Validity evidence based on internal structure and reliability for the Locus of Control Scale (ELOCUS)*

Evidencia de validez basada en estructura interna y confiabilidad para la Escala de Locus de Control (ELOCUS)

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ABSTRACT
The Locus of Control Scale (ELOCUS) is a new self-report instrument to measure generalized expectations of control in adults. Accordingly, validity evidence based on the internal structure of this instrument is presented. A total of 1,324 participants, over 18 years of age (M = 37.7 years; *SD* = 12.8), completed a sociodemographic questionnaire and the ELOCUS in a virtual environment. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were conducted using the full sample. A two-factor solution was found, consistent with the theoretical framework, with all fit indices in both analyses being satisfactory. The internal consistency coefficients were adequate: Composite Reliability (CR), Cronbach's alpha and McDonald's omega of 0.89, 0.83 and 0.84 for the external locus and 0.96, 0.94 and 0.94 for internal locus, respectively, were found. Therefore, the ELOCUS presented satisfactory evidence based on the internal structure. Limitations of this study and suggestions for future studies are discussed.

Keywords
internal-external control; test validity; test reliability; factor analysis; psychological assessment.

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RESUMEN
La Escala de Locus de Control (ELOCUS) es un nuevo instrumento de autoinforme para medir las expectativas generalizadas de control en adultos. Se presentan evidencias de validez basadas en la estructura interna de este instrumento. 1324 participantes, mayores de 18 años (M = 37.7 años; DT = 12.8), completaron un cuestionario sociodemográfico y ELOCUS virtualmente. Los análisis fueron Análisis Factorial Exploratorio (EFA) y Análisis Factorial Confirmatorio (CFA) utilizando la muestra completa. Se encontró una solución de dos factores, consistente con el marco teórico, y todos los índices de ajuste fueron satisfactorios. Los coeficientes de consistencia interna fueron adecuados: Fiabilidad compuesta (CC), alfa de Cronbach y omega de McDonald para locus

externo de 0.89, 0.83 y 0.84 y para locus interno de 0.96, 0.94 y 0.94 respectivamente. Así, ELOCUS presentó evidencia satisfactoria basada en la estructura interna. Se discuten las limitaciones de este estudio y sugerencias para estudios futuros.

Palabras clave
control interno-externo; validación de prueba; precisión de prueba; análisis factorial; evaluación psicológica.

The locus of control is a psychological attribute that is related to the individual's perception of the "place" from which the control of their actions comes. It can be internal, when the person attributes the outcome of the action as arising from their own behavior or external, when the individual believes that the consequence of an action did not come directly from their action (Rotter, 1966). This psychological attribute aroused the interest of some researchers to develop scales, mostly in the 1970s and 1980s, however, even with so much effort, there are still some gaps around these measures, such as dimensional instability and a lack of explanation regarding the internal and external dimensions. In an attempt to broaden the discussion on dimensionality and add to the theoretical field with more up-to-date and robust analyses, this study proposes to present the validity evidence based on the internal structure and reliability for a new locus of control scale for adults, which aims to measure the generalized expectations of this attribute, without context dependence. We sought to differentiate it from the other scales through the theoretical descriptors for both loci, such as self-efficacy, autonomy, proactivity and responsibility composing internality and "powerful others", "chance/luck/destiny", passivity and disengagement composing the externality.

The need to understand the functioning of this attribute stems from the fact that the perception of control has been shown to be related to relevant aspects of mental health, indicating that changing the locus of control can affect the individual's psychological health (Klonowicz, 2001; Yu & Fan, 2016). This attribute therefore gained notoriety in the field of studies in Psychology, while several areas have produced studies related to the influence of the locus of control on their domains, such as the areas of Clinical, Social, Organizational, Educational Psychology and human development (Cheng et al., 2012; Horst & Jacovidis, 2018).

Among the gaps in the different locus of control scales, one of them is that there is no consensus on the dimensionality of the construct, with this aspect generating controversies among scholars from the initial studies conducted in the 1970s to more recent works (Suárez-Álvarez et al., 2016). Among the main locus of control scales designed to measure general expectations of control is Rotter's Internal-External Locus of Control Scale (I-E Scale; Rotter, 1966) with a unidimensional factor structure, the Multidimensional Locus of Control Scales (I-P-C Scale; Levenson, 1973) composed of three factors (internality, "powerful others" and "chance"), the unidimensional Adult Nowicki-Strickland Internal-External Control Scale (Nowicki & Duke, 1974), the Reid-Ware Three-Factor Internal-External Scale (Reid & Ware, 1974) with three factors (social system, self-control and fatalism), and the Oviedo Locus of Control Scale (Suárez-Álvarez et al., 2016) with two factors (internal and external), among others.

