

# **Grit Assessment: Is One Dimension Enough?**

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## **Grit Assessment: Is One Dimension Enough?**

Grit is one of the non-cognitive variables that has received the most attention in recent years given its relationship to and influence in various aspects of life. There are very few reliable, valid instruments to evaluate it in Spanish-speaking countries. Because of that, the aim of this study is the development and validation of a new scale to evaluate grit in Spanish-speaking contexts. We used a sample of 531 Spanish participants (60% women) from the general population ( $M_{\text{years}} = 38.60$ ,  $SD_{\text{years}} = 14.90$ ). We examined the structure and measurement invariance of the instrument. We calculated the instrument's reliability and obtained evidence of validity in relation to other variables. We examined the differences in grit as a function of gender and age. The factorial analyses confirmed the unidimensionality of the instrument, along with the measurement invariance of the scores with respect to sex and age. The new grit scale demonstrated excellent reliability ( $\alpha = .94$ ;  $\omega = .94$ ). We found clear evidence of validity in relation to other variables; the Grit short scale ( $r = .691$ ), self-control ( $r = .595$ ), self-efficacy ( $r = .703$ ), and conscientiousness ( $r = .661$ ). The new scale for evaluating grit (Oviedo Grit Scale) is essentially unidimensional, and scores produced by it exhibit excellent indicators of reliability and validity.

*Keywords:* Grit, assessment, scale, reliability, validity

One of the objectives of psychology is to attempt to explain why some people use a small part of their resources in comparison with others who use them to the limit (William James, 1907), or to put it another way, why some people are more successful than others who demonstrate the same aptitudes, talents, and opportunities. One of the possible explanations revolves around non-cognitive variables (Farrington et al., 2012), which have been demonstrated to influence various aspects of life such as education and health (Heckman & Kautz, 2012; Smithers et al., 2018). Among these, grit has been the subject of much attention in the literature since the well-known study from Duckworth, et al. (2007), in which the authors defined it as follows: “Grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress. The gritty individual approaches achievement as a marathon; his or her advantage is stamina” (Duckworth et al., 2007, pp. 1087). For this reason, grit is considered a positive trait based on an individual’s perseverance combined with their passion for reaching a long term goal (Duckworth, 2016), and according to this author, has two dimensions: perseverance of effort and consistency of interests.

There has been a proliferation of research looking into the relationships between grit and other important aspects of people’s daily lives such as education (e.g. Duckworth et al., 2007; Duckworth & Quinn, 2009), health (Datu et al., 2019; Moore et al., 2018; Silvia et al., 2013), marriage (Eskreis-Winkler, Shulman, Beal et al., 2014), and work (Baum & Locke, 2004; Jordan et al., 2019; Vallerand et al., 2014). One of the aspects of grit that has been most widely studied is its relationship to academic performance. High scores in grit have demonstrated relationships with better school grades at all educational levels (Fong & Kim, 2019; Hagger & Hamilton, 2018; Steinmayr et al., 2018). In this educational context there have also been findings that go

beyond school grades such as predicting which students will be more likely to graduate a year later (Eskreis-Winkler, Shulman, Beal et al., 2014), or which new teachers are more likely to continue in the profession, as well as who will be more effective (Duckworth & Quinn, 2009; Robertson-Kraft & Duckworth, 2014). Outside of the academic arena grit has also been shown to be important in other contexts such as the military (Duckworth et al., 2007; Eskreis-Winkler, Shulman, Beal et al., 2014), the workplace (Eskreis-Winkler, Shulman, & Duckworth, 2014; Eskreis-Winkler, Shulman, Beal et al., 2014), and entrepreneurial activity. In the latter, grit has recently been shown to help predict entrepreneurial success (Mooradian et al., 2016; Mueller et al., 2017; Newman et al., 2019), those with higher levels of grit being more likely to become entrepreneurs (Arco-Tirado et al., 2019) and to be more successful in business (Mueller et al., 2017). Grit has also been studied in relation to sociodemographic variables such as sex and age, with contradictory results. In terms of sex, although the meta-analysis by Credé et al. (2017) did not find differences, other studies have shown that women have higher levels of grit (Eskreis-Winkler, Shulman, Beal et al., 2014; Oriol et al., 2017). When it comes to age, Duckworth et al. (2007) showed that grit seemed to be stable over time and context. However, in a longitudinal study West et al. (2016) showed that grit scores decreased over two years, while recent studies have shown that grit increases with age (Cosgrove et al., 2016; Peña & Duckworth, 2018).

Despite the findings about grit, the construct has not been free from controversy, motivated according to some authors by the close statistical relationship and substantial overlap with other, more classical psychological variables: self-control, self-efficacy, conscientiousness, and motivation. Self-control, or the capacity to change oneself to develop a better fit between the person and the world (Mischel et al., 1996), has demonstrated the closest correlations with the grit construct (Duckworth & Gross, 2014;

