

## Assessment of the Enterprising Personality: A Short Form of The BEPE Battery

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### Abstract

**Background:** Enterprising personality is related to business creation and success. The objective of this study was the development and psychometric analysis of a reduced version of the BEPE Battery for the Evaluation of Enterprising Personality. **Method:** We used a sample of 1,170 people, 60% women, with a mean age of 42.34 years (SD = 12.96). We carried out psychometric analyses within the frameworks of Classical Test Theory and Item Response Theory models. **Results:** The short version (BEPE-16) consists of 16 items, demonstrating an essentially unidimensional structure. The reliability was excellent ( $\alpha = .94$ ;  $\Omega = .94$ ) and evidence of validity was found in relation to various variables: Measure Of Entrepreneurial Talents And Abilities (META test) ( $r = .71$ ), extraversion ( $r = .57$ ), conscientiousness ( $r = .50$ ), neuroticism ( $r = -.54$ ). The correlation between scores from the BEPE-16 and the original version was very high ( $r = .95$ ). **Conclusions:** The BEPE-16 reduced version for the evaluation of enterprising personality demonstrated good psychometric properties, both in terms of reliability and validity. As such, it can be used in place of the original when the professional or research circumstances require it.

**Keywords:** Enterprising Personality, assessment, reduced version.

### Resumen

**Evaluación de la Personalidad Emprendedora: Versión Corta de la Batería BEPE. Antecedentes:** la personalidad emprendedora está relacionada con la creación y éxito empresarial. El objetivo del presente trabajo es el desarrollo y análisis psicométrico de una versión reducida de la Batería BEPE para la Evaluación de la Personalidad Emprendedora. **Método:** se empleó una muestra de 1.170 participantes, 60% mujeres, con media de 42,34 años y desviación típica de 12,96. Se llevaron a cabo análisis psicométricos dentro del marco de la Teoría Clásica de los Test y de los modelos de Teoría de Respuesta a los Ítems. **Resultados:** la versión corta desarrollada (BEPE-16) consta de 16 ítems, mostrando una estructura esencialmente unidimensional. La fiabilidad fue excelente ( $\alpha = .94$ ;  $\Omega = .94$ ), y se obtuvieron evidencias de validez en relación con distintas variables: Test META de tendencias y capacidades empresariales ( $r = .71$ ), extraversión ( $r = .57$ ), responsabilidad ( $r = .50$ ), neuroticismo ( $r = -.54$ ). La correlación entre las puntuaciones de la versión corta BEPE-16 y la versión original fue muy elevada ( $r = .95$ ). **Conclusiones:** la versión reducida BEPE-16 para la evaluación de la Personalidad Emprendedora muestra unas buenas propiedades psicométricas, tanto en lo relativo a la fiabilidad como a la validez; por tanto, puede utilizarse en vez de la original cuando el contexto profesional y de investigación lo demande.

**Palabras clave:** personalidad emprendedora, evaluación, versión reducida.

Nowadays, enterprising people are considered to be fundamental in the progress of any economy (OECD, 2013), which has driven research into enterprising behavior (Chandra, 2018; Liñán & Fayolle, 2015). Various organizations such as the *Global Entrepreneurship Research Association* (GEM), and the *Organization for Economic Co-operation and Development* (OECD) currently evaluate enterprising activity in many countries (GEM, 2020; OECD, 2018). There are many contextual and individual factors that influence enterprising behavior, some centered on economic and social aspects (Obschonka et al., 2015)

and others on more personal characteristics such as attitudes and personality (Cuesta et al., 2018). There have been attempts to link enterprising behavior with many personality variables such as achievement motivation, risk-taking, innovation, autonomy, self-efficacy, stress-tolerance, optimism, and internal and external locus of control (Frese & Gielnik, 2014; Miller, 2015; Muñoz et al., 2014; Rauch & Frese, 2007a, 2007b; Suárez-Álvarez et al., 2014; Zhao et al., 2010). Various measuring instruments have been developed to assess these and other variables: achievement motivation (Suárez-Álvarez et al., 2013), locus of control (Goldberg et al., 2006; Suárez-Álvarez et al., 2016), self-efficacy (Moriani et al., 2012), autonomy (Lumpkin et al., 2009), initiative (Frese et al., 1997), innovation (De Jong & Den Hartog, 2010), and risk-taking (Shead & Hodgins, 2009). However, there are few comprehensive measuring instruments which evaluate Enterprising Personality as a whole and which allow a profile of Enterprising Personality to be described (Suárez-Álvarez & Pedrosa, 2016). One such

instrument is the Battery for Evaluating Enterprising Personality (BEPE; Cuesta et al., 2018), which has demonstrated suitable metric properties. The properties of the BEPE have been studied both from the perspective of Classical Test Theory (CTT) (Muñiz et al., 2014; Suárez-Álvarez et al., 2014), and from Item Response Theory (IRT) models (Pedrosa et al., 2016; Postigo et al., 2020). The BEPE battery contains 80 items, evaluating a general factor of Enterprising Personality using eight specific dimensions: self-efficacy, autonomy, innovation, internal locus of control, achievement motivation, optimism, stress tolerance, and risk-taking (Cuesta et al., 2018; Muñiz et al., 2014). The high number of items (80) is a practical limitation to the BEPE, as that means it is difficult to apply in contexts where time is limited. This raises the need for a short version, which is normal practice in research and professional contexts (Blanca et al., 2020; Muñiz & Fonseca-Pedrero, 2019; Smith et al., 2000). Organizations who finance entrepreneurial projects may benefit from a reduced version of the battery to support their decision making (Lumpkin, 2007; Rauch & Frese, 2007b). Other areas, such as personnel selection, careers guidance, counselling, coaching, and workplace promotion may also benefit from a short version of the BEPE battery to evaluate Enterprising Personality.