From the above, observing the diversity of scales and their dimensional variety, it is clear that, in addition to a lack of consensus regarding dimensionality, there is a lack of clarity around the construct. Skinner (1996) in a seminal theoretical review study highlighted the diversity of concepts and theories linked to the idea of control, with at least 111 distinct concepts being raised, however, in many cases, they were approximate and even overlapping, which the author argued is an issue that makes studies in the area difficult.

Even in the two locus of control scales of generalized expectations for adults most used worldwide, there is dimensional inconsistency. A series of factorial studies were conducted in the 1970s and 1980s with the intention of testing the unidimensionality of the I-E Scale (Rotter, 1966) and the multidimensionality of the I-P-C Scale (Levenson, 1973). The I-E Scale presented between one and nine factors, while the I-P-

C Scale maintained the three-factor structure in the majority of studies, however presented low or borderline internal consistency indices for the internality factor (Author, 2021). Another important aspect is that these studies were carried out using statistical methods that were not very robust, common at the time due to the level of technological development, which differentiates the current study and justifies the development of a new scale.

Another gap is that little is known about internality. Although the literature tends to emphasize the benefits of internal orientation for control, little research indicates which elements lead individuals to establish this orientation over the other, with this lack of knowledge prejudicing the field as it hinders the development of interventions (Ahlin & Antunes, 2015). Therefore, investigating, even initially, the internality with a view to broadening the understanding of the attributes that possibly form it composed a secondary objective of this work. This knowledge could help in interventions, as it will indicate which elements of internality the subject has and which they need to develop to improve their performance and to acquire gains in mental health and well-being.

Accordingly, in order to broaden the comprehension of the dimensionality of the locus of control, as well as internality, this study sought to include some complementary elements in the internal and external dimensions of the locus of control, and, based on these elements, develop the Locus of Control Scale (*Escala de Locus de Controle* - ELOCUS). Currently, there seems to be a tendency to think about the dimensionality for the *locus* of control from a two-dimensional model, as highlighted in the study by Suárez-Álvarez et al. (2016), which aimed to construct a new scale for locus of control based on this model. The difference between the Oviedo Locus of Control Scale (OLCS; Suárez-Álvarez et al., 2016) and the ELOCUS is that the descriptors, especially those referring to internality, are not restricted to personal effort and responsibility for outcomes, but consider aspects related to self-efficacy and autonomy, in addition to not presenting any item linked to context. Furthermore, the OLCS does not consider control aspects arising from intangible beings for the externality.

In the specific case of the ELOCUS, for the constitution of the two factors (i.e. internal and external) and in order to broaden the discussion on these dimensions, it was considered that the external locus of control is formed by the descriptors "other powerful people" (people who exercise power); "other powerful deities" (God, deities or other higher forces), chance/luck/fate, passivity (indulgence) and disengagement (non-commitment). Internal locus of control was constituted by the descriptors self-efficacy (capacity), autonomy (freedom), proactivity (effort/persistence) and responsibility (commitment) (Author et al., 2021).

The descriptors that made up the external dimension have been addressed since the initial work of Rotter (1966), when he discussed the beliefs in chance, luck and fate, based on studies by social scientists, and passivity, when he mentioned the concept of alienation linked to the subject's inability to control their life. The dimension "powerful others" was included by Levenson (1973, 1974), and this study sought to expand this understanding, beyond people who exercise power, to intangible beings, such as God, deities or any other type of "higher force". This takes into account the influence of religiosity in the formation of Brazilian cultural thought (Silva, 2009), as this influence has such significance for Brazilian culture that there are public policies and social projects of a religious/cultural nature (Giumbelli, 2021). Disengagement was included because it considers that people who are externally oriented present little commitment to everyday actions and decisions, as they attribute the consequences and accountability of these actions to elements external to them.

For the internal dimension, although its factors were not explicitly mentioned by Rotter (1966), some of them were highlighted in his work, such as competence, being moderated by effort and persistence, which in this study is considered proactivity; the need for

achievement, understood as the belief in the ability that personal efforts determine the result, understood as self-efficacy (concept developed 11 years later, with the work of Bandura, in 1977), and autonomy as the motivation of an organism toward the active domain of the environment in which it is inserted. Responsibility is understood as a component of internality, as "internal" individuals hold themselves responsible for the outcomes of the events they experience (Connolly, 1980; Nowicki, 2016). This study aimed to present evidence of validity based on the internal structure for the ELOCUS from complementary models, the first unrestricted (Exploratory Factor Analysis; EFA) and the second restricted (Confirmatory Factor Analysis; CFA), as well as the reliability of the instrument.