Muenks et al., 2017; Oriol et al., 2017). However, self-control is a variable that is more related to a person's behaviour in the short term and their capacity to delay gratification (Mischel, 2014), and is considered a facet of conscientiousness. In contrast, grit is more about consistency of interest (in whether interests change over the long term) (Duckworth et al., 2007), so the two constructs differ in the time assigned (short and long term) (Duckworth & Gross, 2014). Self-efficacy, or a person's belief in their ability to employ behaviours that influence the events that affect their lives (Bandura, 1977), has also been shown to be closely correlated to grit (Oriol et al., 2017; Usher et al., 2019). However, whereas self-efficacy as a variable depends on the context in which it is measured, grit can be significant regardless of the domain in which it works (Duckworth et al., 2007). Finally, conscientiousness is understood as the tendency to be self-controlled, responsible in the eyes of others, a planner who is able to delay gratification, hard-working, ordered, and someone who obeys the law (Roberts et al., 2009). This has been the most controversial variable given its close relationship to grit (Credé et al., 2017; Ivcevic & Brackett, 2014; Schmidt et al., 2018). Within the facets making up conscientiousness, the relationship with grit is particularly striking with the facet of industriousness, understood as diligence or the tendency to work hard (Schmidt et al., 2018, 2020), and grit has even been considered as a facet of conscientiousness. In their meta-analysis, Credé et al. (2017) found strong correlations between the two constructs, once they had controlled for sample sizes and the reliability of the instruments used to measure the variable conscientiousness. In this regard, although it is challenging to differentiate between the two constructs, the difference may be due to consistency of interests, with *continuing interest* being a different aspect. In this way, these two traits differ in that people with high levels of grit not only complete tasks on time (which a person with high levels of conscientiousness would also do), but they are

also able to continue to maintain consistency in their objectives for years (Duckworth et al., 2007). Nonetheless, consistency of interests may be attributed to the measure used to evaluate conscientiousness. Finally, grit has also been related to motivation, although this has focused on the educational arena (Muenks et al., 2017; Steinmayr et al., 2018).

Despite the research on grit in recent years, there is no consensus about its evaluation or measurement. The first instrument proposed for measuring grit was the *Grit Scale* (Duckworth et al., 2007), from which Duckworth and Quinn (2009) developed a short version (Grit-S). From that point on, most researchers interested in the construct used this scale, which has been validated in many countries and cultures, including versions in German (Schmidt et al., 2019), Korean (Kim & Lee, 2015), Japanese (Nishikawa et al., 2015), Chinese (Li et al., 2016), Russian (Tyumeneva et al., 2014), and Spanish (Arco-Tirado et al., 2018). The Grit-S scale has two dimensions (with four items each): perseverance of effort and consistency of interests. Despite the boom in grit research, there are various ongoing debates about measuring this construct, including the dimensionality and reliability, two of the most important aspects in the psychometric study of any questionnaire. In terms of dimensionality, the Grit-S scale was initially validated with two first-order factors (perseverance of effort and consistency of interests) and one second-order factor (grit) (Duckworth & Quinn, 2009). However, this higher order view of the structure of grit does not appear to be correct (see, Credé, 2018). In this regard, some recent studies have proposed a unidimensional structure with a single first-order factor (Areepattamannil & Khine, 2017; Gonzalez et al., 2019), or a two-factor structure with independent factors (Abuhassan & Bates, 2015; Datu et al., 2016; Wolters & Hussain, 2015). The underlying reason for these different results may be due to an overlap of the two dimensions, making it difficult to distinguish which items fit in one or the other. Something to note about the

dimensionality of the test is that one of the two dimensions, consistency of interests, has all of its items in an inverse form, which may have helped the Factorial Analysis fit with two differentiated factors in the initial study in which the instrument was created (Duckworth & Quinn, 2009). This is because human beings tend to respond differently depending on the meaning of the question owing to the cognitive processing of direct and inverse items not necessarily being the same, particularly when reading ability is low (Marsh, 1986; Mestre, 2013). For this reason, inverse items in Likert-type scales, and even including inverse and direct items in the same questionnaire, can have a negative impact on the psychometric properties, and it is advisable to formulate all items in a direct manner (a more positive answer is associated with a higher level of the construct being evaluated) (Suárez-Álvarez et al., 2018; Vigil-Colet et al., 2020). One final aspect of the issues with dimensionality of the Grit-S scale is that authors such as Muenks et al. (2017) and Karaman et al. (2019) found that item 2 of the perseverance of effort dimension (“Setbacks don’t discourage me”), had a factorial loading well below the recommended level, affecting the analysis of dimensionality.

The second debate about the Grit-S scale is reliability. Clark and Malecki (2019) found that many of the studies which used the Grit-S scale found it difficult to get a Cronbach  $\alpha$  over 0.70, whether in one of the two dimensions noted above or in the overall test score, which would indicate that the Grit-S scale is not very reliable for measuring grit. Lastly, these issues have also been reflected in the validation of the Grit-S scale in Spain (Arco-Tirado et al., 2018), in which the reliability as estimated using the  $\alpha$  coefficient for perseverance of effort was below 0.5, and the test demonstrated a better fit when it was taken as unidimensional.

All of this prompted the development of other measuring instruments (Clark & Malecki, 2019; Datu et al., 2017; Sturman & Zappala-Piemme, 2017). This included

identifying the need to develop and validate a new instrument to measure grit in Spanish, incorporating the most recent developments in psychometry, both in terms of Classical Test Theory and Item Response Theory models (AERA, APA, NCME, 2014; Downing & Haladyna, 2006; Haladyna & Rodriguez, 2013; Irwing, 2018; Lane et al., 2016; Muñiz, 2018; Muñiz & Fonseca-Pedrero, 2019; Schmeiser & Welch, 2006). In summary, the objective of this study is the development and validation of the first grit instrument for the Spanish-speaking population. To do that, we will review the evaluation of the grit construct based on the theory from Duckworth et al. (2007), and therefore the Grit-S scale (Duckworth & Quinn, 2009). This will allow us to take a new theoretical approach to the grit construct, considering it as a psychological trait composed of two theoretically different facets, the empirical evaluation of which is tested in a Spanish population.

