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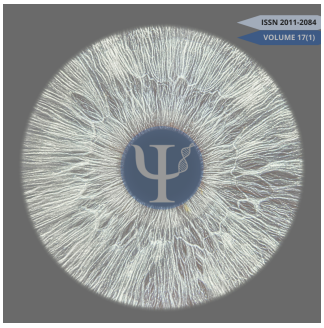

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Brief Version of the Revised-Abbreviated Eysenck Personality Questionnaire in a Spanish Young Adult Population

Versión breve del Cuestionario Revisado y Abreviado de Personalidad de Eysenck en una población de jóvenes adultos españoles

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Abstract.
Eysenck's PEN model is one of the most relevant and fruitful models with empirical support, and continues eliciting a large research corpus. Nevertheless, the systematic limitations regarding the psychoticism dimension and questionable inclusion of social desirability as a personality dimension have limited the model. The current research aimed to estimate an alternative PEN model including social desirability as a control and test its validity and reliability. This sample consists of 2969 Spanish young adults. Confirmatory factor analysis was carried out to test the fitting of four different models to the data. Once the best-fitting model was obtained, multiple-group analyses were carried out to assess the configural, metric, and scalar invariance of the model across sexes. The results showed that the three-dimension PEN model and two-dimension EN model controlling social desirability best fit the data and were invariant across sexes. Despite the apparent appropriateness of both models, the EN model controlling for social desirability is more appropriate due to the weakness of the P dimension.

Resumen.
El modelo PEN de Eysenck es uno de los modelos con evidencia empírica más relevantes y fructíferos que sigue suscitando investigación. Sin embargo, las limitaciones sistemáticas del modelo relacionadas con la dimensión de psicoticismo y la inclusión de la deseabilidad social como dimensión de personalidad han limitado al modelo. El objetivo de la investigación actual fue estimar un modelo PEN alternativo, incluyendo la deseabilidad social como control, y testar su validez y fiabilidad. La muestra estuvo compuesta por 2962 españoles adultos jóvenes. Se evaluó el ajuste de cuatro modelos diferentes a los datos. Una vez establecido el mejor ajuste, se llevó a cabo un análisis multigrupo para evaluar la invarianza configural, métrica y escalar por sexos. Los resultados indicaron que el modelo PEN de tres dimensiones y el modelo EN de dos dimensiones, controlando la deseabilidad social, tenían el mejor ajuste a los datos y eran invariantes entre sexos. A pesar de la aparente adecuación de los modelos, el modelo EN, controlando la deseabilidad social, se consideró más apropiado atendiendo a las debilidades de la dimensión P.

Keywords.
EPQ-RA, Personality Assessment, Confirmatory Analysis, Measurement Invariance, Young Adults.

Palabras Clave.
EPQ-RA, evaluación de la personalidad, análisis confirmatorio, invarianza, adultos jóvenes.

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1. Introduction

The personality model developed by H. J. Eysenck is one of the most fruitful models with empirical support and continues eliciting a large research corpus (Bowden et al., 2018; Revelle, 2016). Eysenck argued that three main personality dimensions (neuroticism [N], extraversion [E], and psychoticism [P]) could capture most of the variance of the personality (Eysenck & Eysenck, 1975). Eysenck developed different measurement instruments to precisely assess his personality model following this model. Although the first antecedents of PEN model measures can be found since the early 1950s (Eysenck, 1952, 1958, 1959; Eysenck & Eysenck, 1964), the inclusion of the P scale was not made until 1975 in the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975). Nevertheless, the poor psychometric properties of the P dimension were hardly criticized, and a revised version of the EPQ (EPQ-R; Eysenck et al., 1985) was developed.

As Maragakis (2020) pointed out, the evolution to the EPQ-R is characterized by an increasing number of items (100 in the EPQ-R). This progressive increase in the length of instruments can be accounted for by the introduction of an additional dimension of personality (P dimension) and by the psychometric principle that greater length enhances reliability. However, this increase in the length of the EPQ-R also made it barely useful for applied research and clinical settings (Maragakis, 2020). For example, it is usual that a research project would benefit from including a personality measure, but an additional 100 items would increase the overall questionnaire to an unacceptable length, which in turn would increase the fatigue, frustration, and boredom of participants (Villarejo & Puertas-Martín, 2011; Gosling et al., 2003).

To overcome these limitations, brief or short versions of the EPQ were created to obtain a valid, reliable, and easy-to-apply personality measure instrument: the EPQ-R Short (EPQ-RS; Eysenck & Eysenck, 1991). The EPQ-RS was originally composed of 48 items (twelve for each dimension of the PEN model and twelve for sincerity or Lie scale [L]), making it easier to use because of the lower time required for its application and inherent lower cognitive demand for participants. Despite the decreasing item numbers and doubts about the psychometric properties (Maragakis, 2020), different researchers have pointed out the appropriateness of the scale, but with some limitations in the P dimension (e.g., Alexopoulos & Kalaitzidis, 2004; Francis et al., 2006; Tiwari et al., 2009). In the same way, the efforts to develop brief and valid versions of the EPQ-R continued, and a briefer version of 24 items was also proposed (six for each dimension of the PEN model and six for L): The Abbreviated form of the EPQ-R (EPQ-RA; Francis et al., 1992). As in previous versions, all the dimensions of the EPQ-RA, except the P dimension, showed acceptable-to-good reliabilities, and it has been proposed as equivalent to the EPQ-RS (Bouvard, 2010; Francis et al., 1992; Ibáñez et al., 1999; Karanci et al., 2007) despite the lower number of items.

