the developed scale in study 2 was 0.879 which is indicative of acceptable reliability (Tavakol & Dennick, 2011). The internal consistency for dimension 1 (adaptability to situations) was 0.725, dimension 2 (perseverance of effort) was 0.742, dimension 3 (spirited initiative) was 0.668 and dimension 4 (steadfastness in adverse situations) was 0.639.

Table 2. CFA goodness of fit indices

| Factor          | df  | Chi Square | RMSEA | CMIN | CFI  | SRMR | BIC  | TLI  | p      |
|-----------------|-----|------------|-------|------|------|------|------|------|--------|
| Non-Hierarchical | 48  | 104.63     | 0.10  | 2.180| 0.889| 0.083| 248.257| 0.847| 0.00**  |
| Hierarchical    | 47  | 87.151     | 0.08  | 1.85 | 0.921| 0.067| 253.563| 0.88  | 0.00**  |

**p < 0.01
9. Discussion
The proposed hierarchical model of MDSG is a better fit when compared to non-hierarchical models. The Cronbach alpha for the scale in study 2 was also adequate. The findings from Studies 1 and 2 together demonstrate evidence that the MDSG scale is psychometrically adequate. The scale showed a robust factor structure with good internal consistency. The factors derived make conceptual sense in light of theoretical frameworks from eastern and western perspectives. Understanding the person’s steadfastness in working towards their goal is highlighted in the present scale. The next objective was to demonstrate the convergent and discriminant validity and test-retest reliability of the scale.

10. Study 3
The purpose of study 3 was to establish the psychometric properties of the Multi-Dimensional Scale of Grit.

11. Method

11.1. Participants
Necessary Permissions from the concerned authorities were taken before initiating the administration of the scale. 120 postgraduate students pursuing social sciences (age: $M = 21$ years, $SD = 2.07$) from the same university participated. Participants were from urban settings and about 103 of them were women. A subsample of 70 university students had participated in the study to examine the test-retest reliability.

11.2. Procedure and material
We administered 6 measures: two for criterion validity, two for convergent validity and two for divergent validity. After a minimum time gap of three weeks, 70 of the participants were re-administered the MDSG scale to examine the test-retest reliability. The following measures were used to investigate the validity of Multi-Dimensional Scale of Grit:

11.3. Short grit scale (Grit-S)
Duckworth and Quinn (2009) developed a revised version of the Grit-O. The scale consisted of 8 items and measured the dimensions: perseverance of effort and consistency of interests. The respondents mark their response on a five-point Likert scale ($1 = $Not like me at all$, and $5 = $Very much like me$). The reliability of the measure is 0.82 and a superior validity as a consequence of the superior reliability.

11.4. Triarchic model of grit scale (TMGS)
Datu et al., (2017a) developed a 10-item scale wherein the respondents mark their response on a five-point Likert scale ($0 = $Not like me at all$, and $5 = $Very much like me$). The scale measured dimensions – perseverance of effort, consistency of effort and adaptability to situations. For each dimension the reliability analysis is 0.84, 0.84 and 0.88, respectively.

11.5. Perceived choice and awareness of self scale (PCASS)
The scale is based on the self-determination theory (Sheldon & Deci, 1996). The 10-item scale assesses perceived choice and awareness of self. The scale consists of good internal consistencies ranging from 0.85 to 0.93 and validity.

11.6. Revised Norwegian dispositional resilience (hardiness) scale
A 15-item scale wherein the respondents are to mark their response on a four-point Likert scale ($0 = $not at all true$, and $3 = $completely true$) was developed by Hystad et al. (2010). The scale reports reliability coefficients of the three subscales – commitment, challenge and control, ranging from 0.62 to 0.79.

11.7. Pure procrastination scale (PPS)
The French version was validated by Rebetez et al. (2014). The version consisted of 11 items on a 5-point Likert scale ($1 = $Very seldom or not true of me$ and $5 = $very often true or true of me$). The
results reported internal consistency of 0.89 of the scale and validity was measured by examining
the scale with other measures, which indicated significant correlations.