Method

Participants

The sample consisted of 1,324 participants, over 18 years of age ($M = 37.7$; $SD = 12.8$), of both genders, 1,011 of whom were female (76.4%). The sample showed a predominance of high levels of education, with 34.0% ($n = 450$) having completed postgraduate studies and 25.2% ($n = 334$) having completed higher education. In terms of religion, 31.6% ($n = 418$) of the participants declared themselves without religion (i.e. atheists, agnostics or no religion), 26.7% Catholics ($n = 353$) and the same percentage for Spiritualists or Spiritists ($n = 354$).

Instruments

The study participants completed the sociodemographic questionnaire and the ELOCUS scale. The instrument for the characterization of the sample consisted of questions related to age, gender, education level and religion.

The Locus of Control Scale (ELOCUS), composed of two factors (internal locus of control and external locus of control) and nine descriptors, divided so that four descriptors composed the items for the internal locus of control (i.e., self-efficacy, autonomy, proactivity, and responsibility) and five for the composition of the items of the external locus of control (i.e., other powerful people, other powerful deities, chance/luck/fate, passivity, and disengagement). The instrument has a Likert-type response scale, with the options "1 = has nothing to do with me", "2 = has little to do with me", "3 = sometimes has to do with me", "4 = has a lot to do with me", and "5 = has everything to do with me". Regarding content-based validity, the ELOCUS has accumulated satisfactory evidence, both in the assessment made by judges and by the target audience through the pilot study (Author et al., 2021).

Procedures

The sample was selected by convenience through social networks, mainly Facebook, Instagram, Messenger, WhatsApp and LinkedIn, as well as through the researchers' personal contacts. The data collection procedure was carried out using the Google Forms platform and participants were invited to participate in the study via the internet. Upon accessing the platform to respond to the study, the participants first accessed general information about it and, subsequently, they were directed to read and accept the consent form. After acceptance, the instruments were made available for completion. The completion time was estimated at 20 minutes per person and the collection period lasted approximately three months (February/2021 to May/2021). It should be noted that ethical procedures for research with human subjects were respected and this study was previously approved by the Research Ethics Committee of Universidade São Francisco – Campinas – Brazil.

Data analysis

For this study, the analysis of the internal structure of the Locus of Control Scale (ELOCUS) was performed, through Exploratory

Factor Analysis (EFA), preceded by Parallel Analysis with random permutation of the observed data (Timmerman & Lorenzo-Seva, 2011) for factor retention. The factorability of the data matrix was measured through the Kaiser Meyer-Olkin measure (KMO > 0.80) of sampling adequacy and by Bartlett's Sphericity test ($p < 0.05$) (Tabachnick & Fidell, 2012). The analysis was implemented from a polychoric matrix, by the Robust Diagonally Weighted Least Squares (RDWLS) extraction method (Asparohov & Muthen, 2010) and Robust Promin rotation was used (Lorenzo-Seva & Ferrando, 2019).

The adequacy of the model was verified through the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA) fit indices. Values greater than or equal to 0.90, preferably greater than 0.95, and RMSEA less than or equal to .08, preferable .06 or less, with the maximum value within the confidence interval not exceeding .10 (Brown, 2015), were used as cutoff points for CFI and TLI. The items with factor loadings >0.45 in the EFA were maintained in the model, as the intention of using a stricter criterion was to reduce the scale by keeping the items with the highest factor loadings (Hair et al., 2018).

Unidimensionality was measured through the UniCo (Unidimensional Congruence), ECV (Explained Common Variance) and MIREAL (Mean of Item Residual Absolute Loadings) coefficients. The reference values indicative of unidimensionality of the data are for UniCo greater than 0.95, for ECV greater than .85 and for MIREAL less than 0.30 (Ferrando & Lorenzo-Seva, 2018).

The *H* index was used to assess the stability of the factors, which aims to demonstrate how much a certain set of items represents a factor, with the . value > 0.80 being indicated as a cutoff point, in order to suggest the stability of a latent variable and its possible replicability in other studies (Ferrando & Lorenzo-Seva, 2018). The thresholds of the items and the discrimination parameter from Reckase's parameterization (Reckase, 1985) were also analyzed.