The objective of the current study is the development and psychometric analysis of a reduced version of the BEPE battery for the evaluation of Enterprising Personality. This general objective gives rise to three specific objectives. Firstly, to study the factorial structure of the original BEPE battery, from which we will construct the reduced version. Secondly, to examine the psychometric properties of this reduced version with regard to internal structure, reliability, evidence of validity in relation to other psychological variables, and to study the possible differences between groups based on sex, being self-employed, or being a potential entrepreneur. The third and final objective is to produce a norm reference based on the percentiles of the new, reduced version.

## Method

### Participants

The sample was initially composed of 1,324 Spanish adults from the general population. The sampling was done via the snowball method. The final sample comprised 1,170 people as we removed those who did not give sufficiently correct responses to the control questions included in the questionnaires. Most of the sample (60%) were women, the mean age was 32.34 years old ( $SD = 12.96$ ), and 13% of the sample were self-employed.

### Instruments

*Battery for the Evaluation of Enterprising Personality (BEPE).* This questionnaire assesses eight dimensions of Enterprising Personality: self-efficacy, autonomy, innovation, internal locus of control, achievement motivation, optimism, stress tolerance, and risk-taking (Cuesta et al., 2018; Muñiz et al., 2014). Responses to the items are on a five-point Likert-type scale (1 –completely disagree, 5 –completely agree). The items are all formulated in a direct manner to minimize response bias (Lozano et al., 2008; Suárez-Álvarez et al., 2018; Vigil-Colet et al., 2020). From the classical perspective, the psychometric properties of the scale are very satisfactory, both in terms of the reliability of the

dimensions and the evidence of validity (Cuesta et al., 2018). The alpha coefficients for the sample in this study were: *Overall Enterprising Personality Score* ( $\alpha=.97$ ), *Self-efficacy* ( $\alpha=.88$ ), *Autonomy* ( $\alpha=.81$ ), *Innovation* ( $\alpha=.88$ ), *Internal locus of control* ( $\alpha=.85$ ), *Achievement motivation* ( $\alpha=.86$ ), *Optimism* ( $\alpha=.89$ ), *Stress tolerance* ( $\alpha=.84$ ), and *Risk-taking* ( $\alpha=.87$ ).

*NEO-Five Factor Inventory (NEO-FFI).* Initially developed by Costa and McCrae (1985), in our study we used the version adapted for the Spanish population by Cordero et al. (2008). This inventory contains 60 items (12 in each scale) with five-point Likert-type response options (from “completely disagree” to “completely agree”). It evaluates the Big Five personality factors: *Neuroticism* ( $\alpha=.90$ ); *Extraversion* ( $\alpha=.84$ ); *Openness* ( $\alpha=.82$ ); *Agreeableness* ( $\alpha=.83$ ); and *Conscientiousness* ( $\alpha=.88$ ) (Cordero et al., 2008). The alpha coefficients for the sample in this study were *Neuroticism* ( $\alpha=.88$ ), *Extraversion* ( $\alpha=.83$ ), *Openness* ( $\alpha=.81$ ), *Agreeableness* ( $\alpha=.73$ ), and *Conscientiousness* ( $\alpha=.81$ ).

*Measure of Entrepreneurial Tendencies and Abilities (META).* This instrument was developed by Ahmetoglu et al. (2011), there is a Spanish version available, which we used in this study. It contains 44 Likert-type items with 5 responses for each item (from “completely disagree” to “completely agree”). It assesses four traits of Enterprising Personality: *Proactivity* ( $\alpha=.84$ ); *Creativity* ( $\alpha=.83$ ); *Opportunism* ( $\alpha=.86$ ); and *Vision* ( $\alpha=.76$ ) (Ahmetoglu et al., 2011). The values of alpha for the sample used in this study were: *Proactivity* ( $\alpha=.70$ ), *Creativity* ( $\alpha=.81$ ), *Opportunism* ( $\alpha=.86$ ), and *Vision* ( $\alpha=.76$ ).

*Control of attention scale.* This is a scale made up of 10 Likert-type items with 5 responses for each item. The purpose of this scale is to detect participants who answer the questionnaire without sufficient care and attention. The items are of the type “If you are reading this question, you should answer completely agree”, and were included among the items in the various questionnaires. We removed 154 participants from the study who responded incorrectly to two or more of these items.

### Procedure

Initially we made individual contact with potential participants who met the inclusion criteria (over 18 and working). We asked them to complete the questionnaire online and to provide the email addresses of other potential participants. We then contacted those new potential participants and asked them to do the same. This process continued for three months. The participants received no incentives to participate. Respondents’ anonymity was scrupulously ensured, bound by professional confidentiality and according to the code of ethics of the Board of Spanish Psychologists’ Associations.

### Data analysis

Firstly, we confirmed that the factorial structure of the original BEPE was the best fit to the data. In order to do that, we performed various Confirmatory Factor Analyses (CFA) on the polychoric correlation matrix, testing the fit of unidimensional, multidimensional (eight dimensions), and bifactor models. We used the cut-off points for the various indices of fit (RMSEA, SRMSR, NNFI, and CFI) proposed by Hu and Bentler (1999). To evaluate the overall fit of the model to the ordinal response format, we calculated the M2\* statistic (Cai & Hansen, 2013). To

select the model with the best fit, we calculated the AIC and BIC for each model. The criteria are that a difference of nine points or more between the AIC and BIC indices is indicative that the model with a lower index has a better fit to the data (Anderson, 2008). In addition, because we were dealing with added models, we also performed a hierarchical chi-square tests to determine which model had the best fit to the data. Subsequently, we assessed the fit of the model to the data at the item level. This was to understand the extent to which the proposed model predicted the item responses. To do that, we used the index of fit proposed by Orlando-Thissen-Bjorner (Orlando & Thissen, 2003), correcting it via the Benjamini-Hochberg procedure to keep type I error constant (Benjamini & Hochberg, 1995). When the value obtained is not statistically significant, the evaluated model is considered to adequately predict the item responses.