1.1 The Spanish context

As in many other contexts, the PEN model has also promoted a large research corpus in the Spanish context, and different researchers have aimed to test the psychometric properties of the EPQ-RA to obtain an appropriate personality measure instrument for this context (e.g., García-González et al., 2021; Ibáñez et al., 1999; Sandín et al., 2002a, 2002b; Vázquez et al., 2019) From these attempts, two Spanish versions of the EPQ-RA have been proposed by Ibáñez et al. (1999) and Sandin et al. (2002a,2002b), with the general tendency to select the second version.

The version of the EPQ-RA proposed by Sandin et al. (2002a, 2002b) is an adaptation of the version of Francis et al. (1992). Following this approach, Sandin et al. (2002a) analyzed the structure of the EPQ-RA through principal component analyses using the data of 263 university students. These authors identified four dimensions of P, E, N, and L, but indicated low factor weights in the P dimension and thus poor identification of the dimension. To obtain a more robust structure, the authors replaced two items of P dimensions present in the original EPQ-RA with another two items of the EPQ based on theoretical criteria. Using this modified version, Sandin et al. (2002b) redid the analyses using the data of another 199 university students and obtained similar results. Regarding the reliability of the dimensions, they were only calculated for the slightly modified version, obtaining low to acceptable indexes ($\alpha_P = .63$; $\alpha_E = .74$; $\alpha_N = .78$; $\alpha_L = .54$).

Nevertheless, recent research has shown barely acceptable fitting of the model even when the P dimension was omitted (see García-González et al., 2021; Vázquez et al., 2019). These results are congruent with previous research, indicating the potential limitations of ignoring cultural influence on personality measurement. Different researchers have indicated that some of the original items considered appropriate in the United Kingdom were not appropriate in other contexts (Eysenck & Barrett, 2013), emphasizing the potential lack of cross-cultural invariance of the model (Dong & Dumas, 2020; McLarnon & Romero, 2020). Considering the potential cultural bias of the measurement instrument, Ibáñez et al. (1999) developed the Spanish version of the EPQ-RA from the EPQ-R, instead of adapting English EPQ-RA. Using the data of 1269 participants aged between 16 and 73 years and applying empirical (exploratory factor analysis and item discrimination) and theoretical (item content analysis) criteria, Ibáñez et al. (1999) proposed a 24-item (six per dimension) EPQ-RA from the Span-

ish EPQ-R (Ortet et al., 1999). This version has the same number of items, but it differed from the version proposed by Francis et al. (1992), adapted by Sandin et al. (2002a, 2002b), in the items composing each dimension: only 13 of the 24 are equal (one for P, three for E, four for N, and five for L). The authors obtained good reliability indexes for N ($\alpha = .77$), E ($\alpha = .83$), and L ($\alpha = .81$), higher than other studies for P ($\alpha = .62$) (e.g., Francis et al., 1992, 2006), and generally higher than Sandin et al. (2002a, 2002b).

1.2 Reconsidering the role of the lie dimension

The low reliability of the P dimension is not a unique problem related to the EPQs and their validation. Twenty-five percent of the items are oriented for measuring sincerity (Lie [L] scale) but not personality. The L scale has been traditionally ignored or questionably included in the PEN model. This scale was originally added not as part of the personality model but as a measure of the untrusty response style of the participants, as far as this dimension measures the tendency to participants to deceive (Eysenck & Eysenck, 1964) and thus as a social desirability measure. In this line, it has also been defined as a measure of symptom minimization (Bowden et al., 2018) At this point, a question about the place of the L scale inside the PEN model arises. It has sometimes been omitted when testing the model (e.g., Sato, 2005; Shevlin et al., 2002), and other times, it has been included as another dimension of the PEN model, creating a four-factor model (e.g., Colledani et al., 2019; Vázquez et al., 2019). Nevertheless, to the best of our knowledge, the L scale has not been used before as a control for testing the PEN model.

It is usual in applied research and clinical settings to use measures of potential bias responses such as social desirability. The purpose of the researchers is to know when the participants are responding sincerely and exclude the data of participants who give untrusty responses. In other cases, these kinds of measures are not used to exclude cases but to control the responses, and they are included as covariables. Undoubtedly, this point represents the limitations that are still present in the validation of the PEN model. As Bowden et al. (2018) pointed out, there is still the necessity to use modern factor analytic techniques for further validations of the instruments, which can include the consideration of covariables in the estimation of the PEN model.

1.3 The current research

The current research aimed to analyze the factor validity and reliability of the Spanish EPQ-RA proposed in the Spanish young-adult population. As mentioned above, the EPQ-RA proposed by Ibáñez et al. (1999) is unique and has taken into account the cultural influence in its development as far as it was developed from the EPQ-RA based on Spanish participants' responses. Nevertheless, the validity and reliability of this EPQ-RA version have been less studied due to the general tendency to use the version of Francis et al. (1992), adapted by Sandin et al. (2002a, 2002b) to the Spanish population. Unfortunately, the version proposed by them has shown significant limitations and did not show good psychometric properties (e.g., García-González et al., 2021; Vázquez et al., 2019), and the loss of inappropriate items has been a significant limitation due to the low number of items.