The reliability of the instrument was verified from the internal consistency coefficient, through composite reliability (CR) (Raykov, 1997), Cronbach's alpha and McDonald's omega. For this study, the CR and McDonald's omega coefficients were prioritized as the most adequate, with the alpha coefficient presenting a complement.

Finally, to verify the hypothesis that the ELOCUS has a factor structure composed of two factors, a Confirmatory Factor Analysis (CFA) was conducted from the final version of the scale. The Weighted Least Squares Mean and Variance Adjusted (WLSMV) estimation method was used, due to the data being categorical. The analysis parameters for the fit indices considered were the same as those mentioned for the EFA. Data processing was performed for the EFA using the FACTOR version 11.02.04 software, (Lorenzo-Seva & Ferrando, 2017), recognized as the most complete program for conducting EFA and developed exclusively for this purpose (Lloret et al., 2017). For the descriptive analyses and internal consistency coefficients (Cronbach's alpha and McDonald's omega) the Jamovi software (2021) was used. The statistical mind (Colwell, 2016) was used to calculate the composite reliability and MPlus 8.4 (Muthén & Muthén, 2017) was used for the CFA.

Results

With all the items, the Parallel Analysis indicated the existence of six factors, however, the distribution of items in the factors did not correspond to the projected facets for the construction of the items, leaving the factors, apparently, without theoretical adequacy. Therefore, a decision was taken to reduce the number of items and factors seeking a parsimonious model consistent with the theoretical aspects recommended for the locus of control.

The scale, which had 69 items, had its quantity reduced to 29 items (13 items for the external

locus of control and 16 for the internal locus of control), after the EFA results. Exclusion criteria for the items were those that did not have factor loadings above 0.45, items with cross loadings (i.e., having loadings above 0.30 in the two retained factors) and negative items, that is, an item that was constructed for the external locus of control negatively loading in the internal locus of control and vice versa. From this, the 29 items that made up the final version of the scale were obtained. For the final version, Bartlett's test of sphericity (15110.7; $df = 406$; $p < 0.001$) and the KMO (0.938; 95% CI = 0.937 - 0.939) indicated interpretability of the correlation matrix of the items. The Parallel Analysis in this configuration indicated two factors as representative of the data (Table 1). In this analysis with 29 items, the use of bootstrapping was considered.

Table 1
Result of the Parallel Analysis

Factors	% Explained variance of actual data	% Explained variance of random data (95% CI)
1	43.2863*	7.5340
2	14.3586*	7.1648
3	5.2669	6.8579
4	4.1180	6.5132
5	3.9234	6.2321

Note. CI = Confidence Interval.

The items presented high factor loadings in the factors, above 0.45, without the cross-loading pattern, and composite reliability, Cronbach's alpha, McDonald's omega and *H* indices (latent and observed) above their cutoff points (0.70 for the internal consistency coefficients and 0.80 for the *H* indices). In the case of the *H* indices, their values suggest that the factors are likely to be replicable in future studies. These data are presented in Table 2.

Table 2
Factorial Structure of the Locus of Control Scale (ELOCUS)

Items	LOC E	LOC I
V 3	-0.014	**0.751**
V 8	**0.604**	-0.132
V 9	**0.578**	-0.125
V 10	-0.005	**0.702**
V 16	**0.687**	0.101
V 17	**0.650**	-0.097
V 18	**0.567**	-0.010
V 21	-0.055	**0.809**
V 22	-0.044	**0.797**
V 23	**0.545**	0.010
V 26	**0.494**	-0.066
V 31	0.027	**0.716**
V 32	**0.542**	-0.010
V 34	**0.742**	0.155
V 35	**0.596**	-0.187
V 37	-0.002	**0.775**
V 39	-0.088	**0.680**
V 40	-0.005	**0.787**
V 43	**0.757**	0.133
V 44	**0.561**	-0.210
V 46	0.032	**0.833**
V 48	0.016	**0.776**
V 54	0.027	**0.784**
V 56	0.008	**0.814**
V 60	**0.601**	0.196
V 61	0.035	**0.796**
V 62	0.031	**0.717**
V 63	0.019	**0.861**
V 68	-0.006	**0.772**
Composite reliability	0.89	0.96
Cronbach's α	0.83	0.94
McDonald's ω	0.84	0.94
H-latent	0.898	0.963
H-observed	0.874	0.933

Note. LOC E = external locus of control; LOC I = locus of internal control; bolded loads indicate values above 0.45.