From the factorial structure obtained for the BEPE battery, we selected the 16 items that demonstrated the greatest factorial loadings in the general dimension of Enterprising Personality (Ferrando et al., 2019). This produced the 16 items in the short version of the battery (BEPE-16). The first step with the BEPE-16 was to carry out an analysis of the descriptive statistics: mean, standard deviation, item discrimination indices, skewness, and kurtosis. We examined the impact and both uniform and non-uniform Differential Item Functioning (DIF) using the logistical regression procedure (Gómez-Benito et al., 2013). We calculated reliability using the  $\alpha$  and  $\omega$  coefficients (Revelle & Condon, 2019). Subsequently, following Samejima's (1969) graded response model, we calculated the  $b$  (difficulty) and  $a$  (discrimination) parameters for each of the items in the BEPE-16, along with the test Information Function. To examine dimensionality, we performed a CFA on the polychoric correlation matrix; the extraction method was Weighted Least Square Mean and Variance (WLSMV). To examine the validity in relation to other variables, we calculated the Pearson correlation between the overall BEPE-16 score and the different dimensions of the NEO-FFI, the overall META score, and the various dimensions and overall score of the full 80-item BEPE, correcting for attenuation (American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, 2014). To produce evidence of the discriminating capacity of the BEPE-16, we examined whether there were differences by sex, by being a self-employed or not, and by being a potential entrepreneur or not. We performed various one-tailed t tests for independent samples. We used Cohen's  $d$  to assess effect size, according to which, effect sizes are small when  $d$  is between 0.2 and 0.4, medium, when it is between 0.4 and 0.7, and large when it is greater than 0.7 (Cohen, 1988). Lastly, we norm referenced the scores, based on percentiles.

We used the program Jamovi (The jamovi project, 2020) to perform the descriptive analysis and to calculate discrimination indices, reliability, and between group differences. The CFAs were performed using Mplus 8 (Muthén & Muthén, 2017). We used the "mirt" package in R (Chalmers, 2012) for Samejima's graded response model.

## Results

### Selection of items for the BEPE-16

Using the fit of the various models tested to the data (Table 1), we confirmed that the bifactor model, according to the criteria set

out by Hu and Bentler (1999), gave the best overall indices of fit. Similarly, comparing the values of AIC and BIC for the different models, the bifactor model gave the lowest values in both indices, with the differences greater than 9 points (Anderson, 2008). These results are consistent with the comparison of the different models via chi-square hierarchical testing, which showed that the multidimensional model had a better fit than the unidimensional model  $\chi^2(28) = 6,118.056, p < .001$ ; and that the bifactor model had a better fit than the multidimensional model  $\chi^2(52) = 3,442.602, p < .001$ .

The values from M2\* indicated that none of the models we evaluated fit strictly to the data, which may be because M2\* is very sensitive in terms of rejecting model fit when the sample size is large (Xu et al., 2017). In terms of item-level fit of the model (last row in Table 1) we confirmed that the totality of the items in the unidimensional and bifactor models were not significant, which indicates that these two models adequately predict the response of all of the items making up the BEPE. In contrast, the eight-dimension model could only adequately predict the response to four of the items. Although the unidimensional and bifactor models gave identical results for item-level fit, overall the bifactor model demonstrated a better fit to the data. Therefore, we used that model as the basis for selecting the items to make up the short version, the BEPE-16. We selected the two items in each specific aspect with the greatest factorial loading on the general Enterprising Personality factor (Table 2), producing the reduced version with 16 items (BEPE-16). For *innovation* and *achievement motivation*, we used the additional criterion of the explained common variance for each item, as they had the same factorial loading.

### Descriptive statistics and reliability of BEPE-16

We assessed the descriptive statistics of the BEPE-16, with most of the items exhibiting suitable values in both skewness and kurtosis (Table 3). None of the items demonstrated impact, nor uniform or non-uniform DIF. We also confirmed that all of the items had high discrimination indices, above 0.49.

The reliability of the BEPE-16 scores via the alpha and omega coefficients was excellent ( $\alpha = .94; \omega = .94$ ).

Table 1  
Fit of the unidimensional, multidimensional, and bifactor models

	Unidimensional	Multidimensional	Bifactor
RMSEA	.087 [.086 - .087]	.086 [.084 - .086]	.045 [.044 - .046]
SRMSR	.075	.255	.054
NNFI	.75	.75	.93
CFI	.76	.77	.94
AIC	174,816.2	168,754.1	165,415.5
BIC	176,821.8	170,901.6	167,826.3
M2*	28,006.15 (2,844)***	26,985.24 (2,816)***	9,386.93 (2,764)***
Number of items fit to the model	80	4	80

Note: RMSEA = Root mean square error of approximation [90% CI]; SRMSR = Standardized root mean square residual; NNFI = Non-normed fit index; CFI = Comparative fit index; AIC = Akaike information criterion; BIC = Bayesian information criterion.  
\*\*\*  $p < .001$

*Table 2*  
Factorial loadings of the items on the general factor of Enterprising Personality (BEPE)