## **Materials and method**

### **Participants**

The sample was initially made up of 630 participants from the general Spanish population. The sampling type was incidental. The final sample comprised 531 participants after removing 18.3% for responding incorrectly to two or more items in the control scale, which is described in the *instruments* section. The people in the sample came from 15 of the 17 autonomous communities making up Spain, which can be split into six zones (North: 67.4%; South: 5.8%; East: 10.3%; West: 3.9%; Central: 11.1%; and Islands: 1.1%). The members of the sample were aged between 18 and 83 years old, with a mean age of 38.60 and standard deviation 14.90 years. Almost two-thirds (60%) were women, and almost three-quarters (73.8%) were actively employed.

### **Instruments**



### ***Oviedo Grit Scale (EGO; Escala Grit de Oviedo)***

In developing the Oviedo Grit Scale (EGO), we followed the criteria laid down by the European Federation of Psychological Associations (EFPA) for test evaluation (Evers et al., 2013) and the Standards for Educational and Psychological Evaluation (AERA, APA, NCME, 2014), along with the recommendations from current psychometric literature (Downing & Haladyna, 2006; Lane et al., 2016; Moreno et al., 2006, 2018; Muñiz & Fonseca-Pedrero, 2019). We constructed a sufficiently broad set of items (50 items) to cover each aspect of the two dimensions that *a priori* made up grit: perseverance of effort and consistency of interests. All of the items were written in a direct form (Suárez-Álvarez et al., 2018; Vigil-Colet et al., 2020). The first phase of the study involved performing quantitative and qualitative analyses to assess how representative the content was (Sireci & Faulkner-Bond, 2014). The first step was for these items to be reviewed by 24 psychologists. We asked them to rate the wording and the vocabulary of items on a scale of 1 to 10 (1 meaning “not suitable at all” and 10 “very suitable”), where the vocabulary had to be understandable to the general population and the wording had to be grammatically correct and clear. The scores the judges assigned were evaluated using Aikens V index, which for vocabulary produced a value of .93 [.87-.96 CI= 95%], and for wording .92 [.86-.95 CI= 95%], indicating excellent agreement (Penfield & Giacobbi, 2004). Nonetheless, two items were eliminated after scoring less than 8 in either vocabulary or wording. In the next step, we asked 57 experts in psychometry or psychological evaluation from various Spanish universities to assign each of the 48 items to one of two dimensions that theoretically make up grit: perseverance of effort and consistency of interests. The level of inter-rater agreement about which dimension items belonged to was examined. In addition, we performed a chi-square test for each of the items to determine whether there were

statistically significant differences between belonging to one or the other dimension. We removed 28 items for one of the following reasons: a) the initial assignment of the item was to a different dimension from the experts' assignment (in the judgement of 20% or more of the experts); b) there were no significant differences between belonging to one dimension or the other, according to the experts ( $p > .05$ ); and c) the item had inter-rater agreement about which dimension it should be in below 80%. This allowed us to construct a preliminary instrument of 20 items (10 per dimension) to be analysed in the quantitative pilot study. The response item was a Likert-type with 5 alternatives (1 completely disagree, 5 completely agree).

***Grit Short Scale*** (Grit-S; Duckworth & Quinn, 2009)

Grit-S is a questionnaire with 8 items evaluating two dimensions (4 items per dimension): perseverance of effort and consistency of interests. The item responses are given on a Likert scale from 1 (completely disagree) to 5 (completely agree). The validated Spanish version (Arco-Tirado et al., 2018), gave reliability coefficients of .75 for the grit construct overall, .77 for the consistency of interests dimension, and .48 for the perseverance of effort dimension. In the current study, the reliability ( $\alpha$ ) coefficients were: Grit: .73; consistency of interests: .66; and perseverance of effort: .53.

***Battery for Enterprising Personality Assessment*** (BEPE; Cuesta et al., 2018)

The BEPE is questionnaire with 80 items that evaluate the eight personality dimensions that the literature identifies as most closely related to enterprising personality (10 items per dimension): self-efficacy, autonomy, innovativeness, internal locus of control, achievement motivation, optimism, stress tolerance, and risk-taking (see, Muñiz et al., 2014). The items are on a Likert scale from 1 (completely disagree) to 5 (completely agree). The instrument demonstrates good fit to a bifactor model, with

excellent reliability from the classical perspective,  $\alpha = [.808 - .965]$  (Cuesta et al., 2018). It also demonstrates adequate precision from the point of view of IRT (Postigo et al., 2020). In the current study, the reliability ( $\alpha$ ) coefficients were as follows: Entrepreneurial Personality: .97; Self-efficacy: .89; Autonomy: .83; Innovativeness: .87; Internal locus of control: .87; Achievement motivation: .90; Optimism: .91; Stress tolerance: .83; and Risk-taking: .87.

#### ***Brief Self-Control Scale*** (BSCS; Tangney et al., 2004)

The BSCS is a questionnaire with 13 items which evaluates self-control (e.g. “I am good at resisting temptation”) on a Likert scale from 1 (completely disagree) to 5 (completely agree). We used a Spanish version (Garrido et al., 2017). In the current study we used the total score as recommended by Lindner et al. (2015), which had a reliability ( $\alpha$ ) coefficient of .84.

#### ***Overall Personality Assessment Scale*** (OPERAS; Vigil-Colet et al., 2013)

The OPERAS is an instrument which evaluates the five personality traits in the Big Five model (Extraversion, Emotional Stability, Conscientiousness, Agreeableness, and Openness to Experience) (Costa & McCrae, 1992) via 7 items per dimension, using a Likert scale from 1 (completely disagree) to 5 (completely agree). The subscales demonstrate reliability ( $\alpha$ ) coefficients between .71 and .86, and the instrument has adequate evidence of convergent validity (Vigil-Colet et al., 2013). In the current study the reliability ( $\alpha$ ) coefficients were as follows: Extraversion: .82; Emotional Stability: .83; Conscientiousness: .72; Agreeableness: .67; Openness to Experience: .70.