11.8. Learned helplessness scale
The self-report tool for Learned Helplessness and Mastery Orientation was developed by Sorrenti et al. (2014). For the purpose of divergent validity out of the 13 items, 6 items were used as they were pertaining to learned helplessness. The respondents were to mark the 6 items on the basis of 5-point Likert scale (1 = not true and 5 = absolutely true). The LH has good internal consistency of 0.77.

12. Results
To verify the construct validity for the MDSG, we tried to establish the convergent and discriminant validity. Even though there are no fixed rules for stating the sample size for validation (Osborne & Costello, 2004), a 10:1 respondent to item ratio (Nunnally, 1978) was followed for the present scale. The correlation between MDSG, Grit-S and triarchic grit scores were considered. Table 3 shows the means, standard deviations and correlations. As assumed, the MDSG scores positively correlated with Grit-S scores ($r$ (120) = .56, $p < .01$) and triarchic grit scale scores ($r$ (120) = .58, $p < .01$). The results are indicative of validity which shows that grit assessed through MDSG is not an exact replica for pre-existing scales (Carmines & Zeller, 1979).

12.1. Test-retest reliability
A subsample of 70 participants completed the Multi-Dimensional Scale of Grit. The analyses were carried out in a span of three weeks. Pearson correlation for Multi-Dimensional Scale of Grit was 0.795 ($p < 0.01$) that indicates good reliability.

12.2. Convergent validity
The developed scale was correlated with scales that include a construct similar to the already existing one. The Multidimensional Scale of Grit scores positively with PCASS ($r$ (120) = 0.527, $p < 0.01$) and Revised Norwegian Dispositional Resilience (Hardiness) Scale ($r$ (120) = 0.565, $p < 0.01$). This indicates that the developed tool is measuring what it must.

12.3. Divergent validity
The developed scale was correlated with scales that measure the opposite of the proposed measure. The Multi-Dimensional Scale of Grit scores negatively with Learned Helplessness Scale ($r$ (120) = −0.598, $p < 0.01$) and Pure Procrastination Scale ($r$ (120) = −0.475, $p < 0.01$). This indicates that the developed measure stands opposite to the divergent measures.

| Scale                        | Mean  | SD    | 1       | 2       | 3       | 4       | 5       | 6       |
|------------------------------|-------|-------|---------|---------|---------|---------|---------|---------|
| MDSG (1)                     | 44.675| 7.34  |         |         |         |         |         |         |
| Grit-S (2)                   | 27.256| 5.25  | .565**  |         |         |         |         |         |
| TMGS (3)                     | 36.880| 5.67  | .582**  | .761**  |         |         |         |         |
| Self-Determination (4)       | 36.342| 8.52  | .527**  | .475**  | .460**  |         |         |         |
| Hardiness (5)                | 28.983| 6.53  | .565**  | .618**  | .605**  | .565**  |         |         |
| Learned Helplessness (6)     | 13.632| 5.77  | −.598** | −.578** | −.562** | −.599** | −.584** |         |
| Pure Procrastination (7)     | 29.402| 10.07 | −.475** | −.549** | −.512** | −.389** | −.359** | .598**  |

* * p < 0.01
13. Discussion
In the current study, construct validity was indicated by its expected performance on the measures of convergent and discriminant validity against the constructs which are theoretically related and unrelated. The criterion validity indicates that the tool is in line with the construct of grit and is also not identical; hence, it provides new ideas to grit. The convergent validity indicates that the developed tool is in line with constructs similar to grit such as hardness and self-determination. The divergent validity indicates that the developed tool is the opposite of learned helplessness and procrastination, ensuring the validation of the developed tool.