Item	Factor loading	Item	Factor loading	Item	Factor loading	Item	Factor loading
<b>Self-efficacy</b>		<b>Innovation</b>		<b>Achievement motivation</b>		<b>Stress tolerance</b>	
01	.74	01	.52	01	.66	01	.77*
02	.81	02	.64	02	.74	02	.30
03	.70	03	.60	03	.63	03	.55
04	.74	04	.64	04	.57	04	.39
05	.74	05	.54	05	.74*	05	.45
06	.82*	06	.57	06	.74*	06	.40
07	.70	07	.62	07	.66	07	.40
08	.79	08	.75*	08	.71	08	.41
09	.85*	09	.64*	09	.69	09	.34
10	.76	10	.57	10	.62	10	.62*
<b>Autonomy</b>		<b>Internal locus of control</b>		<b>Optimism</b>		<b>Risk-taking</b>	
01	.44	01	.49	01	.60	01	.67
02	.16	02	.70*	02	.54	02	.78*
03	.67*	03	.54	03	.58	03	.56
04	.65*	04	.55	04	.66	04	.63
05	.33	05	.44	05	.82*	05	.71*
06	.29	06	.35	06	.64	06	.60
07	.35	07	.66*	07	.52	07	.60
08	.52	08	.40	08	.55	08	.69
09	.59	09	.46	09	.75*	09	.62
10	.61	10	.51	10	.52	10	.49

\* Items selected for the short version

*IRT analysis of BEPE-16 items*

From the analysis using Samejima’s graded model, the *a* discrimination parameters for the items were high. The *b* parameters for each item were adequate and were found to scale

in the expected order, always going from lower to higher (Table 2). With respect to the test Information Function, the precision is adequate throughout the full ability scale, and demonstrates lower precision for moderate ability levels and for the highest ability levels (Figure 1).

*Table 3*  
Descriptive statistics and IRT parameters for the items in BEPE-16

Item	Mean	SD	Skewness	Kurtosis	D.I.	$\lambda$	a	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	b <sub>4</sub>
i01	3.99	0.67	-1.05	2.78	.64	.77	2.29	-3.49	-2.14	-1.36	1.18
i02	3.81	0.66	-0.85	1.79	.70	.81	2.75	-3.12	-2.03	-0.83	1.56
i03	3.51	0.83	-0.31	-0.26	.56	.65	1.56	-4.07	-1.74	-0.19	2.04
i04	3.98	0.68	-0.78	1.69	.49	.57	1.38	-4.97	-2.96	-1.53	1.40
i05	3.67	0.83	-0.78	0.53	.63	.72	2.00	-3.13	-1.64	-0.64	1.67
i06	3.78	0.67	-0.81	1.35	.52	.62	1.51	-4.61	-2.55	-0.97	2.10
i07	3.92	0.63	-0.72	2.08	.52	.65	1.58	-4.28	-2.97	-1.31	1.62
i08	3.76	0.81	-0.58	0.32	.52	.61	1.43	-4.32	-2.23	-0.80	1.60
i09	3.77	0.71	-0.65	0.89	.57	.68	1.78	-3.98	-2.28	-0.79	1.75
i10	3.95	0.70	-0.88	1.75	.61	.75	2.00	-3.86	-2.23	-1.26	1.2
i11	4.01	0.61	-0.95	3.06	.65	.80	2.59	-3.91	-2.19	-1.44	1.21
i12	3.69	0.72	-0.43	0.26	.60	.71	1.78	-4.39	-2.22	-0.55	1.88
i13	3.67	0.72	-0.70	0.89	.66	.77	2.18	-3.30	-1.97	-0.54	1.88
i14	3.73	0.82	-0.77	0.64	.50	.60	1.41	-3.98	-2.09	-0.87	1.80
i15	3.73	0.75	-0.78	0.92	.66	.78	2.30	-3.19	-1.82	-0.69	1.59
i16	3.84	0.74	-0.96	1.71	.55	.66	1.68	-3.60	-2.19	-1.08	1.57

Note: n = 1,170; SD = standard deviation; D.I. = discrimination index;  $\lambda$  = item factorial loading; a = discrimination parameter (IRT); b = threshold (IRT)

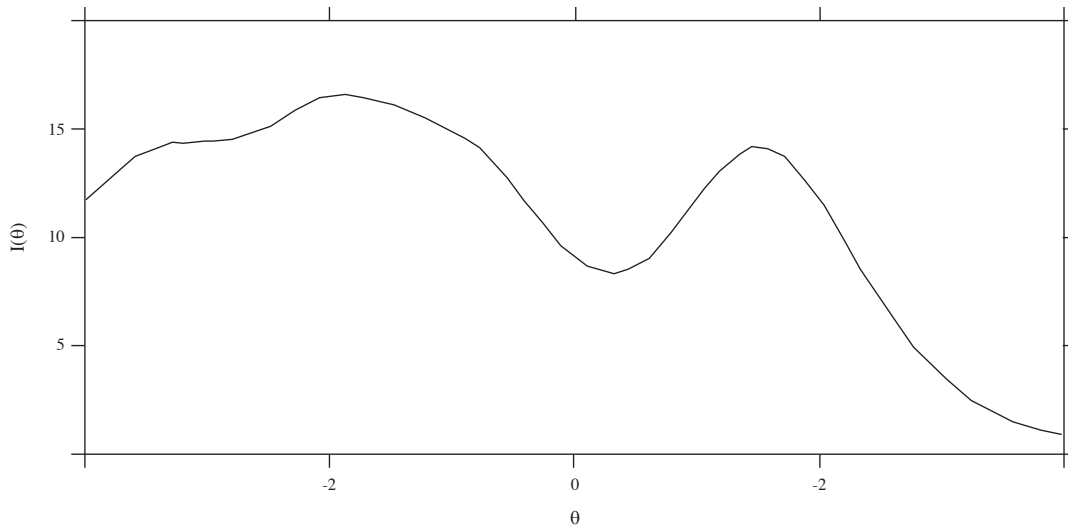


Figure 1. Information Function for BEPE-16

Validity evidence for the internal structure

We performed a CFA to provide evidence of validity related to the internal structure. The CFA demonstrated a good fit, thus it seems reasonable to say that the test can be considered essentially unidimensional (RMSEA= .058 90% CI [.053-.063], CFI= .982, NNFI= .977, SRMR= .032). The factorial loadings are given in Table 3, and range between .57 and .81.