#### ***Attentional control scale***

This scale is made up of 10 Likert-type items with 5 response alternatives. The scale is used to detect participants who respond to the questionnaire randomly. The

items are of the type “In this question, please select option 4”, and were included amongst the items in the various instruments.

## **Procedure**

We made individual contact with potential participants who met the inclusion criteria (being aged 18 or over). They were asked to respond to the questionnaire online, and to provide email addresses for other potential participants. The same process was repeated with these new potential participants. The questionnaire items were applied in a random order together with the attentional control scale items. We carried out the procedure for one month (March 2020). On average, participants took 40 minutes to complete their responses. Participants did not receive any remuneration for participating in the study. The anonymity of each participant was carefully respected, confidentiality was maintained, and we ensured strict compliance with current data protection laws (Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y garantía de los derechos digitales).

## **Data analyses**

### ***Quantitative pilot study***

Once we had obtained the 20 items for the questionnaire (10 per dimension), we made a preliminary application of it to a sample of 222 people taken from the general Spanish population ( $M_{\text{years}} = 34.23$ ,  $SD_{\text{years}} = 15.85$ ) for a preliminary evaluation of the quality of the item set. We performed an Exploratory Factor Analysis (EFA) to examine the dimensionality of the instrument. We used KMO and the Bartlett statistic to assess the suitability of the data for factorial analysis. The EFA was performed on the Pearson correlation matrix, using Exploratory Robust Maximum Likelihood (RML) (Ferrando & Lorenzo-Seva, 2017) as the method of estimation. We determined the dimensionality of

the instrument by optimal implementation of parallel analysis (Timmerman & Lorenzo-Seva, 2011) with 1,000 random correlation matrixes. In addition, we used *Unidimensional Congruence* (UniCo), *Explained Common Variance* (ECV), and *Mean of Item Residual Absolute Loadings* (MIREAL) to examine how well the data fit a single dimension. The following values support treating the data as essentially unidimensional: UniCo>.95; ECV>.85; MIREAL<.30 (Calderón-Garrido et al., 2019). We used the *Comparative Fit Index* (CFI) and the *Root Mean Square Error of Approximation* (RMSEA) as indices of fit, establishing a good fit when CFI>.95 and RMSEA<.06 (Hu & Bentler, 1999).

Following this, we used a mixed statistical-substantive strategy to choose the final 10 items for the questionnaire. The strategy consisted of choosing those items that differed most between each other from those that had a factorial loading over .50. In addition, we kept in mind that there should be at least 3 items from each domain and that there should be items related to perseverance in long term objectives, as well as consistency and passion for interests. Once the 10 final items were chosen, we performed an EFA to assess the dimensionality of the instrument, using all of the indicators and indices described above.

### ***Psychometric assessment of the EGO instrument***

Firstly, we examined the descriptive statistics of the 10 items in the new instrument. We analysed the item-test correlations (discrimination index) of each item, with them being considered suitable above .20 (Muñiz et al., 2005; Muñiz & Fonseca-Pedrero, 2019). Using Samejima's graduated model (Samejima, 1969) within the Item Response Theory (IRT) framework, we calculated the  $a$  parameter of item discrimination, which is adequate for values above 0.64 and very high when above 1.7 (Baker, 1985). We assessed whether items had an impact based on sex. For those items

that did, we examined Differential Item Functioning (DIF) using logistical regression (Gómez-Benito et al., 2013).

Following this, we examined the internal structure of the instrument via Confirmatory Factor Analysis (CFA) in order to confirm the unidimensional factorial structure found in the pilot study EFA. We used Maximum likelihood with robust standard errors (MLM) as the estimation method, and as indices of fit CFI, and RMSEA, with suitable fit indicated when  $CFI > .95$ , and  $RMSEA < .06$  (Hu & Bentler, 1999). We also looked at information about  $X^2$ , degrees of freedom, and p-values, and the model residuals, as suggested by Kline (2011). In addition, owing to the importance of studying the factorial structure of a construct via different populations (Amérigo et al., 2020), we assessed measurement invariance based on sex and age ( $\leq 30$  or  $> 30$ ), calculating configural, metric, and scalar invariance via Multi-Group Confirmatory Factor Analysis (MG-CFA). Because we are dealing with added models, to accept measurement invariance we allowed a change in CFI of less than  $-.01$  ( $\Delta CFI < -.01$ ) (Chen, 2007).

We examined the reliability of the instrument via the alpha coefficient for ordinal data (Elosua & Zumbo, 2008) and McDonald's Omega coefficient (McDonald, 1999). We also looked at the precision of the instrument within the framework of IRT via the Test Information Function.

As evidence of validity in relation to other variables (AERA, APA, NCME, 2014), we calculated the Pearson correlation between the new EGO instrument and the Spanish validation of the Grit-S scale (Arco-Tirado et al., 2018; Duckworth & Quinn, 2009). In addition, we calculated the Pearson correlations between the new EGO and the following: a) the big five personality traits; b) self-control; and c) the eight specific dimensions of enterprising personality.

Lastly, we assessed possible differences in the grit construct as a function of sex and age ( $\leq 30$  or  $> 30$  years old). In both cases we performed an independent samples  $t$  test.

The descriptive statistics, the DIF, the Pearson correlations, and the inter-group differences were calculated using the SPSS 24 statistics package (IBM Corp, 2016). The EFAs and the reliability coefficients were produced using FACTOR 10.5.03 (Lorenzo-Seva & Ferrando, 2013). The various CFAs were carried out using MPlus8 (Muthén & Muthén, 2017). Item Response Theory analyses were done using IRTPro (Cai, Thissen, & Du Toit, 2011).