The factor loadings of the internal dimension items ranged from 0.680 to 0.861 and for the external items these ranged from 0.494 to 0.757. The correlation between the factors was negative and of moderate magnitude (-0.421). The fit indices of the instrument in question were adequate, with RMSEA = 0.066 (95% CI = 0.062 – 0.067), CFI = 0.977 (95% CI = 0.974 – 0.981), and TLI = 0.973 (95% CI = 0.969 – 0.978) indicating a good fit of the model to the data. Regarding dimensionality, all coefficients indicated that there was no unidimensionality: UniCo = 0.808 (95% CI = 0.766 - 0.850); ECV = 0.755 (95% CI = 0.735 - 0.777); MIREAL = 0.321 (95% CI = 0.304 - 0.334). Discrimination parameters and item thresholds were checked using the Item Response Theory. Table 3 presents the discrimination parameters.

Table 3
Discrimination Parameters of the ELOCUS Items

Items	*a* LOC E	*a* LOC I	MDISC
V 3	-0.021	**1.150**	1.150
V 8	**0.814**	-0.178	0.833
V 9	**0.753**	-0.162	0.770
V 10	-0.007	**0.989**	0.989
V 16	**0.906**	0.134	0.916
V 17	**0.906**	-0.135	0.917
V 18	**0.691**	-0.013	0.691
V 21	-0.099	**1.467**	1.470
V 22	-0.076	**1.380**	1.382
V 23	**0.648**	0.012	0.648
V 26	**0.580**	-0.077	0.585
V 31	0.038	**1.009**	1.010
V 32	**0.647**	-0.012	0.647
V 34	**1.026**	0.214	1.048
V 35	**0.830**	-0.261	0.870
V 37	-0.002	**1.228**	1.228
V 39	-0.128	**0.983**	0.992
V 40	-0.008	**1.281**	1.281
V 43	**1.077***	0.190	1.094
V 44	**0.762**	-0.285	0.814
V 46	0.056	**1.457**	1.458
V 48	0.025	**1.215**	1.215
V 54	0.042	**1.237**	1.238
V 56	0.013	**1.392**	1.392
V 60	**0.718**	0.235	0.755
V 61	0.056	**1.278**	1.280
V 62	0.044	**1.009**	1.010
V 63	0.037	**1.649***	**1.649**
V 68	-0.009	**1.222**	1.222

Note. * indicates the most discriminative item for the factor; MDISC = multidimensional discrimination; *a* LOC E = discrimination parameter for external locus of control; *a* LOC I = discrimination parameter for internal locus of control.

According to Table 3, the most discriminative item of the external locus of control factor was item V43 ("Destiny controls me"; $a = 1.077$), followed by item V34 ("Luck is fundamental in my life"; $a = 1.026$) with both items referring to the chance/luck/destiny descriptor. Regarding the locus of internal control factor, the item with the highest discriminative power was V63 ("I'm struggling in my tasks"; $a = 1.649$), item from the proactivity/effort descriptor, in addition to two other items with close scores: item V21 ("When something is difficult, I dedicate myself to getting it"; $a = 1.467$), which is a proactive/effort item, and item V46 ("It is through my ability that I am able to finish my activities"; $a = 1.457$), which is a self-efficacy item. It should be highlighted that item V63 was the most discriminating item for the scale as a whole, and that the internal items showed higher discriminative values in general than the external items. Table 4 illustrates the thresholds of the ELOCUS items according to Likert scale.

Table 4
Thresholds of the ELOCUS Items

Locus of Control	Items	*b1*	*b2*	*b3*	*b4*
Internal	V 63	-4.273	-3.241	-1.717	0.004
	V 46	-4.132	-3.076	-1.552	0.166
	V 61	-3.793	-2.883	-1.425	0.269
	V 54	-3.778	-2.911	-1.593	0.075
	V 21	-3.765	-2.448	-0.748	1.080
	V 22	-3.687	-2.347	-0.993	0.701
	V 68	-3.605	-2.559	-1.071	0.396
	V 48	-3.568	-2.589	-1.222	0.292
	V 40	-3.528	-2.622	-1.133	0.746
	V 56	-3.524	-2.473	-1.046	0.671
	V 3	-3.414	-2.282	-0.881	0.588
	V 37	-3.345	-2.371	-1.013	0.494
	V 31	-3.213	-2.559	-1.588	0.381
	V 10	-3.211	-2.015	-0.495	0.917
	V 62	-3.080	-2.184	-0.894	0.567
	V 39	-2.683	-1.843	-0.597	0.784
External	V 23	-0.624	0.452	1.595	2.414
	V 32	-0.585	0.344	1.232	2.069
	V 26	-0.569	0.668	1.668	2.502
	V 16	-0.259	0.924	1.972	2.806
	V 34	0.013	1.186	2.181	2.873
	V 8	0.026	0.941	1.833	2.661
	V 18	0.037	1.085	2.053	2.719
	V 44	0.067	1.103	2.050	2.801
	V 60	0.086	0.731	1.404	1.869
	V 17	0.199	1.253	2.079	2.734
	V 43	0.460	1.539	2.542	3.207
	V 9	0.573	1.622	2.705	3.119
	V 35	0.798	1.992	2.769	3.250

Note. b_1, b_2, b_3, b_4 = difficulty of the parameters (thresholds).