Validity evidence in relation to other variables

In relation to other variables, the BEPE-16 demonstrated strong correlations with the overall META score and its various dimensions, as well as with the original 80-item BEPE. The BEPE-16 also exhibited strong correlations with extraversion,

conscientiousness, and neuroticism, although the correlation with the latter was negative (Table 4).

Differences between groups in the BEPE-16

In terms of differences by sex, men had higher mean scores than women in the BEPE-16 ( $t_{(1168)} = 4.92, p < .001, d = 0.29$  95% CI [0.17; 0.41]). The differences between the self-employed and others were not so clear, although they were close to statistical significance and the effect size was small ( $t_{(1168)} = 1.64, p = 0.0502, d = 0.14$  95% CI [0.03; 0.25]), however there were differences between those who were not self-employed but who intended to become so in the next few months (who might be considered potential entrepreneurs) and those who did not ( $t_{(1016)} = 1.81, p = 0.035, d = 0.20$  95% CI [0.08; 0.32]).

*Table 4*  
Correlation between total score in the BEPE-16 and the BEPE, NEO-FFI, and META

	BEPE-16			
	R	95% CI	Attenuated R	95% CI
<b>NEO-FFI</b>				
Agreeableness	.10***	[.04, .16]	.12	[.06, .18]
Openness to experience	.24***	[.18, .29]	.28	[.19, .29]
Extraversion	.50***	[.46, .54]	.57	[.53, .61]
Neuroticism	-.49***	[-.53, -.45]	-.54	[-.58, -.50]
Conscientiousness	.45***	[.40, .49]	.50	[.46, .54]
<b>META</b>				
Opportunism	.49***	[.44, .53]	.55	[.51, .59]
Proactivity	.42***	[.37, .47]	.53	[.37, .47]
Creativity	.54***	[.49, .58]	.63	[.59, .66]
Vision	.56***	[.52, .60]	.70	[.67, .73]
Total	.65***	[.62, .69]	.71	[.68, .74]
BEPE 80	.95***	[.94, .95]	-	-

*Note.* R = Pearson correlation coefficient; CI = confidence interval.  
\*\*\*  $p < .001$

Norm reference

Lastly, we norm referenced the scores based on percentiles (Table 5).

*Table 5*  
Norm referenced scores for BEPE-16

Total BEPE-16 score	Men's score BEPE-16	Women's score BEPE-16	Percentiles
16 - 49	16 - 50	16 - 48	5
50 - 53	51 - 54	49 - 52	10
54 - 56	55 - 58	53 - 55	20
57 - 58	59 - 60	56 - 58	30
59 - 60	61	59	40
61	62	60 - 61	50
62 - 63	63	62	60
64	64 - 65	63	70
65 - 66	66 - 68	64 - 65	80
67 - 70	69 - 72	66 - 69	90
71 - 75	73 - 77	70 - 73	95
76 - 80	78 - 80	74 - 80	99

## Discussion

The objective of this study was the development of a reduced version of the BEPE battery for the evaluation of Enterprising Personality. The new short version (BEPE-16) has sixteen items, two from each of the eight dimensions in the original. This ensures that all of the relevant aspects of Enterprising Personality are assessed. We studied the psychometric properties using CTT and IRT models. We tested different models to examine the factorial structure of the original BEPE battery, with the bifactor model demonstrating the best fit both overall and for the items. Using the bifactor model, we selected the two items from each aspect with the greatest factorial loading in the general factor, in this way attempting to best reflect the eight factors that define Enterprising Personality. This gave us a short version containing 16 of the original 80 items.

Once the new short version, the BEPE-16 was constructed, we examined its psychometric properties. The results of the CFA allow us to speak of an essentially unidimensional structure (Calderón-Garrido et al., 2019). In terms of item analysis, the discrimination index (CTT) and parameter  $a$  (IRT) were very high for all items, indicating that the BEPE-16 discriminated very well between those with low and high levels of Enterprising Personality. The reliability of the scores was excellent ( $\alpha = .94$ ;  $\omega = .94$ ), especially given the drastic reduction in the number of items from 80 to 16. The Information Function indicated adequate precision over the whole ability range. The lowest precision was for moderate and for the highest levels of Enterprising Personality.

The evidence of validity in relation to other variables was consistent with findings from previous studies using the BEPE (Cuesta et al., 2018; Muñiz et al., 2014; Pedrosa et al., 2016; Postigo et al., 2020). Firstly, the BEPE-16 demonstrated a .95 correlation with the original BEPE, indicating that the reduced version similarly assesses Enterprising Personality. Secondly, the BEPE-16 exhibited a strong relationship to META (Ahmetoglu et al., 2011), one of the most well-known instruments for evaluating Enterprising Personality, both with its four dimensions (Proactivity:  $r = .53$ ; Opportunism:  $r = .55$ ; Creativity:  $r = .63$ ; and Vision:  $r = .70$ ), and its overall score ( $r = .71$ ). Therefore the correlation between the BEPE-16 and the META can be regarded as adequate, according to the evaluation criteria in the European Federation of Psychologists' Associations' Test Review Model (Evers et al., 2013). In terms of correlations between the BEPE-16 and the Big Five personality factors, it is worth highlighting the relationship with extraversion ( $r = .57$ ), neuroticism ( $r = .54$ ), and conscientiousness ( $r = .50$ ), with the latter being the most strongly related to Enterprising Personality and entrepreneurial success (Zhao et al., 2010). These relationships once again highlight the connection between specific personality traits and the Big Five, as shown in the adapted model from Suárez-Álvarez and Pedrosa (2016). Nonetheless, it is important to note that specific traits, which make up the BEPE-16, increase the predictive

validity of entrepreneurial success compared to the sole use of the general Big Five personality model (Leutner et al., 2014).

