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Analysis of the Internal Structure of the Garra Scale: International Version in Portuguese Language (EAGrIt-LP)

Análise da Estrutura Interna da Escala de Avaliação da Garra: Versão Internacional em Língua Portuguesa (EAGrIt-LP)

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Abstract

Objective
This study aimed to investigate the psychometric properties of an assessment scale of human drive, understood as a trait. The construct consists of two components, consistency of interests and maintenance of effort. The scale used in this study was developed in Portuguese. The objective of this study was to investigate the internal structure, through the Exploratory and Confirmatory Factor Analysis, the accuracy rates, and the invariance of the scale regarding the nationality of the respondent.

Method
A total of 671 university students with a mean age of 26.53 (*SD* = 10.07) participated. A total of 77.8% were female.

Results
The results confirmed the structure of two factors (χ^2/df = 1.83, GFI = 0.999, CFI = 0.994, RMSEA = 0.035 [0.024-0.046]), with excellent reliability (α = 0.85 and α = 0.86), and coefficient correlation 0.84 between the factors.

Conclusion
The scale invariance was confirmed.

Keywords: Personality; Positive psychology; Psychological tests; Validation.

Resumo

Objetivo
Este estudo teve como objetivo investigar as propriedades psicométricas de uma escala de avaliação da Garra, entendida como um traço. O construto é composto por dois componentes, consistência de interesses e manutenção do esforço. A escala utilizada neste estudo foi construída em português. O objetivo deste estudo foi investigar a estrutura interna, por meio da Análise Fatorial Exploratória e Confirmatória, os índices de precisão e a invariância da escala quanto à nacionalidade do respondente.

Método
Participaram 671 estudantes universitários, com média de idade de 26,53 (DP = 10.07) e 77.8% mulheres.

Resultados
Os resultados confirmaram a estrutura de dois fatores ((χ^2/gl = 1.83, GFI = 0.999, CFI = 0.994, RMSEA = 0.035 [0.024-0.046]), com excelente precisão (α = 0.85 e α = 0.86), e coeficiente de correlação 0.84 entre os fatores.

Conclusão
Foi confirmada a invariância da escala.

***Palavras-chave**: Personalidade; Psicologia positiva; Testes psicológicos. Validação.*

The quality of psychological research and intervention is deeply dependent on the procedures used in the assessment. Without proper assessment tools, for example, little rigor exists about the psychological constructs and realities being studied, and little confidence exists in the diagnoses produced and in the results about the effectiveness of a given intervention program. In this line, the psychological instruments that precede the intervention must go through strict processes of construction, search for evidence of validity and precision estimates that prove their psychometric qualities. Determining whether the questionnaire allows measuring a psychological construct, and whether it replicates the theoretical foundation used as a support for the construction of the items, is one of the most difficult and necessary tasks (American Educational Research Association [AERA] et al., 2014). In this sense, the present study tested validity evidence for the Evaluation Scale of Grit: International Version in Portuguese, with the objective of analyzing the internal structure and its invariance taking Brazilian and Portuguese samples.

With the advent of Positive Psychology (Seligman & Csikszentmihalyi, 2001), several constructs emerged in psychological science and practice involving personal characteristics and strengths, which deserve in-depth definition and measurement work. One of these recent constructs with some projection is grit or claw. In this connection, the construction process and presents the validation studies of a new scale for the assessment of human drive (Garra), developed in Portuguese, in the light of the Grit assertions proposed by the original authors (Duckworth et al., 2007) was presented by Noronha and Almeida (2022). The preliminary pilot study, judges' assessment and confirmation of potential items for the scale was carried out with university students from Brazil and Portugal (Noronha & Almeida, 2022). The inclusion of two samples, Brazilian and Portuguese, motivated the investigation of Multigroup Confirmatory Factor Analysis (MCFA) currently, to answer whether the measure is equal for both audiences. MCFA is understood as a statistical technique, its purpose is to assess whether the structure of a structural equation model remains equivalent (invariant) across different groups or populations with distinct characteristics (Marôco, 2014).