The values were organized in Table 4 from the lowest to the highest value of parameter b_1. In terms of thresholds, there was no unexpected response pattern, indicating increasing *theta* levels in all items. There was a clear division between the two dimensions of the locus of control. In this case, the easiest item to endorse was V63 ("I'm struggling in my tasks"). For external locus of control, the hardest item to endorse was V35 ("most tasks are solved by other people"). According to the patterns presented,

on the one hand, it is possible to identify that the items allocated in the internal dimension need a lower level of latent trait to be endorsed. On the other hand, a higher level of latent trait is needed to mark the higher points of the Likert scale (i.e., 4 and 5) in external locus of control factor.

The results obtained with the analysis from a restricted model (CFA), aiming to verify the two-dimensionality for the final configuration of the scale, indicated adequate but borderline indices, with RMSEA = 0.082 (90% CI 0.080 - 0.085), CFI = 0.903 and TLI = 0.895. The factor loadings for the ELOCUS items, from this analysis, are presented in Table 5.

Table 5
Factor Loadings from the CFA for the ELOCUS

LOC E		LOC I	
Items	Estimate	Items	Estimate
V 8	0.714	V 3	0.752
V 9	0.671	V 10	0.700
V 16	0.579	V 21	0.846
V 17	0.724	V 22	0.826
V 18	0.561	V 31	0.694
V 23	0.540	V 37	0.768
V 26	0.553	V 39	0.726
V 32	0.541	V 40	0.784
V 34	0.576	V 46	0.809
V 35	0.767	V 48	0.758
V 43	0.578	V 54	0.761
V 44	0.751	V 56	0.795
V 60	0.375	V 61	0.784
		V 62	0.706
		V 63	0.833
		V 68	0.765

Note. LOC E = external locus of control; LOC I = internal locus of control.

According to Table 5, the factor loadings for the external locus of control ranged from 0.375 to 0.767 and for the internal locus of control from 0.694 to 0.846, values close to those found in the unrestricted model, except for item V60 ("I think that my fate is already determined"), an item of the external dimension, with the descriptor chance/luck/destiny, which presented the lowest loading of 0.375. The correlation between the factors in CFA was negative and of moderate magnitude (-0.457).

Discussion

The main focus of this study was to present the validity evidence based on the internal structure and reliability for a new scale that aims to measure the generalized expectations of locus of control in adults, designed to overcome the lack of tools of this type in the Brazilian culture. The scale in question presented a two-factor structure, conforming to what was theoretically expected: the locus of control has an internal dimension, representing the internal aspects of individuals that make them attribute any consequence as arising from the action itself, such as self-efficacy, autonomy, proactivity and responsibility; and the external locus of control expressed by individuals who interpret the results of their actions as consequences of external agents, such as people who exercise power over the person's action, luck or fate leading the outcomes of events, passivity and disengagement directed toward the actions.

In terms of the theoretical model, although it was expected that the locus of control would present two factors, due to the elaboration of the descriptors for the composition of the internal and external locus, it was not known how this model would behave. Therefore, it was first decided to test the model through EFA, as the literature indicates that EFA is suggested to test models in which it is not known which factorial structure will result, as a way of tracking the model and providing a general view regarding the structure of the items, making it possible to indicate a potential model (Ferrando & Anguiano-Carrasco, 2010; Hair et al., 2018).

As this is a new instrument, starting the analyses with an EFA is acceptable, however, as the instrument, although new, was constructed considering a theoretical framework, it is desirable that it be minimally testable by a restricted model, as initial hypotheses were constructed based on a theoretical model for the construction of the measure (Ferrando & Anguiano-Carrasco, 2010). Therefore, the use of both analyses, unrestricted at first and subsequently restricted, is justified, even though the same sample was used (Hauck-Filho, 2019).