The current research also includes innovation in the analysis of the PEN measurement model by including the L scale as a covariable and thus controlling the effect of potential response bias instead of including it as the fourth personality dimension or even ignoring it. As mentioned above, the inclusion of the L scale implies a theoretical and practical problem. Although the dimension was originally thought of as a (in)sincerity measure, it has been included as the fourth personality trait. Nonetheless, it has also been proposed to omit it for the model considering that in case of necessity, other social desirability scales could be used with the EPQ (Sato, 2005). The inclusion of other sincerity indexes (e.g., social desirability) in applied research is made to control biased responses, so following this premise and the recommendation of Sato (2005), it was considered more appropriate to use the L scale for control proposals.

Considering all these limitations, the current research aimed to test the validity and reliability of an alternative version proposed by Ibáñez et al. (1999) through the following specific aims: (1) test the fitting of the two-correlated dimensions (N-E) and one orthogonal dimension (P) model, three-correlated dimensions model, and two-correlated dimension model (N-E) fitting to the data; (2) analyze the configural, metric, and scalar invariance of the best-fitted model across sexes (male-female); (3) estimate the reliability of the neuroticism, extraversion, psychoticism dimensions; and (4) examine the sex differences.

2. Method

2.1 Participants

The sample included 2962 young adult participants, aged 18 to 26 years old ($M = 19.63$, $SD = 1.77$). A total of 63.2% ($n = 1872$) were women and 36.8% ($n = 1090$) were men. The majority of participants perceived themselves as middle socioeconomic level 94.9% ($n = 2796$) and only 5.1% ($n = 150$) perceived belonging to the low (3%, $n = 89$) or high (2.1%, $n = 61$) socioeconomic levels. Participants belonged to five categories regarding their educational level: 39.7% ($n = 1171$) were university students, 16.9% ($n = 498$) were higher education students, 20% ($n = 591$) were vocational education and training students, 20.7% ($n = 612$) were GCE students, and 2.6% ($n = 78$) were students from GCSE.

2.2 Measures

The present study was conducted using the Spanish Abbreviated version of the Eysenck Personality Questionnaire-Revised (EPQ-RA; Ibáñez et al., 1999). This is a 24-item inventory consisting of four subscales of six items each. Three of these four subscales are personality dimensions: extraversion (E) —assess positive emotivity, sociability, spontaneity, vitality, and surgent—, neuroticism (N) —includes negative emotivity, anxiety, sensibility, concern, and self-awareness—, and psychoticism (P) —aggressive, impulsivity, low socialization, nonconformity, irresponsibility, and schizoids or antisocial behavior—. The fourth scale is the relative to Lie (L) to validate the test. The questionnaire was scored on a dichotomic response format of 0 (= No) and 1 (= Yes). The scores were summed to obtain the score of each dimension, which ranged from 0 to 6, indicating lower and higher levels of each personality trait.

2.3 Procedure

The data used in the current research are the product of a broader research project: authors were invited to take part in the study to previous collaborators of different Spanish provinces who shared the questionnaire in educational centers based in La Coruña, Pontevedra, and Principado de Asturias in the north and Huelva and Sevilla in the south. The final sample consists of data collected from educational centers that agreed to participate in the research. The study employed convenience sampling approach, as participants were selected based on their accessibility and willingness to take part in the research. Prior to data collection, all participants received comprehensive information about the research objectives and the assurance of data collection and analysis anonymity. Additionally, participants were explicitly informed of their right to withdraw from the study at any point without facing penalties or consequences. Before responding to the questionnaire, participants were required to provide informed consent for the use of their data in various research proposals.

2.4 Statistical Analyses

Confirmatory factor analysis (CFA) was carried out to test the fitting of different models to the data. First, the model proposed by Eysenck (1952) of three dimensions with neuroticism and extraversion correlated and psychoticism independent (model 1) was tested. Second, the generally tested model of four correlated factors, including the L scale (model 2), was tested. Third, an alternative model with the three dimensions correlated (model 3) was estimated. Fourth and finally, an alternative model of two correlated factors of neuroticism and extraversion (model 4) was tested. Models 1, 3 and 4 were estimated controlling for the L score, including it as a covariable. The χ^2 statistic, the comparative fit index (CFI $\geq .95$), and root mean square error of approximation (RMSEA $\leq .05$) and its 90% confidence interval (CI) were considered to test the assessment of the model to the data (Hu & Bentler, 1999). Once the best-fitting model was obtained, multiple-group analyses were carried out to assess the invariance of the model across sexes (male and female). Three invariance configurations were tested: configural, metric, and scalar. Configural invariance refers to the invariance of model form and means that the organization of the tested constructs is supported in both sexes. Metric invariance refers to the contribution of the items to the latent construct, and it is obtained if these contributions are similar in both sexes. Finally, scalar invariance means that differences in the latent construct capture all mean differences in the shared variance of the items. The $\Delta\chi^2$ test and its associated probability, ΔCFI ($< .010$) and ΔRMSEA ($< .015$), were considered to test the invariance across groups (Rutkowski & Svetina, 2017; Svetina et al., 2019). All estimations were carried out using the weighted least squares mean and variance adjusted (WLSMV) estimator with MPlus 8.6 software (Muthén & Muthén, 1998-2021). Theta parameterization for multigroup analysis was also used. Considering that when the item response scale is ordinal, the tendency of coefficients based on the covariance matrix to underestimate the real reliability was estimated based on the polychoric correlation matrix (Dueber, 2017; Elosua & Zumbo, 2008; Gadermann et al., 2012; Viladrich et al., 2017). Finally, the differences between males' and females' scores on P, E, and N were tested. Multivariate analysis of covariance (MANCOVA) included the L score as a covariable. Although the differences in the three dimensions are usually tested by using a series of t tests, the MANCOVA allows us to test multiple related independent variables, better controlling the type I error and better accounting for the related nature of the P, E, and N dimensions. Effect sizes were examined using partial eta squared (η_p^2), considering effect sizes between .01 and .059 small, between .60 and .13 medium and equal or higher than .14 large. The IBM SPSS 22 was used for these analyses.