With respect to differences between groups, there were statistically significant differences according to sex, with men scoring higher in the BEPE-16 (Fisher & Yao, 2017; Verheul et al., 2012). This may help to explain why men tend to start new businesses more than women (OECD, 2017). In addition, there were significant differences between working people who wanted to start businesses and those who did not, with the former scoring higher in Enterprising Personality. This has already been demonstrated in other studies (López-Núñez et al., 2020; Obschonka et al., 2017; Şahin et al., 2019).

In summary, we have developed a reduced version of the BEPE with 16 items (BEPE-16) that reliably evaluates Enterprising Personality, with suitable evidence of validity. The BEPE-16 is offered as a complementary tool to the original BEPE (Cuesta et al., 2018; Muñiz et al., 2014). The original version of the BEPE allows a more thorough and detailed study of Enterprising Personality, allowing profiles within the construct to be studied in accordance with its dimensional structure. In contrast, we present the BEPE-16 as a screening tool, which has advantages for both research and professional contexts. In a more general context, organizations that provide funding for entrepreneurial projects can use the BEPE-16 in support of their decision-making, with rapid evaluation of people's Enterprising Personality. In a more organizational context, more related to internal business innovation, companies can benefit from the BEPE-16 providing initial information on candidates to help in the selection process and shortlisting, saving them time and money. Outside of personnel selection, the BEPE-16 can also be a useful tool within a company, such as when offering training courses in the various psychological traits that make up Enterprising Personality, with the intention of assessing possible effects and efficacy of the courses given. Finally, in the research context, the BEPE-16 will offer a rapid, viable alternative for evaluating Enterprising Personality when it is being measured in relation to other variables. One of the limitations of the current study is that we did not use a social desirability scale to control the possible bias of the participants wanting to present a favorable image. It would be interesting for future studies to extend the sample of entrepreneurs, although the problem lies in the thin line separating them from the self-employed (Henrekson & Sanandaji, 2014), who are not necessarily entrepreneurs, but work for themselves because they have to (GEM, 2019), or merely to make a living (Baum et al., 2007; GEM, 2020).

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## References

- American Educational Research Association, American Psychological Association, and National Council on Measurement in Education (2014). *Standards for educational and psychological testing*. American Psychological Association.
- Ahmetoglu, G., Leutner, F., & Chamorro-Premuzic, T. (2011). EQ-nomics: Understanding the relationship between individual differences in trait emotional intelligence and entrepreneurship. *Personality and Individual Differences*, 51(8), 1028-1033. <https://doi.org/10.1016/j.paid.2011.08.016>
- Anderson, D. R. (2008). *Model Based Inference in the Life Sciences: A Primer on Evidence*. Springer Science & Business Media.
- Baum, J. R., Frese, M., Baron, R. A., & Katz, J. A. (2007). Entrepreneurship