## **Results**

### ***Quantitative pilot study***

In the first EFA, both the KMO (.96) and Bartlett's statistic ( $<.001$ ) demonstrated that the data was suitable for factorial analysis. With the results we obtained, it seemed wise to reject a bidimensional structure for grit and maintain the hypothesis that a single factor was sufficient to demonstrate the psychological processes that could explain grit (Calderón-Garrido et al., 2019). A single factor explained 52% of the total variance, the optimal implementation of parallel analysis suggested a single dimension, and we found the following indicators for a unidimensional structure, UniCo: .956, ECV: .901, MIREAL: .174, CFI: .988, and RMSEA: 0.057. Following this, and using the mixed statistical-substantive strategy described previously, we selected the 10 final items for the questionnaire.

We performed an EFA with the 10 final items, looking at the dimensionality of the instrument, indicating the data was suitable for factorial analysis (KMO: .96, Bartlett's statistic:  $<.001$ ). Again, the results pointed towards rejecting a bidimensional

structure for grit, and we maintained the hypothesis that a single factor was sufficient to explain the psychological processes underlying grit (UniCo: .972; ECV: .905; MIREAL: .155; CFI: .999 and RMSEA: .001). From an exploratory perspective, that allowed us to determine the instrument to be essentially unidimensional.

***Psychometric assessment of the EGO instrument***

Firstly, we assessed the descriptive statistics for the items (Table 1). The values for each item in skewness and kurtosis were appropriate. The discriminatory power for each of the items was very high, both from a Classical Test Theory perspective (D.I: [.629 - .764]) and from IRT (parameter  $a$  [1.80 - 3.40]). Items 1, 2, 9, and 10 demonstrated an impact depending on sex, but none exhibited DIF.

..... *Insert Table 1 about here*.....

In the next step, we assessed the unidimensional factor structure of the instrument via a CFA. As Table 1 shows, the factor loadings were all very high [.536 - .804]. In addition, Table 2 shows the fit of the CFA for the overall sample, which was good (Hu & Bentler, 1999). The correlations between the residual values were adequate, ranging between -0.001 and 0.063 (Kline, 2011). Once the unidimensional factor structure of the EGO was confirmed, we continued with examining measurement invariance in relations to sex and age, the results of which are given in Table 2. Invariance was confirmed at the three levels examined (configural, metric, and scalar) in relation to both sex and age (Chen, 2007).

..... *Insert Table 2 about here*.....

We continued by examining the instrument's reliability. From the point of view of the classical model, both Cronbach's alpha and McDonald's Omega demonstrated excellent reliability ( $\alpha = .94$ ;  $\omega = .94$ ). From an IRT standpoint, Figure 1 shows the



Information Function, where it is clear that the standard error is very low for the ability levels between -3 and +1.5 (S.E.<.50), and shows lower precision for those with ability levels greater than  $\theta=1.5$ .

.....*Insert Figure 1 about here*.....

With regard to validity evidence in relation to other variables, Table 3 shows the Pearson correlations between grit, measured using the new EGO instrument, and the other variables. The correlation between EGO and Grit-S was high, particularly in the perseverance of effort dimension and in the overall score. In addition, grit demonstrated strong relationships with self-efficacy, self-control, and conscientiousness. This is all evidence of convergent validity, as the new grit test demonstrates a relationship to these external variables but is not reduced to them, it has its own identity. People who are considered *able* to do a task or achieve a long-term goal (self-efficacy), those who have some control over their short-term behavior (self-control), and those who are considered responsible, perfectionist, hard-working, and ordered (conscientiousness), tend to be those who exhibit more passion and perseverance for long-term objectives (EGO). It is worth noting the strong correlation with achievement motivation, and with the overall BEPE scores (Enterprising Personality). As evidence of discriminant validity, the EGO instrument exhibited weak correlations with stress tolerance, extraversion, agreeableness, emotional stability, and openness to experience. Both EGO domains demonstrated very similar correlations with all of the external variables. This is consistent with the hypothesis of the unidimensionality of the grit construct. All of this provides evidence for the validity of the EGO test scores, showing it to be an essentially unidimensional instrument allowing the evaluation of passion and perseverance for long-term objectives in various contexts.

On the other hand, Table 4 gives the correlations between Grit-S and the other variables. Grit-S shows moderate-high correlations with EGO domains items. It is worth calling attention to the weak evidence of validity in relation to other variables shown by the *consistency of interests* dimension, exhibiting very low correlations with all of the external variables except self-control and conscientiousness. In addition the overall Grit-S score has a low-moderate correlation with the various external variables, and it is perseverance of effort that exhibits the highest correlations, particularly with self-efficacy, achievement motivation, conscientiousness, risk-taking, and self-control.

..... *Insert Table 3 about here*.....

..... *Insert Table 4 about here*.....

Lastly, we examined whether there were differences in grit as a function of sex and age. Women ( $M= 40.24$ ) exhibited no statistically significant differences ( $p=.059$ ) to men ( $M= 39.22$ ), and subjects aged between 18 and 30 ( $M= 39.51$ ) exhibited no statistically significant differences ( $p= .266$ ) to those over 30 ( $M= 40.10$ ).

## **Discussion**

The aim of this study was the development and validation of the Oviedo Grit Scale. This new instrument, in addition to being in Spanish, is an attempt to overcome some of the psychometric issues found in prior grit scales related to dimensionality as well as reliability and validity (Arco-Tirado et al., 2018; Clark & Malecki, 2019; Gonzalez et al., 2019).

