Is it time to replace the Big Five personality model? Factorial structure of the NEO PI-R in a community sample of Spanish adults

Ana Sanz-García

María Paz García-Vera

Jesús Sanz

Universidad Complutense de Madrid

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Correspondence address:

Jesús Sanz. Departamento de Personalidad, Evaluación y Psicología Clínica, Facultad de Psicología, Universidad Complutense de Madrid, Campus de Somosaguas, 28223 Madrid, Spain (jsanz@psi.ucm.es)

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Abstract

Recent studies have revived the issue of whether the five-factor personality model or Big Five is the most valid to summarize the most relevant personality traits or whether, on the contrary, the basic structure of personality traits would better fit a six-factor model such as the HEXACO model: Honesty–Humility (H), Emotionality (E), Extraversion (X), Agreeableness (A), Conscientiousness (C), and Openness to Experience (O). In a Spanish community sample of 682 adults, the factorial structure of the 30 facets of the NEO-Revised Personality Inventory (NEO PI-R) and its 16 facets common to the HEXACO model was analyzed. In two subsamples of participants, the internal structure of the NEO PI-R, of 30 and 16 facets, fit the five-factor Big Five model better than the six-factor HEXACO model. In addition, the internal 30-facet structure of the NEO-PI-R replicated that obtained in the original US validation and those previously obtained in Spain, although the latter used different participant samples (people evaluated in personnel selection processes, university students). These results suggest that, at least in Spain, the five-factor personality model or Big Five is still the most valid taxonomy of personality traits.

Key words: personality traits, five-factor model, Big Five model, HEXACO model, validity, factor analysis.

Is it time to replace the Big Five personality model? Factorial structure of the NEO PI-R in a community sample of Spanish adults

Since the late 90s of the last century, the five-factor model of personality or Big Five model has emerged as the most valid, accepted and used taxonomy of personality traits (John, 2021; McCrae, 2020). According to this model, most of the relevant personality traits can be hierarchically organized in terms of five broad dimensions of personality: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. The Big Five model has been found with different populations and instruments in different languages and countries (John, 2021; McCrae, 2020; Sanz et al., 2008).

Costa and McCrae (1985) developed one of the first personality questionnaires specifically designed to assess the Big Five, the NEO Personality Inventory. This instrument, in its revised version or NEO PI-R (Costa & McCrae, 1992), has become, together with its abridged version (NEO-FFI) and its subsequent revisions (NEO-FFI-R, NEO-FFI-3 and NEO-PI-3), the standard for the evaluation of the five-factor model (Costa & McCrae, 2009; Sanz et al., 1999). In fact, the thousands of published studies that have used the NEO PI-R are one of the most important sources of evidence supporting the validity of the five-factor model, including studies that have analyzed the instrument's internal structure.

The NEO PI-R provides a measure of each of the five basic personality dimensions of the Big Five, and it also measures 30 specific traits or facets that, according to Costa and McCrae (1992), make up those five dimensions, six facets for each dimension. Therefore, the fact that factor analyses of the NEO PI-R facets in adult samples have generally resulted in a five-factor solution and that these factors are defined by the six facets that theoretically correspond to each dimension constitutes one of the strongest validity points of the Big Five model. This is especially so when this five-factor structure was found in adults from more than 50 countries, both with self-reports (McCrae et al., 1998; Rolland, 2002) and observer

ratings (McCrae et al., 2005).

In Spain, for example, the internal structure of the Spanish version of the NEO PI-R in adults has been analyzed in a sample of 2000 people evaluated in personnel selection processes (Costa & McCrae, 1999) and in a sample of 1679 volunteers, mostly (63%) university students (Aluja et al., 2008), including those who participated in the study of Aluja et al. (2005). After extracting five factors from the correlation matrix of the 30 facets of the NEO PI-R and rotating them orthogonally with the varimax procedure, the five-factor solutions obtained in both adult samples adequately reflected the Big Five model underlying the instrument. Moreover, they were very similar to each other and to the original structure of the NEO PI-R found in the US normative sample (Costa & McCrae, 1999; Aluja et al., 2008).