- as an area of Psychology study: An introduction. In J. R. Baum, M. Frese, & R. A. Baron (Eds.), *The psychology of entrepreneurship* (pp. 1-18). Lawrence Erlbaum.
- Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B (Methodological)*, 57(1), 289-300. <https://doi.org/10.1111/j.2517-6161.1995.tb02031.x>
- Blanca, M. J., Escobar, M., Lima, J. F., Byrne, D., & Alarcón, R. (2020). Psychometric properties of a short form of the Adolescent Stress Questionnaire (ASQ-14). *Psicothema*, 32(2), 261-267. <https://doi.org/10.7334/psicothema2019.288>
- Cai, L., & Hansen, M. (2013). Limited-information goodness-of-fit testing of hierarchical item factor models. *British Journal of Mathematical and Statistical Psychology*, 66(2), 245-276. <https://doi.org/10.1111/j.2044-8317.2012.02050.x>
- Calderón-Garrido, C., Navarro-González, D., Lorenzo-Seva, U., & Ferrando, P. J. (2019). Multidimensional or essentially unidimensional? A multi-faceted factor-analytic approach for assessing the dimensionality of tests and items. *Psicothema*, 31(4), 450-457. <https://doi.org/10.7334/psicothema2019.153>
- Chalmers, R., P. (2012). mirt: A Multidimensional Item Response Theory package for the R environment. *Journal of Statistical Software*, 48(6), 1-29. <https://doi.org/10.18637/jss.v048.i06>
- Chandra, Y. (2018). Mapping the evolution of entrepreneurship as a field of research (1990-2013): A scientometric analysis. *PLoS One*, 13(1), 1-24. <https://doi.org/10.1371/journal.pone.0190228>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Erlbaum.
- Cordero, A., Pamos, A., & Seisdedos, N. (2008). NEO PI-R, Inventario de Personalidad NEO Revisado [Revised NEO Personality Inventory]. TEA Ediciones.
- Costa, P. T., & McCrae, R. R. (1985). *The NEO Personality Inventory Manual*. Psychological assessment resources.
- Cuesta, M., Suárez-Álvarez, J., Lozano, L. M., García-Cueto, E., & Muñiz, J. (2018). Assessment of eight entrepreneurial personality dimensions: Validity evidence of the BEPE battery. *Frontiers in Psychology*, 9, 2352, 1-10. <https://doi.org/10.3389/fpsyg.2018.02352>
- De Jong, J., & Den Hartog, D. (2010). Measuring innovative work behaviour. *Creativity and Innovation Management*, 19(1), 23-36. <https://doi.org/10.1111/j.1467-8691.2010.00547.x>
- Evers, A., Muñiz, J., Hagemester, C., Hstmaelingen, A., Lindley, P., Sjöberg, A., & Bartram, D. (2013). Assessing the quality of tests: Revision of the EFPA review model. *Psicothema*, 25(3), 283-291. <https://doi.org/10.7334/psicothema2013.97>
- Ferrando, P. J., Navarro-González, D., & Lorenzo-Seva, U. (2019). Assessing the quality and effectiveness of the factor score estimate in psychometric factor-analytic applications. *Methodology*, 15(3), 119-127. <https://doi.org/10.1027/1614-2241/a000170>
- Fisher, P. J., & Yao, R. (2017). Gender differences in financial risk tolerance. *Journal of Economic Psychology*, 61, 191-202. <https://doi.org/10.1016/j.joep.2017.03.006>
- Frese, M., Fay, D., Hilburger, T., Leng, K., & Tag, A. (1997). The concept of personal initiative: Operationalization, reliability and validity in two German samples. *Journal of Occupational and Organizational Psychology*, 70(2), 139-161. <https://doi.org/10.1111/j.2044-8325.1997.tb00639.x>
- Frese, M., & Gielnik, M. M. (2014). The Psychology of entrepreneurship. *The Annual Review of Organizational Psychology and Organizational Behavior*, 1, 413-438. <https://doi.org/10.1146/annurev-orgpsych-031413-091326>
- Global Entrepreneurship Monitor [GEM] (2019). *Global Report 2018/19*. London Business School.
- Global Entrepreneurship Monitor [GEM] (2020). *Global Report 2019/20*. London Business School.
- Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. G. (2006). The international personality item pool and the future of public-domain personality measures. *Journal of Research in Personality*, 40(1), 84-96. <https://doi.org/10.1016/j.jrp.2005.08.007>
- Gómez-Benito, J., Hidalgo, M. D., & Zumbo, B. D. (2013). Effectiveness of combining statistical tests and effect sizes when using logistic discriminant function regression to detect Differential Item Functioning for polytomous items. *Educational and Psychological Measurement*, 73(5), 875-897. <https://doi.org/10.1177/0013164413492419>
- Henrekson, M., & Sanandaji, T. (2014). Small business activity does not measure entrepreneurship. *Proceedings of the National Academy of Sciences*, 111(5), 1760-1765. <https://doi.org/10.1073/pnas.1307204111>
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1-55. <https://doi.org/10.1080/10705519909540118>
- Leutner, F., Ahmetoglu, G., Akhtar, R., & Chamorro-Premuzic, T. (2014). The relationship between the entrepreneurial personality and the Big Five personality traits. *Personality and Individual Differences*, 63, 58-63. <https://doi.org/10.1016/j.paid.2014.01.042>
- Liñán, F., & Fayolle, A. (2015). A systematic literature review on entrepreneurial intentions: Citation, thematic analyses, and research agenda. *International Entrepreneurship and Management Journal*, 11(4), 907-933. <https://doi.org/10.1007/s11365-015-0356-5>
- López-Núñez, M. I., Rubio-Valdehita, S., Aparicio-García, M. E., & Díaz-Ramiro, E. M. (2020). Are entrepreneurs born or made? The influence of personality. *Personality and Individual Differences*, 154, 1-5. <https://doi.org/10.1016/j.paid.2019.109699>
- Lozano, L. M., García-Cueto, E., & Muñiz, J. (2008). Effect of the number of response categories on the reliability and validity of rating scales. *Methodology*, 4(2), 73-79. <https://doi.org/10.1027/1614-2241.4.2.73>
- Lumpkin, G. T. (2007). Intrapreneurship and innovation. In J. R. Baum, M. Frese, & R. A. Baron (Eds.), *The psychology of entrepreneurship* (pp. 237-264). Lawrence Erlbaum.
- Lumpkin, G. T., Coglisier, C. C., & Schneider, D. R. (2009). Understanding and measuring autonomy: An entrepreneurial orientation perspective. *Entrepreneurship: Theory and Practice*, 33(1), 47-69. <https://doi.org/10.1111/j.1540-6520.2008.00280.x>
- Miller, D. (2015). A downside to the entrepreneurial personality? *Entrepreneurship: Theory and Practice*, 39(1), 1-8. <https://doi.org/10.1111/etap.12130>
- Moriano, J. A., Topa, G., Molero, F., Entenza, A. M., & Lévy-Mangin, J.-P. (2012). Entrepreneurial leadership self-efficacy. Adaptation and validation of CESE scale in Spain. *Anales de Psicología*, 28(1), 171-179.
- Muñiz, J., & Fonseca-Pedrero, E. (2019). Ten steps for test development. *Psicothema*, 31(1), 7-16. <https://doi.org/10.7334/psicothema2018.291>
- Muñiz, J., Suárez-Álvarez, J., Pedrosa, I., Fonseca-Pedrero, E., & García-Cueto, E. (2014). Enterprising personality profile in youth: Components and assessment. *Psicothema*, 26(4), 545-553. <https://doi.org/10.7334/psicothema2014.182>
- Muthén, L. K., & Muthén, B. O. (2017). *Mplus User's Guide*, 8th Edn. Muthén & Muthén
- Obschonka, M., Hakkarainen, K., Lonka, K., & Salmela-Aro, K. (2017). Entrepreneurship as a twenty-first century skill: Entrepreneurial alertness and intention in the transition to adulthood. *Small Business Economics*, 48(3), 487-501. <https://doi.org/10.1007/s11187-016-9798-6>
- Obschonka, M., Stuetzer, M., Gosling, S. D., Rentfrow, P. J., Lamb, M. E., Potter, J., & Audretsch, D. B. (2015). Entrepreneurial regions: Do macro-psychological cultural characteristics of regions help solve the "knowledge paradox" of economics? *PLoS One*, 10(6), e0129332. <https://doi.org/10.1371/journal.pone.0129332>
- OECD (2013). *The missing entrepreneurs: Policies for inclusive entrepreneurship in Europe*. OECD Publishing. <https://doi.org/10.1787/9789264213593-en>
- OECD (2017). *Gender differences in self-employment rates*. In *Entrepreneurship at a Glance 2017*. OECD Publishing. [https://doi.org/10.1787/entrepreneur\\_aag-2017-22-en](https://doi.org/10.1787/entrepreneur_aag-2017-22-en)
- OECD (2018). *Entrepreneurship at a Glance 2018*. <https://www.oecd.org/sdd/business-stats/EAG-2018-Highlights.pdf>
- Orlando, M., & Thissen, D. (2003). Further investigation of the performance of S-X2: An item fit index for use with dichotomous Item Response Theory Models. *Applied Psychological Measurement*, 27(4), 289-298. <https://doi.org/10.1177/0146621603027004004>
- Pedrosa, I., Suárez-Álvarez, J., García-Cueto, E., & Muñiz, J. (2016). A computerized adaptive test for enterprising personality assessment in youth. *Psicothema*, 28(4), 471-478. <https://doi.org/10.7334/psicothema2016.68>