The authors conceptualized the Grit, translated as Garra into Portuguese, as a relatively stable personality characteristic, understood as an internal trait or characteristic and referring to achievement processes (Noronha & Almeida, 2022). Its two components included consistency of interests and perseverance of efforts, also called passion and long-term effort (Disabato et al., 2018), or the ability to maintain interest, exert effort and persist in the task's performance for long periods of time. As for perseverance, for Duckworth and Quinn (2009), although the construct has been more investigated as an outcome than as a predictor, with the advent of Positive Psychology, interest in trait understanding was renewed. Duckworth et al. (2007) illustrate that US Military Academy cadets with more grit were less likely to drop out than those with low scores on the scale. In turn, consistency of interests is a predictor of greater stability in academic and professional careers in youth and adults.

Garra is thus internationally understood as a psychological construct structured around two dimensions: perseverance and passion. Perseverance (consistency of interests) implies maintenance of interest in the long term and perseverance of efforts can be translated as hard work (passion) towards the achievement of set goals. The individual with stamina (Garra) is defined as one who performs, undertakes and achieves his goals, despite the long effort and the failures and adversities that it may encounter along the way. At this point, we are talking of a person who is resilient to difficulties or who demonstrates high persistence in achieving set goals. Although Grit is associated with performance, it is more in the area of personality, describing personal characteristics of maintenance of interest, even after negative feedback. In this connection, it is considered more as an emotional and motivational construct than a cognitive construct (Schmidt et al., 2018).

After the publication of the Grit Scale (Grit-O) (Duckworth et al., 2007) and the Grit Scale Short (Grit-S) (Duckworth & Quinn, 2009), many studies were carried out with the aim of translating and investigating the internal structure of these versions for different populations and cultures. Collantes-Tique et al. (2021) translated, adapted and investigated validity evidence of Grit-O in Colombia. Exploratory and confirmatory factor analyses indicated two factors and coefficients of internal consistency of the items above 0.76; however, some controversy remains regarding the dimensionality of the scales. One- and two-factor models, as well as second-order models, have been tested with adequate fit indices by taking translations of the scales to several countries (Arco-Tirado et al., 2018; Areepattamannil & Khine, 2017; Beri & Sharma; 2019; Marentes-Castillo et al., 2019; Schmidt et al., 2021; Shaban, 2020; Sordia, 2020; Tan et al., 2019).

In view of the existing controversy, Noronha and Almeida (2022) developed the Garra Assessment Scale: International Version in Portuguese Language (EAGrIt-LP), based on the assumptions of the initial studies (Duckworth et al., 2007; Duckworth & Quinn, 2009). Two groups of Brazilian and Portuguese judges reviewed an original sample of items, ending with 12 items distributed in two dimensions – consistency of interests and perseverance of efforts – with evidence of content validity. Subsequently, the experimental version of the scale was applied to university students in Brazil and Portugal; in this article the psychometric indicators of precision and validity of the results of this scale are reported. In particular, the analysis of the distribution of the results item by item is advanced, and then, the two-factor model and its invariance between groups (Brazilian and Portuguese) are tested, adding information on the accuracy of the results through the internal consistency analysis of the items.

Method

Participants

A total of 676 people responded to the questionnaires; five instruments were excluded due to data inconsistency. Thus, the sample included 671 participants, of which 61.7% (n = 414) from Brazil and 38.3% (n = 257) from Portugal. Age ranged from 18 to 71 years (M = 26.53, SD = 10.07). Of the total number of participants, 77.8% were women, 21.3% were men and 0.9% other or they preferred not to inform. Most of the sample members were single (74.1%), followed by married/common law marriage (21.9), divorced/separated (3.6%) and widowed (0.4%). All were higher education students; 59.8% attended private institutions. Regarding the courses, Psychology was predominant (56.2%), followed by Education/Pedagogy (16.7%), Degree in Oriental Studies (13.4%), Law (3.1%) and Physical Education (2.5%). The other courses had less than 1% of participants. Finally, 56.8% of the participants had a professional job in the areas of Education, Commerce, Health and Industry.

Instruments

The EAGrIt-LP used consisted of 12 items, to be rated on a 4-point Likert-type scale, ranging from totally disagree (1) to fully agree (4). Perseverance of Effort is understood to mean the maintenance of efforts with a view to achieving task performance or completion. Consistency of interests is also called passion, and is defined as sustaining preferences and a commitment to sticking to goals for an extended period of time. An example of an item is 'If I start a task, I focus on fully performing it' (effort perseverance) and 'I have my life goals set for the next few years' (consistency of interests).