Of the nine descriptors defined and used for the semantic construction of the items, only one of them, "other powerful deities", was totally excluded after the series of factor analysis were conducted. Its exclusion was due to criteria mentioned above, however, this was an unexpected result, mainly because the relevance that religion exerts in the formation of Brazilian cultural thought was considered (Silva, 2009). It is therefore suggested that, despite religiosity being something significant for most Brazilians, it does not affect the type of locus of control that they will tend toward. This may indicate that people with high internality scores may have characteristics focused on religiosity/spirituality, contrary to what was intended in their construction. In this sense, Author et al. (2021) found the internal locus of control more closely associated with expressions of religion/spirituality than the external locus of control. Therefore, further research needs to be conducted to better understand the relationship between the influence of these "hidden forces" (i.e., God, deities, energies, saints, and others) and the locus of control.

Another aspect that can be considered for this result is that the convenience sample influenced the scores as almost a third of the participants reported not having a religion (people who declared themselves to be atheists, agnostics or without religion), which justifies the fact that these items did not have explanatory power for the locus of control. Additionally, the level of formal education of participants may have influenced the outcomes. According to some research, more years spent in formal education, less likely one is to adhere to a religion or identify with a religious practice, or to continue exercising individual religious acts (e.g., praying), as well as decreasing the frequency of religious expression. (Dilmaghani, 2019; Hungerman, 2013; Masuda & Yudhistira, 2020). Further research is needed to verify the influence of educational level on the rise in power and influence of "hidden forces" on the establishment of the personal locus of control.

The final scale consisted of six proactive items, five self-efficacy items, four responsibility items and one autonomy item, forming the internal locus of control factor. For the external locus of control, five passivity items were obtained, four of luck/destiny (items referring to chance were excluded), two of "other powerful people" and two of disengagement. The meticulous choice of descriptors to theoretically compose each factor may have contributed to the good results regarding the fit indices presented by the scale in this study. The ELOCUS, from the EFA, obtained adequate fit indices of the data to the model, with the RMSEA value being considered good and for CFI and TLI values very good. Initially, the composition of each locus of control with a series of descriptors would be one of the differentials of the scale, that is, expanded and theoretically updated descriptors, which possibly provides a better theoretical explanation for each locus.

It can be seen that the factor loadings were similar for the unrestricted model and for the restricted model. With the exception of item V26 in the unrestricted model ("I always need someone's help to resolve things") and item V60 ("I think my fate is already determined"), all the other factor loadings were above .50 in the analyses, fulfilling the recommendation of Hair et al. (2018), in which the estimate for standardized loadings should be above .50, preferably above .70.

Another point regarding the factor loadings is that the loadings for the internal items were generally higher than those observed for the external items. It is assumed that the higher factor loadings for the internality factor are linked to social desirability, as the internal items express more socially accepted behaviors than the external items. Another hypothesis is linked to the sample composition that may have biased the results due to it being mostly female. It is recommended that future studies conduct investigations in relation to the invariance of sex, education, age and socioeconomic level, in order to test this hypothesis, an objective not covered in this study, as well as construct items that not only overcome, but assess the social desirability.

With regard to reliability, locus of control scales have historically presented internal

consistency coefficients low or close to the suggested cutoff value of .70, except for the OLCS (Suárez-Álvarez et al., 2016) which presented good Cronbach's alpha values (.87 for the internal locus and .85 for the external locus). In the case of the ELOCUS, all values of the internal consistency coefficients were higher, with even more adequate and robust indices, such as CR and McDonald's omega, being proposed in this analysis. There is a discussion about the inadequacy of the alpha coefficient to measure the reliability of measures, however, this coefficient is still the most used in research. Some scholars indicate that other internal consistency coefficients should be presented in addition to alpha (Revelle & Zinbarg, 2009; Sijtsma, 2009). Based on these discussions, Hayes and Coutts (2020) state that the alpha coefficient is less accurate to measure reliability than the omega, and in this same study, they point out the difficulties for researchers to migrate from one coefficient to others and complement this by illustrating a series of tutorials in order to assist this transition. Both composite reliability (CR) and McDonald's omega are coefficients that are not linked to the assumption of tau-equivalence, being more robust and adequate when compared to Cronbach's alpha (Hayes & Coutts, 2020; Valentini & Damásio, 2017).

Concerning the item discrimination parameters (parameter *a*), the item that best represents the external locus of control is an item that addresses fate, that is, people that more attribute beliefs in fate to outcomes in their daily lives tend to be more "external". The item that was most representative regarding the internal locus of control was a proactive item which attributed personal effort as the main quality for the expression of internality. In other words, this means that the more a person perceives effort in carrying out daily tasks, the more they tend to be "internal". This same item was also appointed as more representative in the multidimensional discrimination, which means that it is an item of which the discrimination indicates the complete set of the scale, taking into account all the factors existing in the model (Damásio et al., 2021).