Despite the high level of consensus, use and validity of the Big Five model, in recent years, the criticisms that already appeared in the 1990s have revived, arguing that the model leaves out important personality traits, consequently, proposing models that added more basic personality dimensions to the five contemplated in the Big Five (Ashton et al., 2014; Feher & Vernon, 2021; John, 2021; McCrae, 2020). Among these alternative models, the one proposed by Ashton and Lee (2001; Lee & Ashton, 2004), known as HEXACO, is notable because it is being used increasingly more in personality research (Ashton et al., 2014; Feher & Vernon, 2021). This model proposes six basic personality dimensions instead of five; three of them —extraversion (X), conscientiousness (C), and openness to experience (O)— are similar to their Big Five counterparts; two other dimensions —emotionality (E) and agreeableness (A)— can be considered variants of the neuroticism and agreeableness rotation of the Big Five, and the sixth dimension —honesty-humility (H)— represents an important novelty from the Big Five model, as it supposedly captures important personality variance that is not represented in the Big Five by reflecting individual differences in the tendency to sincerity, fairness, greed avoidance, and modesty. The HEXACO model emerged from the

results of lexical studies on personality structure conducted in at least a dozen languages, which indicated that six dimensions, not five, better summarized the personality lexicon of those languages (Ashton & Lee, 2001; Ashton et al., 2014; Lee & Ashton, 2008). In order to operationalize this model, Lee and Ashton (2004) developed the HEXACO Personality Inventory or HEXACO-PI, whose revised version, the HEXACO-PI-R (Lee & Ashton, 2018), provides measurements of the six dimensions and also of 24 facets, four per dimension, which make up these dimensions according to the model. Of these 24 facets, 16 reflect stable and consistent patterns of behaviour similar to those collected by 16 of the 30 facets of the NEO PI-R, as shown in Table 1.

Table 1

Given that in the factor analyses of most of the studies analyzing the internal structure of the NEO PI-R in adults, including the aforementioned studies carried out with the two samples of Spanish adults (Aluja et al., 2008; Costa & McCrae, 1999), only five factors have been extracted, not six, so this structure may also be suitable for the HEXACO model. Therefore, it may include a sixth factor that corresponds to the dimension of honesty-humility. Precisely, the analysis of this possibility was the main objective of the present study. For this purpose, the internal structure of NEO PI-R was examined in a sample of adults from the general Spanish population through factor analysis. These analyses were performed both on the correlations of the 30 facets of the NEO PI-R and on the correlations of the NEO-PI-R 16 facets that are similar to 16 of the 24 facets of the HEXACO model measured by the HEXACO-PI-R (see Table 1). Secondarily, a second objective of the present study was to obtain evidence of the validity of the NEO PI-R in Spain concerning its internal structure in adults. There are only three studies of this with two different samples (Costa & McCrae, 1999; Aluja et al., 2005, 2008), but none with a sample composed exclusively of

people from the general population evaluated under the same conditions of voluntariness and confidentiality as the US normative sample of the original NEO PI-R.

Method

Participants

We reanalyzed data of a previous study aimed to provide norms and internal consistency indeces for the NEO PI-R from a community sample of the general Spanish population (Sanz & García-Vera, 2009). There were 292 males and 390 females in the sample, with a mean age of 41.2 years (range = 18-84 years; *SD* = 14.8). The sample was recruited in 2002-2004 using the snowball technique. Psychology undergraduates invited their friends and relatives to voluntarily participate in a study on personality assessment (*n* = 325) or another study on personality and hypertension (*n* = 358), but the Psychology undergraduates themselves were not part of the samples of these two studies nor, consequently, of the present study. Although this sample was not random, it was heterogeneous in sex, age, educational level, marital status, and profession (see Sanz & García-Vera, 2009). For example, 45.3% of the participants had university studes, 30.2% had secondary education, and 22.1% had primary education, and, in terms of sex and age, the profile of this sample was very similar to that of the Spanish adult population in 2004 (see Table 2).