Procedure

The project was approved by the Research Ethics Committee of a higher education institution in the interior of the state of São Paulo, Brazil (CAAE: 57819822.2.0000.5514). After approval, a form was created on Google, which contained the Free and Informed Consent Form (FICF), a sample characterization questionnaire and the EAGrIt-LP. To have access to the instruments, the participant had to agree with the FICF. Only those who signed it were allowed to respond. The link to the form was shared on social networks and with professors from different higher education institutions who made it available to students in their classes, inviting them to participate in the survey. Other students were approached personally, through contacts with colleagues or with the authors of this paper themselves. In all application situations, the anonymity of the responses was ensured. The form was made available for 38 days, and the administration took place simultaneously in Brazil and Portugal. It is estimated that the participants will have taken an average of about 10 minutes to complete the form.

Data Analysis

Data were extracted from the Google Form in an Excel spreadsheet. A visual inspection was performed and, as the answers were mandatory, there were no missing responses (five questionnaires were eliminated after verifying inconsistencies in their completion). Two different softwares were used for the analyses, Factor and Jasp. The parallel analysis and the obtention of the Hull Method, KMO (KMO > 0,80) and Bartlett's coefficient (p < 0,05) (Tabachnick & Fidell, 2012), in addition to the exploratory factorial, were performed with Factor 12.01.02 (Lorenzo-Seva, 2003), using Weighted Least Squares (WLS).

Confirmatory factor analysis, in turn, was performed using Jasp 0.16.2.0. In order to review the quality of the adjustments, the following were considered: (i) ratio between the chi-square value and the degrees of freedom (χ^2/df), whose value must be less than 3, and not exceeding 5; (ii) GFI (Goodness of Fit Index), whose value must not exceed 1.0; (iii) CFI (Comparative Fit Index), with a value equal to or greater than 0.90; (iv) RMSEA (root mean square residual), with a value less than 0.06 or a maximum of 0.08 (Byrne, 2010; Hair et al., 2009). Precision estimation and Pearson correlation tests were also performed.

Finally, regarding the invariance analysis of the dimensional model of the items in the two countries, the values of the Root Mean Square Error of Approximation (RMSEA; 90% confidence interval) and Standardized Root Mean Square Residual (SMSR) were used, with values ≤ than 0.08; Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), with values ≥ 0.90 (Brown, 2015). Measurement invariance, assessed through Multigroup Confirmatory Factor Analysis (MGCFA),

evaluated three models in increasing order of restriction: configural, metric, and scalar. The estimation method for categorical data employed was the Weighted Least Square Mean and Variance Adjusted (WLSMV).

Results

Initially, descriptive statistics of the EAGrIt-LP items are presented. The minimum and maximum values, in addition to the means and standard deviation, are shown in Table 1. Furthermore, the asymmetry and kurtosis coefficients of the distribution of results in each item are presented.

Table 1
Descriptive statistics of EAGrIt-LP items

EAGrIt-LP items	*M*	*SD*	Asymmetry	Kurtosis
Item 1	3.01	0.787	-0.595	0.117
Item 2	3.32	0.683	-0.702	0.156
Item 3	3.47	0.652	-1.003	0.584
Item 4	2.95	0.801	-0.432	-0.256
Item 5	3.02	0.870	-0.659	-0.196
Item 6	3.30	0.723	-0.682	-0.215
Item 7	3.03	0.782	-0.447	-0.288
Item 8	3.19	0.706	-0.441	-0.369
Item 9	2.83	0.853	-0.321	-0.533
Item 10	3.23	0.776	-0.698	-0.202
Item 11	3.37	0.671	-0.742	0.069
Item 12	3.27	0.736	-0.621	-0.379

Table 1 shows a positive trend in the students' responses, as the averages are close to the maximum value of the assessment scale used (4 points or totally in agreement), translating positive self-assessments by the sample. The item with the lowest average was 'Whenever I think about my goals, I feel that they are increasingly consolidated', with item 9 "I try to commit to achieve my goals", a higher average. As for the other items, they presented averages close to each other. On the other hand, in terms of response variability, we can point out that the values were between 0.65 and 0.87 (standard deviations), being considered acceptable values because there were only four response levels in the Likert-type scale used in the responses. On the other hand, the asymmetry and kurtosis coefficients are very low, which suggests normality of the results distribution in each item.