3. Results

Confirmatory factor analysis of the measurement model. The results displayed in Table 1 show poor fitting for model 1 (P independent and E N correlated) and model 2 (four correlated factors) and barely acceptable fitting of model 3 (P E N correlated and L covariable) and model 4 (P E correlated and L covariable).

A deep analysis of the results revealed some particular and common potential modifications that could improve the model fitting. Regarding the common limitations of the models, item 5 did not significantly load on the E dimension in any model, and freely estimating the covariation among items 14 and 22 of the N dimensions would significantly improve the model. Addition-

Table 1

Fitting indexes of the 1 to 4 measurement models with L covariable

Model	$\chi^2(df)$	p	CFI	RMSEA [90% C.I.]
1. P independent and E N correlated	1114.705 (134)	$\leq .001$	.874	.050 [.047,.052]
2. P, E, N, and L correlated	2362.360 (149)	$\leq .001$	.802	.050 [.052,.056]
3. P, E, and N correlated	793.270 (132)	$\leq .001$	.915	.041 [.038,.044]
4. E N correlated	510.149 (53)	$\leq .001$	.933	.054 [.050,.058]

Note. Only 1, 3 and 4 included L as covariable. The fourth model included the L dimension as the fourth correlated dimension.

Table 2

Standardized effects of L on P, E, and N dimensions' items

	Covariable L		
Item	**Model 1**	**Model 3**	**Model 4**
P			
3	.010***	.010***	N/A
7	.032*	.032*	N/A
11	.003	.004	N/A
15	–.025	–.025	N/A
19	–.067***	–.067***	N/A
23	-.012	–.012	N/A
E			
1	.029	.029	.039
5	–.114***	–.114***	-.181***
9	.034	.034	.035
13	.050*	.050*	.057*
17	–.025	–.026	–.039
21	.019	.019	.017
N			
2	–.083***	–.083***	-.081***
6	–.083***	–.082***	-.095***
10	–.062***	–.062***	-.075***
14	–.020	–.020	–.028
18	–.035	–.035	–.037
22	–.045*	–.045*	–.057*

Table 3

Fitting indexes of the 1 to 4 modified measurement models

Model	$\chi^2(df)$	p	CFI	RMSEA [90% C.I.]
1.A. P independent and E N correlated	658.425 (88)	$\leq .001$	.924	.047 [.043,.050]
1.B. P / EN without L covariable	654.571 (88)	$\leq .001$	.924	.047 [.043,.050]
2. P, E, N, and L correlated	1170.354 (182)	$\leq .001$	.901	.043 [.040,.045]
3.A. P, E, and N correlated	280.178 (86)	$\leq .001$	.974	.028 [.024, .031]
3.B. PEN without L covariable	280.204 (86)	$\leq .001$	.974	.028 [.024,.031]
4.A. E N correlated	133.901 (42)	$\leq .001$	.986	.030 [.022,.032]
4.B. EN without L covariable	135.242 (42)	$\leq .001$	.986	.027 [.022,.033]

ally, item 15 showed extremely low factor loading ($< .10$) for the P dimension in models 1 to 3 (the P dimension was not present in model 4), 19 did not significantly load ($p > .05$) on the P dimension for models 2 and 3, and its factor weight was significant but extremely low ($< .10$) in model 1 (the P dimension was not present in model 4). Finally, the results of model 1 also show the necessity of considering the relation of P with N and E.

Table 4

Set of models to test configural, metric, and scalar invariance of models 3 and 4 across females and males omitting the L covariable

	$\chi^2(df)$	p	$\Delta\chi^2(\Delta df)$	p	CFI	ΔCFI	RMSEA (C.I.)	ΔRMSEA
Model 3 – PEN								
Configural	409.616 (172)	≤ .001	N/A	N/A	.968	N/A	.031 (.027,.034)	N/A
WOM	185.713							
MEN	223.902							
Metric	406.210 (185)	≤ .001	10.014 (13)	.693	.970	.002	.028 (.025,.032)	.003
WOM	182.212							
MEN	223.998							
Scalar	534.501	≤ .001	151.269 (12)	≤ .001	.954	.016	.034 (.031,.037)	.006
WOM	218.199							
MEN	273.899							
Model 4 – EN								
Configural	197.159 (84)	≤ .001	N/A	N/A	.983	N/A	.030 (.025,.036)	N/A
WOM	101.357							
MEN	95.802							
Metric	194.751 (94)	≤ .001	6.548 (10)	.767	.985	.002	.027 (.022,.032)	.003
WOM	98.351							
MEN	96.400							
Scalar	302.908 (103)	≤ .001	(9)	≤ .001	.970	.015	.036 (.036,.041)	.009
WOM	127.298							
MEN	139.444							

Note. $^*p \leq .05$; $^{**}p \leq .01$; $^{***}p \leq .001$.

The effects of the L covariable on the items for each model (except model 2, where L is the fourth dimension) are displayed in Table 2. As seen, there is no significant effect on all the items, but there are some items significantly affected by social desirability, with the N dimension being the more affected.