- Postigo, Á., Cuesta, M., Pedrosa, I., Muñiz, J., & García-Cueto, E. (2020). Development of a computerized adaptive test to assess entrepreneurial personality. *Psicología: Reflexão e Crítica*, 33(6), 1-10. <https://doi.org/10.1186/s41155-020-00144-x>
- Rauch, A., & Frese, M. (2007a). Born to be an entrepreneur? Revisiting the personality approach to entrepreneurship. In J. R. Baum, M. Frese, & R. A. Baron (Eds.), *The psychology of entrepreneurship* (pp. 41-65). Lawrence Erlbaum.
- Rauch, A., & Frese, M. (2007b). Let's put the person back into entrepreneurship research: A meta-analysis on the relationship between business owners' personality traits, business creation, and success. *European Journal of Work and Organizational Psychology*, 16(4), 353-385. <https://doi.org/10.1080/00273171.2012.715555>
- Revelle, W., & Condon, D. M. (2019). Reliability from  $\alpha$  to  $\omega$ : A tutorial. *Psychological Assessment*, 31(12), 1395-1411. <https://doi.org/10.1037/pas0000754>
- Şahin, F., Karadağ, H., & Tuncer, B. (2019). Big five personality traits, entrepreneurial self-efficacy and entrepreneurial intention: A configurational approach. *International Journal of Entrepreneurial Behavior & Research*, 25(6), 1188-1211. <https://doi.org/10.1108/IJEBR-07-2018-0466>
- Samejima, F. (1969). *Estimation of latent ability using a response pattern of graded scores* (Vol. No. 1). Psychometric Society.
- Smith, G. T., McCarthy, D. M., & Anderson, K. G. (2000). On the sins of short-form development. *Psychological Assessment*, 12(1), 102-111. <https://doi.org/10.1037//1040-3590.12.1.102>
- Shead, N. W., & Hodgins, D. C. (2009). Probability discounting of gains and losses: Implications for risk attitudes and impulsivity. *Journal of the Experimental Analysis of Behavior*, 92(1), 1-16. <https://doi.org/10.1901/jeab.2009.92-1>
- Suárez-Álvarez, J., Campillo-Álvarez, Á., Fonseca-Pedrero, E., García-Cueto, E., & Muñiz, J. (2013). Professional training in the workplace: The role of achievement motivation and locus of control. *Spanish Journal of Psychology*, 16, 1-11. <https://doi.org/10.1017/sjp.2013.19>
- Suárez-Álvarez, J., & Pedrosa, I. (2016). The assessment of entrepreneurial personality: The current situation and future directions. *Papeles del Psicólogo*, 37(1), 62-68.
- Suárez-Álvarez, J., Pedrosa, I., García-Cueto, E., & Muñiz, J. (2014). Screening enterprising personality in youth: An empirical model. *Spanish Journal of Psychology*, 17, E60. <https://doi.org/10.1017/sjp.2014.61>
- Suárez-Álvarez, J., Pedrosa, I., García-Cueto, E., & Muñiz, J. (2016). Locus of Control revisited: Development of a new bi-dimensional measure. *Anales de Psicología*, 32(2), 578. <https://doi.org/10.6018/analesps.32.2.200781>
- Suárez-Álvarez, J., Pedrosa, I., Lozano, L. M., García-Cueto, E., Cuesta, M., & Muñiz, J. (2018). Using reversed items in Likert scales: A questionable practice. *Psicothema*, 30(2), 149-158. <https://doi.org/10.7334/psicothema2018.33>
- The jamovi project (2020). *jamovi* (Version 1.2) [Computer Software]. <https://www.jamovi.org>
- Verheul, I., Thurik, R., Grilo, I., & van der Zwan, P. (2012). Explaining preferences and actual involvement in self-employment: Gender and the entrepreneurial personality. *Journal of Economic Psychology*, 33(2), 325-341. <https://doi.org/10.1016/j.joep.2011.02.009>
- Vigil-Colet, A., Navarro-González, D., & Morales-Vives, F. (2020). To reverse or to not reverse Likert-type items: That is the question. *Psicothema*, 32(1), 108-114. <https://doi.org/10.7334/psicothema2019.286>
- Xu, J., Paek, I., & Xia, Y. (2017). Investigating the behaviors of M2 and RMSEA2 in fitting a unidimensional model to multidimensional data. *Applied Psychological Measurement*, 41(8), 632-644. <https://doi.org/10.1177/014662161771046>
- Zhao, H., Seibert, S. E., & Lumpkin, G. T. (2010). The relationship of personality to entrepreneurial intentions and performance: A meta-analytic review. *Journal of Management*, 36(2), 381-404. <https://doi.org/10.1177/0149206309335187>