Table 2

Instruments and Variables

The Revised NEO Personality Inventory (NEO PI-R; Costa & McCrae, 1992). The NEO PI-R is a 240-item self-reporting inventory developed to assess the Big Five model. Responses are made on 5-point Likert-type scales scoring from 0 to 4. The NEO PI-R has five 48-item scales to measure the broad dimensions of the Big Five, and 30 8-item scales to

measure the facets or narrower personality traits that, according to Costa and McCrae (1992), make up the Big Five (six facets for each dimension). We used the Spanish adaptation of the NEO PI-R (Costa & McCrae, 1999). In the participant sample of this study, according to the reliability criteria proposed by Hernández et al. (2016), excellent internal consistency coefficients were obtained for the five dimension scales ($r \geq 0.85$), whereas good ($0.80 \leq r < 0.85$; one scale) or appropriate ($0.70 \leq r < 0.80$; 12 scales) internal consistency coefficients were obtained for 13 of the facet scales. The scores from 12 other facet scales obtained adequate coefficients, albeit with some lacks ($0.60 \leq r < 0.70$), but the remaining five facet scales showed inadequate coefficients ($r < 0.60$). Hence, caution is necessary when considering results related to these last five facet scales: the impulsiveness, actions, values, tender-mindedness, and competence scales.

Procedure

All participants signed an informed consent form before completing the NEO PI-R. In the personality and hypertension research, participants filled out other personality questionnaires, with the NEO PI-R as the first, while in the personality assessment research, participants only completed the NEO PI-R. In both investigations, the NEO PI-R was applied individually by the Psychology undergraduate who had invited the participant to collaborate in one of those two investigations. The Psychology undergraduates were trained and supervised in the administration of the NEO PI-R by the last two authors of this study during practical classes or seminars.

Data Analysis

The factor analytic research on the NEO PI-R suggests that the Big Five model has been supported by exploratory factor analysis techniques but not by confirmatory factor analysis (CFA) techniques (e.g., McCrae et al., 1996; Gignac, 2009; see Gignac et al., 2007, for a review). This is not surprising since the structure of personality traits is complex and

difficult to model in terms of restrictive hypotheses typical of CFA (McCrae et al., 1996; Ferrando, 2021). The main problem with CFA is that personality scales are purposely complex in item content and personality trait scales usually never correlate with only one personality dimension or with personality traits from only one personality dimension. In fact, when CFAs were performed with AMOS v. 27.0 using the total sample of participants of this study, their results revealed goodness-of-fit indices that were far from an acceptable standard for both the Big Five model with the 30 NEO-PI-R scales (GFI = .620, CFI = .524, RMSEA = .123) and the Big Five and the HEXACO models with the 16 NEO-PI-R scales common to the HEXACO model (respectively, GFI = .750, CFI = .567, RMSEA = .142, and GFI = .713, CFI = .484, RMSEA = .155). Therefore, in the present study, semiconfirmatory factor analyses were performed since, in this type of factor analysis, all factor loads are estimated, but the fit of different factor solutions is assessed with the goodness-of-fit indices that are common in CFA (Ferrando, 2021).

First, a semiconfirmatory factor analysis was performed on the scores in the 30 facets or subscales of the NEO PI-R of a first subsample (subsample 1; n = 321) of 50% of the cases of the total sample obtained by the SOLOMON method (Lorenzo-Seva, 2022) carried out with the FACTOR program, v. 12.01.02 (Ferrando & Lorenzo-Seva, 2017). A second subsample with the remaining cases was used for cross-validation (subsample 2; n = 341). The SOLOMON method provides two subsamples that comprise, equally, all the sources of variance that operate in the total sample. This equivalence is reflected in a ratio index of communality (S), which, if close to 1, indicates that the two subsamples have a similar amount of common variance. In this case, the S index was 0.998, indicating that the two subsamples were equivalent.