Considering the results obtained in the first analyses and the transversality through different models of the same limitations, items 5 (E), 15 (P) and 19 (P) were omitted, and the covariation between items 14 (N) and 22 (N) was freely estimated. Additionally, based on the poor effect of the L covariable, the models were also tested omitting the covariable. After the modifications, all the models improved their fitting to the data, but differentially. Model 1 still showed poor fitting to the data, while model 3 was equivalent to model 1, although including the correlation between the P dimension and the E and N dimensions showed good fitting to the data. Model 2 of the four correlated dimensions also improved. The fitting, however, was barely acceptable. Finally, model 4 of two correlated dimensions showed, as model 3, good fitting to the data.

Regarding the L covariable, the fitting of the models with and without the covariable L did not differ significantly, so the subsequent analyses were carried out considering the L covariable because of its significant effect on some items, but also omitting the L covariable due to the higher parsimony of the model. This decision was made considering the potential influence of social desirability bias on invariance.

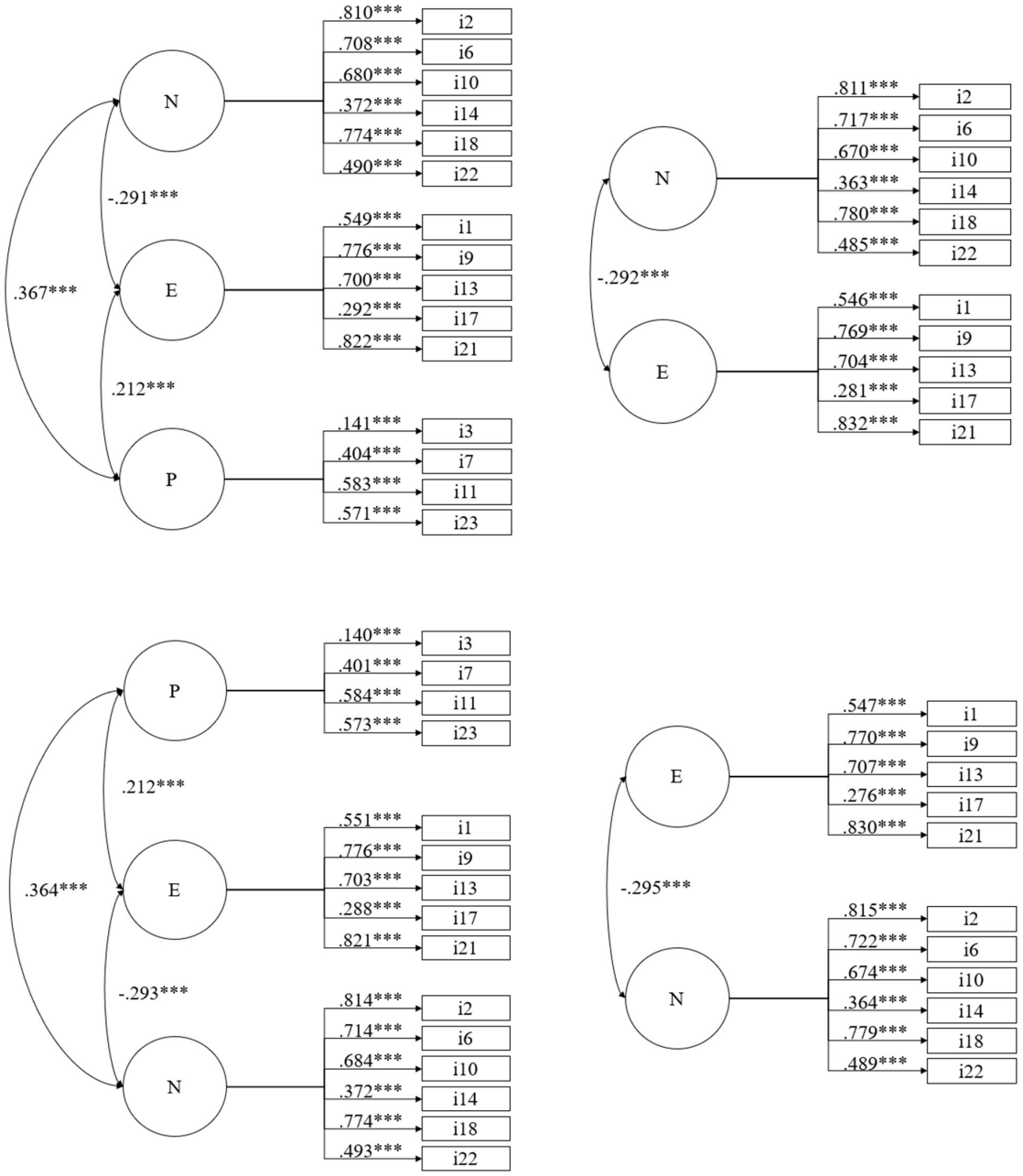
As seen, only models 3 (three correlated dimensions: P E N) and 4 (two correlated dimensions: E N) showed good fitting to the data. Considering previous results, only these two models were considered for further analyses. Standardized factor loadings of models 3 with (A) and without covariables (B) and 4 with (C) and without covariables (D) are displayed in Figure 1.

Sex invariance. After the best-fitting model was obtained for models 3 and 4, multigroup analyses were carried out to determine the configural, metric, and scalar invariance across sexes. Considering the higher parsimony of the models without covariables, the invariance of models B and D was tested first. As seen in Table 3, configural and metric invariance can be assumed in both models. In contrast, the scalar model seems to be significantly worse. Despite the practical fit indexes (CFI and RMSEA) indicating good fitting of the model to the data, the ΔCFI (> .010) indicates poor invariance across sexes for both models.