Subsequently, a parallel analysis was carried out to determine the number of factors to be retained. The Hull method and Parallel Analysis indicated retention of one factor (Lorenzo-Seva et al., 2011). To assess whether the data matrix was factorable, KMO (0.935) and Bartlett's sphericity test (χ^2= 4034.1, $p < 0.001$) were used, both coefficients being adequate. Although there is no consensus in the literature on the importance of the sedimentation graph, we chose to use it in order to help define the number of factors to be retained in our analyses (Figure 1).

Figure 1 allows us to understand that one or two factors can be considered in the analyses regarding the dimensionality of the scale. Considering that the construction of the scale indicated the presence of two factors, Consistency of Interests and Perseverance of Effort, it was then decided to organize the data into two factors. Together they explain 68% of the variance in the results of the 12 items. The distribution of the factor loadings of the items in the two factors (oblimin rotation) is shown in Table 2.

Figure 1
Sedimentation Chart

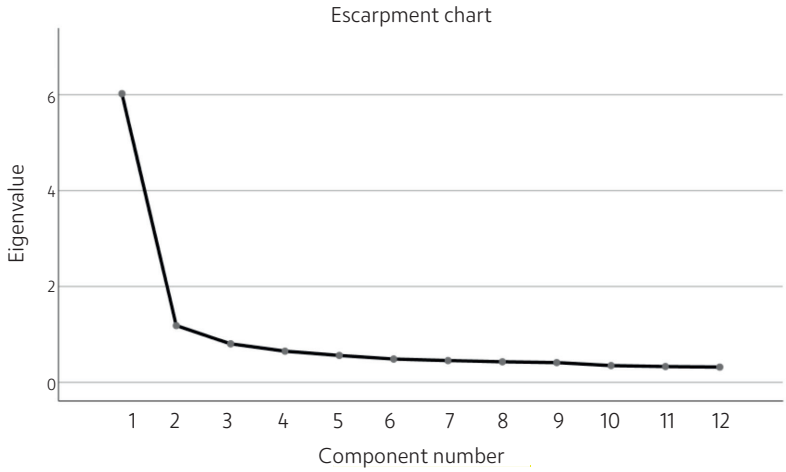


Table 2
Factor loadings of the EAGrIt-LP Scale

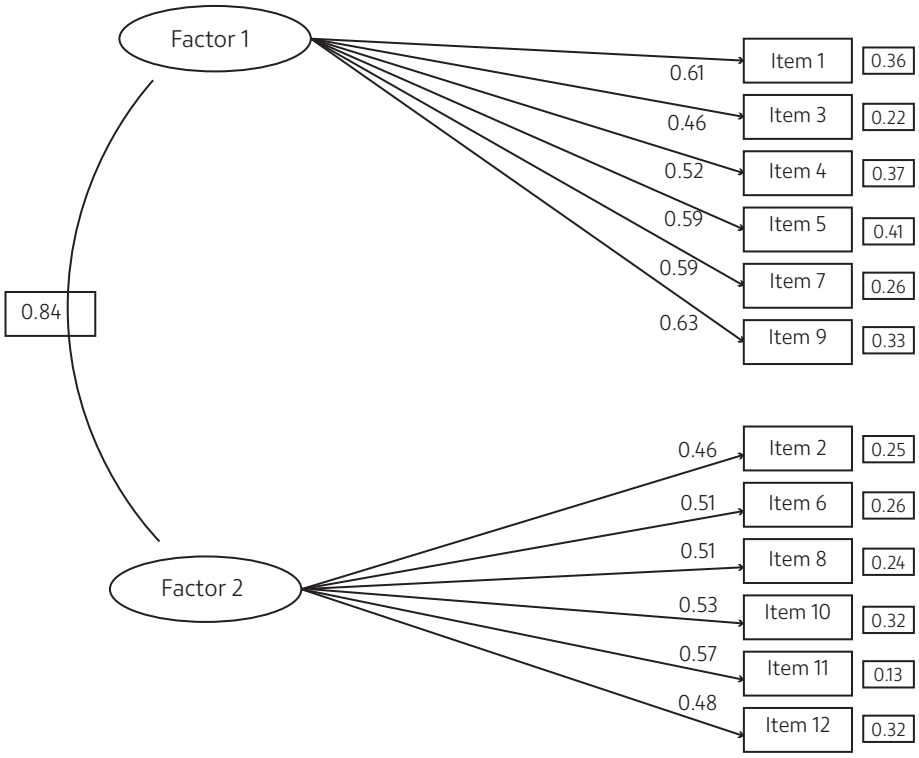
EAGrIt-LP items	1	2	Commonality
I have my life goals set for the next few years (1)		0.888	0.393
I persevere in my effort to achieve my goals (2)	0.693		0.505
I try to commit to achieving my goals (3)	0.653		0.479
My interests are stable (4)		0.696	0.501
I have defined what I intend to do in my life (5)		0.885	0.520
Even if some important activity is difficult, I insist until I manage to do it (6)	0.761		0.513
I maintain a coherent line of goals over time (7)		0.559	0.288
I follow my plans, even if I have adversity to execute them (8)	0.703		0.533
Whenever I think about my goals, I feel that they are increasingly consolidated (9)		0.571	0.457
If I start a task, I focus on its completion (10)	0.773		0.528
I persist to achieve my goals (11)	0.801		0.496
When I start a project, I am able to see it through to the end (12)	0.810		0.566
α	0.85	0.86	