For the factor analysis, we followed the recommendations proposed by Ferrando and Anguiano-Carrasco (2010; Ferrando, 2021) and Lloret-Segura et al. (2014). Thus, as all the

facets or subscales of the NEO PI-R presented, in both subsamples, kurtosis and asymmetry values within the range of values that are considered indicative of a normal distribution of scores (± 1), the factor analysis was performed on the matrix of Pearson correlations. To analyze the adequacy of this matrix to facor analysis, the Kaiser-Meyer-Olkin (KMO) test and the Bartlett sphericity test were calculated.

To determine the number of factor to retain, the following five procedures were used: Cattell's scree test, Hull's method, Schwartz's Bayesian Information Criterion (BIC), classical parallel analysis, and optimal parallel analysis. We extracted as many factors as were recommended by most of these procedures, including the five- and six-factor solutions—if these solutions were not recommended—to contrast the proposals of the Big Five and HEXACO models. For factor extraction, we used the estimation method of unweighted least squares (ULS).

The following goodness-of-fit indices were calculated for these factorial solutions (with the corresponding criteria for an appropriate fit) (West et al., 2012): 1) χ^2/df (≤ 5); 2) goodness of fit index or GFI ($\geq .95$); 3) Bentler comparative fit index or CFI ($\geq .95$); 4) non-normed fit index or NNFI ($\geq .95$); 5) root mean square error of approximation or RMSEA ($\leq .08$); and 6) weighted root mean square residual or WRMR ($< .90$). In addition, the BIC was calculated for each factorial solution. The BIC assesses the possibility of overfactoring by introducing a penalty term for the number of factors in the solution. Among a set of solutions showing good goodness-of-fit indices, solutions with lower BIC are generally preferred.

The results of these indices were assessed in the context of the psychological interpretation of the factorial loading matrix of the different factorial solutions, which was rotated through a varimax orthogonal procedure. For the psychological interpretation, we considered the content of the defining items, that is, the items that in these matrices presented factorial weights $\geq .40$ in one factor and lower weights in the rest.

The factor structure of the NEO PI-R was validated by a factor analysis performed on the replication subsample (subsample 2) with the same procedures and criteria as the previous one. To quantify the degree of convergence between the factorial solutions obtained in the two subsamples, we performed procrustes rotations of the factorial solutions obtained in subsample 2 in relation to the factorial solutions of subsample 1. Further, we calculated Tucker's factorial congruence coefficient *C* between the solutions obtained in both subsamples. *C*-values of .85 – .94 were considered to indicate that the two factor solutions are similar and, at values of ≥ .95, they are virtually identical (Lorenzo-Seva & ten Berge, 2006).

Procrustes rotations were also performed, and Tucker's factorial congruence coefficients *C* were calculated to examine the degree of convergence of the factorial solutions found in the two subsamples of the present study with the five-factor factorial solutions of the normative sample of the original US version of the NEO PI-R (Costa & McCrae, 1992), the normative sample of personnel selection of the Spanish adaptation of the NEO PI-R by TEA (Costa & McCrae, 1999) and the mixed university students-general population sample of the Spanish version of the NEO PI-R of Aluja and his research group (Aluja et al., 2008).

Finally, using the same procedures and indices discussed above, factor analyses were also performed on the scores in the 16 facets of the NEO PI-R that are common to the HEXACO model.

Results

Internal Structure of the NEO PI-R

In the two subsamples of participants, the Pearson's correlation matrices between all facets of the NEO PI-R were suitable for factor analysis, since the results of Bartlett's sphericity tests were both statistically significant at $p < .0001$ (3789.7 for both subsamples) and the KMOs were both good (.849 and .851).

The results of the five factor determination procedures suggested four- or five-factor

solutions, although the five-factor solution was indicated by four of the five indices both in subsample 1 and subsample 2 (see Table 3 and Figure 1). Consequently, five factors were extracted in each subsample. In addition, in line with the proposals of the HEXACO model, six factors were extracted to compare their goodness of fit indices and their psychological interpretation concerning the Big Five and HEXACO models.