From both exploratory and confirmatory perspectives, the new 10-item EGO demonstrates an essentially unidimensional internal structure (Calderón-Garrido et al., 2019), confirming previous studies that had shown grit to be unidimensional (Areepattamannil & Khine, 2018; Gonzalez et al., 2019). In addition, the new EGO

instrument demonstrated measurement invariance in terms of sex and age, and therefore one could assume that the instrument measures the same construct in all of the groups examined, allowing for non-biased comparisons between these groups (Thompson, 2016), as recommended by the standards for Educational and Psychological Evaluation (AERA, APA, NCME, 2014). Furthermore, none of the items exhibited DIF in terms of sex or age, and the discriminatory power of each item was very high, both discrimination indices and the IRT parameter  $a$ .

The new EGO instrument has excellent reliability from within the framework of Classical Test Theory ( $\alpha = .94$ ;  $\omega = .94$ ). From an IRT standpoint, it exhibits adequate precision over all of the ability levels, with the highest errors for ability levels over 1.5. It is important to bear in mind that the precision of EGO is reduced for theta levels over 1.5, therefore caution is advised when evaluating people with very high scores in the EGO scale. In the light of these results, the new EGO scale offers clear advantages over other instruments which have shown lower reliability (Arco-Tirado et al., 2018; Clark & Malecki, 2019).

In terms of evidence of validity in relation to other variables, EGO demonstrated evidence of convergent validity (Evers et al., 2013) with the most well-known, commonly-used instrument for evaluating grit (Grit-S), especially in the correlation with the perseverance of effort dimension ( $r = .752$ ), and with the overall grit score ( $r = .691$ ). Considering that the EGO scale items were relevant to the two facets used to construct it, it is notable that both facets correlate more strongly with the Grit-S scale *perseverance of effort* dimension than its *consistency of interests* dimension. One possible explanation is that in the Grit-S scale, all of the items in the *consistency of interests* scale are reversed, which can give rise to problems in interpreting the items, as the cognitive processing would not necessarily be the same (Marsh, 1986; Mestre,

2013), which may have a negative impact on the test's psychometric properties (Suárez-Álvarez et al., 2018; Vigil-Colet et al., 2020). In addition, looking at the correlations of the two EGO domains, we can see that they are similar with all of the external variables, another indication of the unidimensionality of the EGO instrument. Finally, another explanation might be, as Table 4 shows, that the Grit-S dimension *consistency of interests* exhibits very weak relationships with the external variables in general.

Additionally, the EGO test scores demonstrated strong links with conscientiousness from the Big Five ( $r = .661$ ), as well as with one facet of this construct, self-control ( $r = .595$ ), as previous research has shown (Duckworth & Gross, 2014; Muenks et al., 2017; Oriol et al., 2017; Schmidt et al., 2018, 2020), providing evidence of convergent validity. This fits with the statement that self-control, conscientiousness, and persistence are the three variables that define performance in a task (Kankaraš & Suárez-Álvarez, 2019). Nonetheless, it is worth stressing that these correlations are somewhat weaker than those between EGO and motivational measures such as self-efficacy ( $r = .703$ ) and achievement motivation ( $r = .871$ ) (Steinmayr et al., 2018; Usher et al., 2019). One possible explanation is that conscientiousness, measured via OPERAS (Vigil-Colet et al., 2013), is not focused on any of this construct's facets, the 7 items making it up are centered on being responsible, not avoiding obligations, not leaving things half-done and untidy, and a certain perfectionism without wasting time. This general measure of conscientiousness attempts to address different scenarios in its makeup, but it does not allow sufficient investigation into the facets that make up conscientiousness (and in particular the facet of industriousness), which is why such a general measure can affect the correlation with EGO, although the correlation continues to be medium-high ( $r = .661$ ).

Despite that, EGO cannot be reduced to a measure of industriousness. This industriousness (or productiveness) facet is defined as diligence and the pursuit of objectives, as well as a work ethic, understood as the belief that working hard deserves reward. Thus the industrious instrument focuses on the person setting tasks and objective and doing them effectively. In contrast the grit construct, underlying the EGO items, adds to that these aspects of passion for reaching long-term objectives, through maximum dedication of time and effort to achieve goals, without concern about how often one fails in the attempt (“fall seven times, get up eight”; Duckworth, 2016). EGO also includes persistence in the face of adversity, in addition to this consistency of interests and clarity in established objectives.

Self-efficacy and achievement motivation are two variables in the BEPE (Cuesta et al., 2018; Muñiz et al., 2014; Postigo et al., 2020), a test battery for evaluating enterprising personality. This approach is a little different to other studies which have used these variables in relation to grit, which have been more academic (Steinmayr et al., 2018; Usher et al., 2019). In this regard, our study used these variables with a more business and work related focus (e.g. Mueller et al., 2017).

As evidence of discriminant validity, the EGO exhibited weak correlations with variables such as extraversion, agreeableness, emotional stability, openness to experience, and stress-tolerance. With regard to this last variable, despite prior studies having shown grit to be negatively correlated with clinical tests of depression and anxiety (e.g. Musumari et al., 2018), the fact of demonstrating high levels of grit does not necessarily mean demonstrating high levels of stress-tolerance, understood as appropriate use of coping strategies. It is logical to think that high tolerance to stress would make it easier to cope with adversity and setbacks one may encounter during the process of reaching long-term objectives. Similarly, the fact of demonstrating passion

and perseverance for long-term objectives would make it easier to maintain one's equilibrium, concentration, and to keep calm in adversity. However, they are two variables that can, to a certain extent, function independently ( $r = .354$ ).