Table 4 shows goodness-of-fit indexes for the models and their differences from the baseline (configural) model. Contrary to previous findings omitting the co-

Figure 1

Standardized factor loadings for models 3 and 4 with and without covariable



Note. ***$p \leq .001$. The covariable (Figures A and C) and covariation between items 14 and 22 were omitted in the Figure for simplification.

variable, configural, metric, and scalar invariance can be assumed in both models. Configural and metric invariance are clear, and although the scalar model seems to be significantly worse, the practical fit indexes (CFI and RMSEA) were similar. Briefly, the differences in practical fit indexes were minimal: less than .01 for the CFI, which is considered the most severe criterion. In this regard, the EPQ-RA can be considered equivalent for females and males.

Finally, the reliability of the dimensions was estimated. The E ($\omega = .78$) and N ($\omega = .81$) dimensions showed good reliability, while the reliability of the L scale ($\omega = .69$) was barely acceptable, and the psychoticism dimension ($\omega = .48$) showed poor reliability. Differential analysis. The MANCOVA carried out revealed a small significant effect of the covariable L ($F(3, 2957) = 4.331$, $p = .005$; Wilk's $\lambda = .996$, $\eta^2 = .004$), but the ulterior ANCOVA indicated that it only significantly influ-

Table 5

Set of models to test configural, metric, and scalar invariance of models 3 and 4 across females and males considering the L covariable

	$\chi^2(df)$	p	$\Delta\chi^2(\Delta df)$	p	CFI	ΔCFI	RMSEA (C.I.)	ΔRMSEA
Model 3 – PEN								
Configural	439.619 (196)	≤ .001	N/A	N/A	.967	N/A	.029 (.025,.033)	N/A
WOM	201.227							
MEN	238.392							
Metric	446.407 (212)	≤ .001	21.381 (16)	.164	.968	.001	.027 (.024,.031)	.002
WOM	201.881							
MEN	244.526							
Scalar	492.098 (224)	≤ .001	60.992 (12)	≤ .001	.964	.004	.028(.025,.032)	.001
WOM	218.199							
MEN	273.899							
Model 4 – EN								
Configural	220.450***(102)	≤ .001	N/A	N/A	.982	N/A	.028 (.023,.033)	N/A
WOM	112.907							
MEN	107.543							
Metric	225.924 (114)	≤ .001	15.553 (12)	.213	.983	.001	.026 (.021,.031)	.002
WOM	112.737							
MEN	113.187							
Scalar	266.742 (123)	≤ .001	53.871 (9)	≤ .001	.978	.005	.028 (.023,.033)	.002
WOM	127.298							
MEN	139.444							

Note. $^*p \leq .05$; $^{**}p \leq .01$; $^{***}p \leq .001$.

enced N ($F(1) = 11.488$, $p \leq .001$; $\eta^2 = .004$). The MANCOVA also revealed statistically significant but small differences between females and males in P, E, and N at the multivariate level: $F(3, 2957) = 37.050$, $p \leq .001$; Wilk's $\lambda = .964$, $\eta^2 = .036$. The results of the ANCOVA for each of the three dimensions are presented in Table 6. Males showed higher levels of P than females, but the difference was small ($\eta^2 < .06$). In contrast, females showed higher levels of N than males, and the difference was also small ($\eta^2 < .06$). No significant difference was found in the extraversion dimension.

Discussion

The current research aimed to test the psychometric properties of the Spanish EPQ-RA version proposed by Ibáñez et al. (1999) by testing two classic (Eysenck's original PEN model and four correlated dimensions model) and two alternative models, involving an innovative approach, which included L scale as a control for testing three correlated dimensions PEN model and two correlated dimension E – N model. To achieve this aim, a total of 2962 Spanish young adults were used.

Overall, the Spanish version of the EPQ-RA proposed by Ibáñez et al. (1999) shows more promising psychometric properties than the adaptation made by Sandin et al. (2002a, 2002b). Unfortunately, this version is free from limitations previously recognized in the literature. Regarding the measurement models tested in the current research, the results are congruent with previous research. Of the four models tested, one showed poor fitting, one showed barely acceptable fitting, and two showed good fitting to the data. As expected, the original model of two correlated dimensions (E – N) and one orthogonal dimension (P), as originally proposed by Eysenck, had the same limitations as the rest of the models with the additional gap of nonconsidered relation between the three dimensions (including P). As seen in model 2 (four correlated factors PEN-L) and model 3 (PEN model with L as covariable), when the correlation of the P dimension with the other dimensions was included, the fitting of the model improved. Nonetheless, only the PEN model with covariable L showed good fitting to the data.

Congruent with previous research (García-González, 2021; Vázquez et al., 2019) using the Spanish adaptation made by Sandin et al. (2002a, 2002b), the four correlated dimensions PEN-L model only showed barely acceptable fitting to the data. These results support the lack of appropriateness of the four-dimension PEN-L model congruent with the proposal made in the current research —do not include the L dimension or social desirability as the fourth personality trait, but as con-

Table 6

Descriptive statistics and ANOVAs of neuroticism, extraversion, and psychoticism scores across sexes