14. General discussion
The present work gives a new self-report scale to measure grit relevant for collectivist cultural contexts. The MDSG scale developed through the pioneering work of Duckworth et al. (2007) and Datu et al. (2016). The scale highlights the framework of grit from ancient Indian literature. Though the term grit was not used, its essence was discussed in the holy scripture of Bhagavad Gita. In the present development of the tool to measure grit, the construct is defined as “Determination of goals with steadfastness in adversity and spirited initiative by adapting resourcefully to the demands of the situation.” Unlike the previously established scales, the present scale of grit showcases four dimensions, which are adaptability to situations, perseverance of effort, spirited initiative and steadfastness in adverse situations.

Traces of grit were found in the eastern literature before the term gained popularity in the west. The Multi-Dimensional Scale of Grit is a reflection of the eastern perspective that is blossoming rich with Hindu, Taoism, Islamic and Buddhism literature on grit. The contexts enunciate that grit refers to following the penetrating principle of perseverance for taking action (Rose, 2013) and is a character strength which ensures that the individual stays put on a mission and is steadfast, devoted and tenacious (Qamar, 2016). This understanding is reflected in the dimension of perseverance of effort—an individual’s determination and tenacity to reach the goal which is similar to the teaching of the eastern perspective. On similar grounds, the Holy Bhagavad Gita has emphasized the importance of work that is reflected in the dimension of steadfastness in adverse situations in which an individual stays loyal and committed to his/her work. Supporting the newly found factor also known as “titiksha” is comprehended as the strength of the mind (Brdar and Kashdan, 2010) that an individual maintains during dukkha and difficult situations (Marballi, 2017; Thanissara, 2014). Thus, being steadfast and adaptable in adverse situations leads to a sense of purpose with a balance of mind in the face of success and failure (Satsanggee, 2012). Grit through Upanishads, throws light on the spirited initiative in achieving goals. The literature discussed above is thoroughly indicative of all the four dimensions that have risen in the developed tool.

The present scale did not include items pertaining to long-term or short-term goals. Therefore, does being gritty centre around the duration of the goal? Uhls (2013) pointed out that it is possible to inculcate grit in children, but since they are still developing, it will be difficult for them to set a long-term goal. Hence, it would be essential to let them plan their personal goal and ensure that they are attainable, indicating setting up of short-term goals instead. Bosa (2017) mentions that there has to be a long-term and short-term goal alignment while imbibing grit. The concept of adverse situations provides the understanding that it is not always about the duration of the goal but the goal itself that makes one gritty. Brannigan (2015) highlighted the concept of moral grit in situations of hopelessness and helplessness during catastrophes such as famine, earthquakes, tsunamis and drought wherein the individual imbibes a resilient spirit by enabling moral grit. The author talks about an everlasting expression of the Japanese population, “We refuse to lose, we must get through it together.” This is reflective in the definition as well as it looks at just the aspect of goals which is different from the previous definitions provided by the authors.

Contradictory to the previously established scales, the new scale formulates items based on the literature of the western and eastern perspectives, thus providing a sturdy constitution to the
The concept of grit in the collectivist society. It is imperative to consider the requirement of a tool that could be used in the collectivist culture.

15. Limitations and recommendations
The participants in the studies were university students thereby limiting its generalizability and highlighting the need for exploring the relevance of scale for other age groups. The study sample was skewed as most participants were women and were students from the deanery of humanities and social sciences. Greater number of women enroll for these courses at University level than men. Regardless of the limitations, MDSG scale demonstrates an adequate proof of psychometric strength. The study recommends researchers to use Multi-Dimensional Scale of Grit and measure the academic performance and other psychological constructs for criterion validity. There is scope for future research to study personality traits and self-control with MDSG.

16. Conclusion
The Multi-Dimensional Scale of Grit provides a pedestal to measure the construct of grit on the basis of cultural understanding. The present tool introduces a new dimension (steadfastness in adverse situations) and a relooked version of consistency of interest (spirited initiative). There is also an insight that grit is not just pertaining to long-term goals, but also includes an individual's response to an immediate adverse situation such as a catastrophe.

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