Given all that, EGO is a useful tool for the evaluation of passion and perseverance for long-term objectives, and can be applied in the various contexts in which grit has been shown to have an influence, such as education (Fong & Kim, 2019), health (Datu et al., 2019), and the workplace (Jordan et al., 2019). Nonetheless, it is worth highlighting that this instrument, and the underlying theory behind it, moves away from the bidimensional theory posed by Duckworth et al. (2007) as we consider that both perseverance of effort and consistency of interests are constructs that are difficult to separate. If a person says that they persevere in a certain objective over the long term, it is reasonable to also think that they are going to have a certain consistency of interest (a passion) for that certain objective. As we noted above, one of the possible reasons for the bidimensionality of the Grit-S scale (Duckworth & Quinn, 2009), is that for one of the dimensions, all of the items are reversed (*inconsistency of interests*). However, we are aware that despite the empirical findings of the present study showing that both passion and perseverance to be two facets of grit that make up an essentially unidimensional structure, from a theoretical and conceptual standpoint it makes a great deal of sense to maintain a distinction between them. This represents a line for future research that would be extremely interesting as it would help lead to a much better understanding of the relationship between the theoretical conceptualization of grit and its empirical evaluation.

We did not find differences in grit between men and women, in line with findings in the meta-analysis by Credé et al. (2017). Nor were there differences in grit between younger and older subjects, as Duckworth et al. (2007) found in their initial

study. However, longitudinal studies are needed with EGO to properly establish whether levels of grit change over time, and to answer questions about considering grit a trait or state. Finally, we must consider future lines of research. Firstly, it would be useful to study the EGO in a school context, in under-18s. This would allow us to study the relationship between grit and academic performance in schoolchildren, as it is a variable that educational policymakers consider to be important for educational evaluation (Kirchgasler, 2018). Secondly, the creation of instruments to measure grit as specific domains, such as academic grit (Clark & Malecki, 2019; Schmidt et al., 2019), may be of great interest. In this way it would be possible to study whether formulating items in grit scales independent of their context or not would have an impact on the construct's predictive validity. In addition, in future studies it would be interesting to study EGO with the nomological network of conscientiousness, for example using BFI-2 (Soto & John, 2017), and examining EGO's different correlational patterns with the different facets of conscientiousness.

Finally, EGO demonstrated a strong relationship to the BEPE (Cuesta et al., 2018), both with the eight specific facets and with the overall dimension of enterprising personality. It would be interesting for future studies to analyse EGO in connection with entrepreneurial activity (Arco-Tirado et al., 2019; Mueller et al., 2017). In conclusion, our current study shows a new 10-item tool (EGO) for assessing grit, with appropriate psychometric properties in terms of reliability and validity. In this manner, the construct of grit can be rigorously, objectively evaluated, as can its impact on significant aspects of life that it has an effect on, such as education (Fong & Kim, 2019), health (Moore et al., 2018), and work (Jordan et al., 2019) to cite just a few. These results should be considered in the light of some limitations that future work should take into account. Firstly, the sampling was not strictly random, which should lead to caution when

generalizing from the results. We did not get any data from under 18s, so the results cannot be arbitrarily extended to these ages. The correlational methodology we used does not allow causal relationships to be established unambiguously, nor does it allow the analysis of the longitudinal behaviour of these variables to be analysed.

### **Disclosure statement**

The authors declare that there are no conflicts of interest.

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**Table 1.**

## Descriptive statistics of the items in the Oviedo Grit Scale

Domain	Item	Mean	SD	Sk	K	D.I	<i>a</i>	F.L
Consistency of interests	1. When I set myself an objective, I continue until I achieve it. [Cuando me planteo un objetivo persisto en él hasta conseguirlo]	4.10	.758	-.634	.244	.752	3.06	.789
	2. I do what I set out to do. [Cumplo lo que me propongo]	3.99	.720	-.448	.194	.720	2.62	.536
	3. I am consistent in my interests. [Soy constante en mis intereses]	4.06	.775	-.569	.155	.687	2.30	.725
	4. I am clear about my objectives. [Tengo mis objetivos claros]	4.12	.799	-.733	.428	.729	2.69	.768
	5. Even though the results seem far off, I persist in the task. [Aunque los resultados se vean muy lejos, persisto en la tarea]	3.96	.798	-.665	.630	.669	2.16	.698
Perseverance of effort	6. I work hard every day to get closer to my goals. [Cada día trabajo duro para acercarme más a mis objetivos]	3.97	.823	-.540	-.051	.660	1.99	.688
	7. When I have a project in mind I do everything possible to get it done. [Cuando tengo un proyecto en mente hago todo lo posible por llevarlo a cabo]	4.04	.805	-.599	.078	.735	2.73	.766
	8. I spend as much time and energy as I can on reaching my goals. [Dedico el máximo de mi tiempo y energía a lograr mis metas]	3.60	.904	-.351	-.112	.629	1.80	.660
	9. If I set myself something to do, I will work on it until I achieve it. [Si me propongo algo, trabajaré en ello hasta conseguirlo]	4.08	.701	-.440	.135	.764	3.40	.804
	10. I finish what I start. [Termino lo que empiezo]	3.93	.826	-.700	.614	.675	2.14	.699
	Total. Grit score	39.86	6.04	-.500	.106	-	-	-

*Note.* SD= standard deviation; Sk= skewness; K= kurtosis; D.I= discrimination index; *a*= discrimination index from Item Response Theory; F.L= factor loading

**Table 2.**

Fit indices for the one-factor model of the Oviedo Grit Scale.