	Females ($n = 1872$)	**Males** ($n = 1090$)	F	p	η_p^2
Psychoticism			29.873	$\leq .001$	.010
M	1.65	1.89			
SD	1.13	1.09			
Extraversion			2.109	.147	.001
M	3.20	3.28			
SD	1.43	1.34			
Neuroticism			58.242	$\leq .001$	.019
M	2.61	2.06			
SD	1.83	1.73			

trol variable— especially considering the same results were obtained with two different versions of the Spanish EPQ-RA. Nevertheless, there are some differences between the results obtained with the version of Sandin et al. (2002a, 2002b), García-Gozález et al. (2021) and Vázquez et al. (2019). In the previous research, the authors found the reason for the weak fitting of the model in the P dimension, opting for (1) omitting four of the six items of the P dimension (García-González et al., 2021) or (2) omitting the entire P dimension for testing a three-dimensional ENL model (Vázquez et al., 2019). Unfortunately, these two alternatives present empirical and theoretical limitations. First, by using a two-item dimension, García-González et al. (2021) oversaturated the P dimension, with the lowest number of items recommended per dimension four. Second, the proposal of a three-dimensional ENL model proposed by Vázquez et al. (2019) implies theoretical limitations regarding the interpretability of the model as long as the L dimension is not originally a personality trait in the same way as the P, E, and N dimensions (Sandin et al., 2002a, 2002b; Sato, 2005). Furthermore, the results obtained here differ significantly from those obtained in the previous research in the Spanish context because of the higher robustness of the P dimension. This difference also supports the necessity of taking into account the cultural influence of the measurement instruments. As pointed out by Dong and Dumas (2020) and McLarnon & Romero (2020), the cross-cultural invariance of personality models is still questionable, which limits the comparison across countries, but also makes it necessary to consider the potential differences in brief version because of the differential appropriateness of items across countries (see Eysenck & Barrett, 2013). These previous findings are congruent and can explain the differences found with different Spanish versions of the EPQ-RA, considering that the version of Sandin et al. (2002a, 2002b) is a Spanish translation of the English version proposed by Francis et al. (1992), while Ibáñez et al. (1999) proposed an EPQ-RA version developed from the largest version EPQ-R in the Spanish context and, thus, taking into account the potential influence of the context. These findings support that personality could not be invariant across cultures and the necessity of developing measures considering context influence (Dong & Dumas, 2020; Ibáñez et al., 1999; McLarnon & Romero, 2020; van Hermet et al., 2002).

In this regard, there was no empirical or theoretical reason *a priori* for omitting the entire P dimension. Following this theoretical approach and based on previous empirical results, the three-dimensional PEN model with the covariable L was tested and showed good fitting of the model to the data supporting this proposal. The PEN model with L as a covariable is theoretically congruent and includes the control of social desirability, as it was originally thought and usually included in the applied research (e.g., MANCOVA instead of MANOVA). Despite the results obtained here showing a more robust P dimension compared to previous research (see García-González et al., 2021; Vázquez et al., 2019), it is not free from limitations. As seen, only three of the six items of the P dimension showed appropriate factorial weight ($> .30$), while one (item 3) showed poor ($> .10$). However, significant weight and two items (15 and 19) must be omitted due to lack of significance and extremely low ($< .10$) factorial weight. Considering the factorial weights, it would be reasonable to omit item 3, despite it significantly loaded in the P dimension. Nevertheless, omitting an additional item would make the P dimension oversaturated (three items), biasing the results of the model. Considering this limitation of the P dimension and problems found in previous research, it was considered more appropriate to test an alternative two-dimensional EN model with a covariable L that showed the best fitting of the model to the data. This is also supported by the reliabilities of the dimensions. As in previous research (e.g., Alexopoulos & Kalaitzidis 2004; Almiro & Ferreira, 2020; Almiro et al., 2016; Forrest et al., 2000; Francis et al., 1992, 2006; Karanci et al., 2007; Sato et al., 2005; Vázquez et al., 2019), only the E and N dimensions obtained good reliabilities, while the P dimension was poorly reliable. The better performance

of the two-dimensional EN model and the poor indexes of the P dimension confirmed that the most relevant problem of the PEN model is the P dimension. These findings support the necessity of improving psychoticism measures by developing new items or even reviewing the definition of the construct (Kneževic et al., 2019), which is determinant for appropriate measures development.

The analysis of the covariable also showed relevant results for future research. As seen, some items of the EPQ-RA were significantly influenced by social desirability, but others did not. Following the general tendency, considering that the fitting of the model did not differ with and without the covariable, the more parsimonious model (without covariable) should be chosen. Nevertheless, to guarantee that the influence of covariables could be insignificant in ulterior invariance analyses, both options were tested. From this approach, and as far as the invariance of the personality measurement model across groups is a requisite for considering the model appropriate, and taking into account that models 3 and 4 showed good fitting, their sex invariance was tested including and omitting the covariable L. Contrary to the previous findings on model fitting, different results were obtained when the invariance of the models was tested, including or omitting the covariable. While the covariable was omitted from the model, only the configural and metric invariance of the three-dimensional PEN model and two-dimensional EN model was supported. In contrast, configural, metric, and scalar invariance was confirmed when social desirability was controlled. These results are almost in part congruent with previous research. Dong and Dumas (2020) showed in their review of personality measure studies that the majority of the researchers found at least metric invariance across sexes, but less than half (44.83%) reached scalar invariance. More specifically, two of the reviewed studies analyzed the measurement invariance of PEN model-based questionnaires using CFA. In the first one, carried out by Picconi et al. (2018), the Eysenck Personality Profiler Short was used, including only P, E, and N dimensions, and partial scalar invariance was found. In the second study, carried out by Bowden et al. (2018), the Eysenck Personality Questionnaire was used, including P, E, N and L dimensions, and partial scalar invariance was demonstrated. As in the current research, the traditional approaches of PEN measurement model testing only allow the confirmation of complete metric invariances across sexes.