Regarding distribution of the items among the factors, it is worth noting that one of them did not load the theoretically predicted factor (I try to commit myself to achieving my goals). On the other hand, the saturation indices were higher than 0.40, even though in two items (item 1 and item 7) the variance indices explained by the set of two factors (communality) have moved away from 0.50 (respectively 0, 39 and 0.29).

Then, the Confirmatory Factor Analysis was carried out, with the purpose of analyzing the adequacy of the theoretical model used as a subsidy for the construction of the items. The results pointed to an adequate fit (χ^2/gl = 1.83, GFI = 0.999, CFI = 0.994, RMSEA = 0.035 [0.024-0.046]. To assess precision, in the consistency of interest's dimension, α = 0.85 was found, and in the effort perseverance dimension α = 0.86. Figure 2 presents the factor loadings of the factors, with no modification having been introduced, for example correlation between errors, to improve the fit indices. Finally, a high correlation coefficient is recorded between the two dimensions of the scale

(0.84), which may suggest future developments in the dimensional analysis by bringing together the 12 items of the scale.

Figure 2
Factorial structure of EAGrIt-LP



The factor loadings ranged from 0.46 ("I try to commit to achieving my goals" and "I persevere in my efforts to achieve my goals") to 0.63 ("Whenever I think about my goals, I feel that they are increasingly consolidated"). In this way, the two-dimensional structure recommended for the instrument was confirmed, which are strongly correlated. The first factor was named effort perseverance, and it is composed of items 2, 6, 8, 10, 11 and 12. The second factor was called consistency of interests and the items that compose it are: 1, 3, 4, 5, 7 and 9. Finally, Table 3 presents the results of the scale two-dimensional model of the analysis of invariance of the two countries.

Table 3
Measurement invariance analysis for groups (Brazilian and Portuguese)

Model	χ^2	*gl*	CFI	TLI	RMSEA	SRMR	McDonald
Configurable	112.925	106	0.999	0.999	0.014	0.055	0.995
Metric	137.123	116	0.997	0.997	0.023	0.060	0.984
Scale	146.424	126	0.997	0.997	0.022	0.057	0.985
Thresholds	112.925	106	0.999	0.999	0.014	0.055	0.995
Residual	173.309	138	0.995	0.995	0.028	0.063	0.974

Regarding the Configuration model which assesses whether the dimensional structure of the instrument applies to both groups, the results indicated that there was invariance. Thus, the

internal structure of the two factors, namely consistency of interests and perseverance of efforts, does not differ between Brazilian and Portuguese students. Subsequently, the Metric model was tested, which in turn analyses the equivalence of the items' regression weights, which are equivalent to their factor loadings. The findings indicated invariance, which means that the relationships presented by the items regarding the construct are similar for both groups (Xia & Yang, 2019). Continuing with the comparison analysis between the groups (Brazilian and Portuguese students), the scalar invariance analysis was carried out. This analysis assesses whether the scores obtained are associated with the latent trait level of the study participants, regardless of their group. The results confirmed the invariance. Finally, the Thresholds and Residual were tested, and in both cases the measurement invariance was confirmed.