	X <sup>2</sup> /df (p-value)	CFI	RMSEA [90% CI]	ΔCFI
Total	2.43 (<.001)	.980	.050 [.038-.066]	-
Women	2.26 (<.001)	.994	.062 [.043-.081]	-
Men	1.96 (<.001)	.990	.069 [.044-.094]	-
	1.99 (<.001)	.994	-	-
	1.70 (<.001)	.995	-	.001
	1.55 (<.001)	.994	-	-.001
≤30 years	1.74 (<.001)	.994	.058 [.032-.083]	-
>30 years	2.56 (<.001)	.992	.071 [.052-.089]	-
	2.00 (<.001)	.993	-	-
	1.12 (<.001)	.999	-	.006
	1.10 (<.001)	.999	-	0

*Note.* N= 531; Women, n= 329; Men, n= 202; ≤30 years, n= 219; >30 years, n= 312; X<sup>2</sup>= Satorra-Bentler chi-square; df= degrees of freedom; CFI= comparative fit index; RMSEA= root mean square error of approximation with 90% confidence interval; ΔCFI= CFI change.

**Table 3.**

Pearson correlations between EGO and GRIT-S,  
BEPE, BSCS and OPERAS tests

	EGO Total	EGO Perseverance of effort	EGO Consistency of interests
<b>Grit-S</b>			
Grit-S Perseverance of effort	.752	.744	.704
Grit-S Consistency of interests	.479	.458	.465
Grit-S Total	.691	.674	.657
<b>BEPE</b>			
Self-efficacy	.703	.663	.693
Autonomy	.473	.452	.460
Innovativeness	.532	.515	.510
Internal Locus of Control	.525	.512	.499
Achievement motivation	.871	.836	.842
Optimism	.417	.386	.419
Stress Tolerance	.354	.326	.356
Risk-Taking	.625	.608	.597
BEPE Total	.728	.694	.709
<b>OPERAS</b>			
Extraversion	.183	.177	.175
Emotional Stability	.289	.260	.298
Conscientiousness	.661	.647	.627
Agreeableness	.158	.161	.144
Openness to Experience	.095	.107	.076
<b>BSCS</b>			
Self-Control	.595	.561	.586

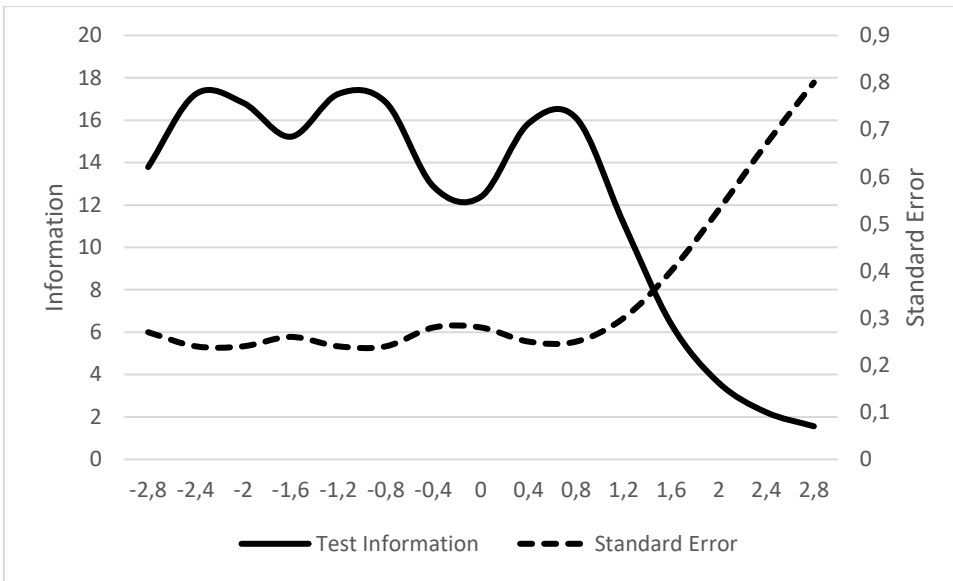
*Note.* EGO= Oviedo Grit Scale; Grit-S= Grit Short Scale; BEPE= Battery for Enterprising Personality Assessment; BSCS= Brief Self-control Scale; OPERAS= Overall Personality Assessment.

**Table 4.**

Pearson correlations between GRIT-S and BEPE, BSCS, OPERAS tests and EGO items.

	GRIT-S Total	GRIT-S Consistency of interests	GRIT-S Perseverance of effort
<b>BEPE</b>			
Self-efficacy	.454	.235	.595
Autonomy	.299	.120	.436
Innovativeness	.303	.098	.472
Internal Locus of Control	.305	.149	.411
Achievement motivation	.590	.362	.702
Optimism	.278	.098	.422
Stress Tolerance	.330	.175	.428
Risk-Taking	.366	.165	.510
BEPE Total	.477	.228	.649
<b>OPERAS</b>			
Extraversion	.152	.087	.190
Emotional Stability	.387	.290	.394
Conscientiousness	.722	.547	.728
Agreeableness	.202	.161	.193
Openness to Experience	.118	.108	.095
<b>BSCS</b>			
Self-Control	.709	.615	.615
<b>EGO items</b>			
Consistency of interests 1		.364	
Consistency of interests 2		.370	
Consistency of interests 3		.375	
Consistency of interests 4		.348	
Consistency of interests 5		.404	
Perseverance of effort 1			.582
Perseverance of effort 2			.554
Perseverance of effort 3			.513
Perseverance of effort 4			.570
Perseverance of effort 5			.704

Note. Grit-S= Grit Short Scale; BEPE= Battery for Enterprising Personality Assessment; BSCS= Brief Self-control Scale; OPERAS= Overall Personality Assessment; EGO= Oviedo Grit Scale.



**Figure 1.** Information Function of the Oviedo Grit Scale.