On the contrary, complete scalar invariance was also reached in the current study when the effect of social desirability on participants' responses was controlled, opening an alternative for future research. This result has important implications not for model fitting testing but for comparison across sexes. As seen, the model showed good fitting to the data, even though social desirability was not controlled, but the appropriateness of the scale to precisely compare males' and females' scores on P, E, and N was conditioned by social desirability control. Contrary to previous research, this finding supports the main proposal made in the current research of including the L scale as a covariable to control the potential biased responses, instead of including it as the fourth dimension or omitting it from the model.

Finally, differential analyses were carried out. Contrary to previous research where multiple t tests were generally used for this analysis (see, for example, Alexopoulos & Kalaitzidis, 2004; Almiro & Ferreira, 2020; Almiro et al., 2016; Colledani et al.; 2018; Cruise et al., 2007; Francis et al., 2006; García-González, 2021; Lewis et al., 2002; Picconi et al., 2018; Sandin et al., 2002b; Sato et al., 2005; Vázquez et al., 2019), MANCOVA analyses were carried out in the current research to avoid increasing the type I error derived from multiple comparisons made by multiple univariate analyses. The results obtained here revealed a significant effect of social desirability (covariable) on N but not on P and E. This analysis also revealed significantly higher levels of P in men and N in women, but the difference was small in both cases. These results are congruent with some previous results but not with others because of the mixture shown in previous research on the intersexual differences on P, E, and N. For example, using Spanish sample, García-González et al. (2021) also found that men scored significantly higher on P and lower on N while Vázquez et al. (2019) only found significantly higher levels of N on women and Sandin et al. (2002b) did not find significant differences on P, E, nor N dimensions' scores. Nonetheless, the mixture of results is not specific to the Spanish context and can be found in other contexts even with longer versions of the questionnaire (e.g., EPQ-R).

In some cases, previous research is congruent with the results obtained by García-González (2021) and the ones obtained here (e.g., Almiro et al., 2016), but in other cases, only partial congruence was found, as in the Spanish context. For example, Alcázar-Córcoles et al. (2017), Almiro et al. (2020), and Sato (Sato, 2005) only found significantly higher levels of N in women. In contrast, Cruise et al. (Cruise et al., 2007) and Forrest (2000) did not show significant differences in N, but observed that men scored significantly higher on P and lower on E than women.

Finally, some researchers have found significant differences in P, E and N, while others did not find differences across sexes. For example, Alexopoulos and Kalaitzidis (2004) found that women scored significantly lower than men on P and higher on N, as in the current research, but they also detected that women scored significantly higher on E. Similarly, Shevlin et al. (2002) showed significant differences between males and females on P (higher for males), E (higher for males), and N (higher for females), but the differences on P and N were due to sex roles (masculinity-femineity) and dif-

ferences on E (higher for males) due to sex roles and biological sex. Using the Eysenck Personality Profiler Short (EPP-S), Picconi et al. (2018) found similar results: men scored significantly higher on P and lower on N, but in this case, men also scored significantly higher on E. In contrast, Bouvard et al. (2010) and Karanci et al. (2007) did not find significant differences in P, E, or N across sexes. The mixed results obtained to date do not allow us to effectively conclude that the same differences across sexes are present in all the samples, and more research is still required considering alternative models (e.g., L dimension as covariable). Nonetheless, the invariance observed in the current research does not support the idea of the sexual-biased items hypothesis proposed in previous research (e.g., Francis, 1992; Lajunen, 2018), which seems to be different among distinct contexts (Lajunen, 2018), explaining the lack of sex bias in the Spanish context.

4. Strengths and limitations

The current research presents different strengths and limitations. The strengths of the current research include the innovation in the model testing and the sample. The proposal made here of including the L scale as a control and not as a personality trait represents innovation and improvement in the PEN model estimation by being more faithful to the original theory. To the best of our knowledge, the model has not been previously tested, including the L dimension, as it was thought to control biased responses due to social desirability. In contrast, it has been generally omitted or controversially included as the fourth personality dimension. The sample size is significantly larger than the samples used in previous research on the PEN model in the Spanish context, permitting more accurate estimations of the model due to the requirements of the technique. Although the sample used in the current research is also an improvement compared to previous research, it is important to note that it is not representative, and generalizations must be done cautiously.

5. Conclusion

Currently, Eysenck's work continues eliciting investigation and monographic numbers (Bowden et al., 2018; Revelle, 2016), and it has become an instrument widely used in research as a measure of personality in different populations (Abdel-Khalek, 2013; Abad & Forns, 2008; Hurlburt et al., 1982). Its relevance makes it necessary to investigate the validity of the model to ensure the precise evaluation of personality across different populations. Considering the results obtained here, where the PEN and EN models with L as a covariable resulted in valid models to test and compare personality across sexes, the two correlated dimension model has been shown to be more appropriate considering that it shows the best fitting to the data and its higher parsimony. Undoubtedly, the limitations of the three correlated dimension model are inherent to the limitations of the P dimension. Based on previous and current findings, the inclusion of social desirability control and improving the items or even the definition of the psychoticism construct seem to be prudent recommendations, because if the major problem of personality is its measurement (Revelle, 2016), the basis for good item development is a precise conceptualization.

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Brief Version of the Revised-Abbreviated Eysenck Personality Questionnaire in a Spanish Young Adult Population
Versión breve del Cuestionario Revisado y Abreviado de Personalidad de Eysenck en una población de jóvenes adultos españoles

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