Discussion

This study continues the investigation on the construction and validation of the Garra Assessment Scale: International Version in Portuguese Language (Noronha & Almeida, 2022), with Brazilian and Portuguese higher education students. In a previous study, the authors reported the process of construction and selection of items, essentially following the qualitative procedures involved in delimiting a construct and collecting behavioral indicators for its evaluation (Noronha & Almeida, 2022). At this point in time, evidence of content validity with Brazilian and Portuguese judges with expertise in the subject or in the construction of instruments, was carried out and confirmed that the items represented two theoretical factors: consistency of interests and perseverance of effort. The pilot study with samples composed of Brazilian and Portuguese university students was also carried out and, together with the other information, contributed to the development of a scale formed by 12 items distributed equitably by the two dimensions.

In view of the AERA et al. (2014) assertions that the assessment instruments must undergo rigorous and different investigations; in order to seek evidence of validity and precision estimates, this study was undertaken with the objective to explore the data structure, using the Exploratory Factor Analysis (EFA) and confirm the two-factor theoretical framework by the Confirmatory Factor Analyses (CFA). In addition, estimates of results accuracy for the scale were tested, as well as the invariance of its dimensionality in the samples of the two countries.

The parallel analysis and Hull's method predicted one factor, but the sedimentation graph, although there is no consensus on its usefulness (Damásio, 2013), indicated two factors. The two-factor solution was tested and the items presented high factor loadings, the lowest referring to "I maintain a coherent line of objectives over time" (0.559), but still quite satisfactory. However, one item did not load the factor it was developed for (I try to commit to achieve my goals), which should be in Consistency of Interests. We proceeded to the CFA, which aims to answer whether the structure of the items is in line with the literature. The adjustment indices were good for the two theoretically recommended factors, reiterating evidence of validity for the EAGrIt-LP, now through the internal structure. The alphas were also satisfactory, considering that each factor has only 6 items.

Validity evidence can be confirmed based on the internal structure, since the items got arranged as theoretically predicted. That is, both theoretical factors were found (Duckworth et al., 2007; Duckworth & Quinn, 2009). It should be pointed out that many studies that translated the scales and tested them in normative samples different from the original studies were not successful in their results, as is the case of Sordia (2020), whose adjustment rates were poor, or the case of Tan et al. (2019) for Georgia and Egypt respectively. Another example to compose this list is the

research by Arco-Tirado et al. (2018), in which the Grit-S was translated and adapted into Spanish. The correlation coefficients between the items were moderate, with the exception of a pair referring to perseverance. It was in this same factor that the lowest alpha index (α = 0.48) was found, and the adjustment indices were considered only acceptable.

Our results demonstrated a high correlation coefficient between the Perseverance of Effort and Consistency of Interests factors, indicating a substantial degree of commonality between them. Consequently, although the two-factor solution for these measures is pertinent for interventions with university students, as observed in other studies (Collantes-Tique et al., 2021), but it is necessary to further explore the dimensionality of the EAGrIt-LP. In a study involving 7,617 participants from 109 countries as part of the International Wellbeing Study (www.wellbeingstudy.com), researchers employed the Duckworth scale to test three models: a one-factor model, a two-factor model (similar to our study), and a two-factor model with a general factor. The findings revealed that the two-factor model provided the best fit indices. Notably, the correlation between the factors in that sample was r = 0.53, which remained statistically significant (Disabato et al., 2018). Therefore, further analyses of the scale's dimensionality are recommended, including testing alternative models.

Thus, it is argued that the psychometric qualities of the measuring instruments must obey the rigor and steps already established in the specialized literature. A final observation concerns the invariance findings. According to Peixoto and Martins (2021), it is urgent to invest in estimates of psychological instruments invariance, since it is a unique strategy to guarantee the fairness of interpretations in the testing processes, which is also endorsed by Andrade and Valentini (2018). The authors stated that the investigation of invariance must precede the establishment of specific norms for groups.

Final Considerations

New studies must be carried out. The sample was composed of Brazilian and Portuguese students, so that invariance analyses can provide relevant information. Comparisons between EAGrIt-LP and other convergent and divergent measures can inform on theoretical approximations and provide evidence of validity based on related constructs. Finally, analyses with academic outcomes are necessary, as a research agenda. The limitations of the research should be mentioned. Samples composed by convenience restrict the possibility of generalizing the results.

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