The threshold, or threshold between responses (parameter *b*), is the amount of latent trait (theta) the individual needs to have to go from a response point, in the current response format on the scale, to the next point (Damásio et al., 2021). One of the necessary observations is to verify whether all the items in the scale present a pattern of increasing threshold values, considering the signal presented, being able to start at the smallest points of the negative signal of the response format. Damásio et al. (2021) indicated that what is expected for this indicator is that as the theta level increases, so does the response category level. All items of the ELOCUS presented an increasing gradation of thresholds, indicating a result in line with what is expected. It is important to note that in this study there was no intention of making a complete analysis based on IRT, as it is known that there are other procedures involved and of great complexity, however, with the data from the FACTOR software, it is possible to have a global view on the process of answering the items. That said, it can be inferred that this is another differential of the ELOCUS, that is, the presentation of studies based on the Classical Test Theory (CTT) and Item Response Theory (IRT).

A final point to be addressed is in relation to the statistical procedures used by most locus of control scales to illustrate the internal structure. When these instruments were constructed, it was common to use Principal Component Analysis (PCA) as Exploratory Factor Analysis (EFA). The use of PCA became widespread due to the fact that some statistical packages only offer this method, erroneously naming it EFA (Cudeck, 2000; Watkins, 2018) and due to the lack of computational technology accessible to most researchers, given that the EFA procedure requires more sophisticated software and hardware than was commercially available at the time (i.e., 1960s to late 1980s).

Therefore, PCA was the most used analysis model in studies of locus of control scales, proving inadequate, as it is important to emphasize that PCA and EFA are different mathematical procedures that start from different algebraic assumptions (Cudeck, 2000).

It cannot be said that PCA generates factors, but components (Brown, 2015; Damásio, 2012; Watkins, 2018), as the components do not represent latent variables (Cudeck, 2000), being more suitable as indicators (e.g. Human Development Index – HDI). In the case of PCA, the indicators influence the component (Watkins, 2018) and in EFA it is the factor, representing a latent variable, which explains the observable behavior portrayed by the items of an instrument. Furthermore, common and specific variance are undifferentiated in the PCA model (Brown, 2015; Damásio, 2012; Ferrando & Anguiano-Carrasco, 2010).

Currently, there is a series of software programs that are easily mastered by researchers who wish to include EFA in their investigations, while modern and accessible equipment (personal computers and desktops) are available (Watkins, 2018). This technological facility allows us to construct psychometric instruments with better conditions, when compared to those arising from the first scales, in the 1960s. Although much of the mathematical and statistical development was already underway at the time, the lack of technology to process data for this type of analysis did not allow this model, for example, to be frequently used. In fact, from the 1970s onwards, due to the complexity of the EFA, it lost space in research to the CFA (Ferrando, 2021). Therefore, providing validity evidence based on the internal structure to the ELOCUS, based on more up-to-date technological resources, adds to the field as the other scales have not presented studies of this nature.

Conclusions

The present study sought evidence of validity based on the internal structure and reliability for the ELOCUS aiming to add to the field of psychological assessment and generate a new tool that investigates aspects of the relationship of individuals locus of control. The consideration of the various descriptors devised for the construction of the items for each locus and statistical procedures based on more up-to-date models promoted different psychometric qualities for the ELOCUS when compared to other scales developed over more than 50 years of history.

This scale can be of great evaluative use in the most diverse areas of Psychology, as it is an instrument with few items, quick to apply and has been created from a perspective of generalized expectations of control, seeking not to have any context-dependent links, therefore making it as neutral as possible. Furthermore, scales with generalized expectations can provide some advantage in relation to their use in research by allowing some flexibility as they are not linked to a specific context and generate comparable results, broadening the understanding of the construct.

Although the sample had an interesting composition of quantity and included people from practically all Brazilian states, it may have presented some biases, such as being composed by mainly females and people with high levels of education, which can be considered limitations. Furthermore, as mentioned above, almost a third of the sample had no religious ties, which may have influenced the removal of items related to the power exercised by deities.

Accordingly, future research could include invariance studies considering the demographic variables presented in this study, Differential Item Functioning (DIF) studies, also considering the crucial need to present validity evidence in relation to external variables. Providing a quick screening of aspects inherent to control, the ELOCUS could constitute an easy-to-handle instrument for the various Psychology professionals and a practical resource in the daily life of the psychologist who works with psychological assessment and intervention.

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Notes

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