Table 3

Figure 1

The goodness-of-fit indices of the five- and six-factor solutions for each subsample are shown in Table 4. In both subsamples, both solutions had good indices, as all general fit indices obtained acceptable or good values. However, the five-factor solutions showed lower BIC than did the six-factor solutions (see Table 4).

Table 4

The rotated factor loading matrices of the five-factor solutions consistently indicated in the two subsamples that the five factors corresponded to the Big Five, because most facets of the NEO PI-R (28 of the 30 facets) had factor loadings greater than .40 on their corresponding factor according to the Big Five model (Table 5). In addition, most facets (24 out of 30) did not have secondary factor loadings greater than .40 in other factors and, of the six that did, in two of them, those secondary factorial loadings were lower than the factorial loadings on the corresponding factor (Table 5). The exceptions to this general pattern of factor loadings were the facets of assertiveness and excitement-seeking. Although these facets presented factor loadings greater than .30 on the corresponding factor—extraversion—, those loadings did not exceed the value of .40 and they also had loadings greater than .40 on

other factors, specifically, on the agreeableness factor, in the case of assertiveness and excitement-seeking in subsample 1, and on the neuroticism factor, in the case of assertiveness in subsample 2.

Table 5

As would be expected from this general consistent pattern of factor loadings in the two subsamples, the congruence coefficients obtained suggested that the five-factor solutions were practically the same in both subsamples of the general Spanish population because, as can be seen in Table 6, both the overall congruence coefficient (*C* = .98) and the congruence coefficients for each of the factors (*C* = .978 – .982) exceeded the standard, indicating that all five factors are identical in the two subsamples. Moreover, the five-factor solutions obtained in the two subsamples of this study were practically the same as the five-factor solutions of the US normative sample, the Spanish normative sample (Costa & McCrae, 1992) obtained in personnel selection processes (Costa & McCrae, 1999), and the combined sample of university students and adults of the general population of Aluja et al. (2008). In all but two comparisons, both the overall consistency coefficient (*C* = .957– .977) and the congruence coefficients for each of the factors (*C* = .961 – .985) exceeded the standard, indicating that all five factors are identical in all the samples mentioned. In comparisons that did not reach that standard, in particular, some of the congruence coefficients of the comparisons of subsamples 1 or 2 with the Spanish normative personnel selection sample, the coefficients of congruence (*C* = .932–.949) far exceeded the standard that indicates that the five factors are similar, and were close to the standard, indicating that all five factors are identical (Table 6).

Tabla 6

On the other hand, the rotated factor loading matrices of the six-factor solutions

indicated, consistently in the two subsamples, that four of the six factors corresponded to the dimensions of openness, conscientiousness, neuroticism and agreeableness of the Big Five, as most of their facets in the NEO PI-R (23 of the 24 facets) had factor loadings greater than .40 on their corresponding factor according to the Big Five model. In addition, most of these facets (18 of 24) did not have secondary factor loadings greater than .40 on other factors and, of the six that did, in two of them, those secondary factor loadings were lower than the factor loadings on the corresponding factor (Table 7).

Table 7

Of the remaining two factors, one appeared to correspond to the extraversion dimension of the Big Five, although only three of the six extraversion facets in the NEO PI-R consistently showed factor loadings greater than .40 on that factor in the two subsamples. The other factor was defined by facets—with factor loadings greater than .40—of various dimensions of the Big Five and HEXACO models, mainly angry hostility and impulsiveness from neuroticism and activity from extraversion, but also deliberation from conscientiousness and compliance from agreeableness. However, in the case of deliberation and compliance, their factor loadings were lower than those obtained on the factors of conscientiousness and agreeableness, respectively (Table 7). In any case, neither of these two factors reflected the dimension of honesty-humility of the HEXACO model because the facets of straightforwardness, dutifulness, and modesty of the NEO PI-R—which resemble the facets of sincerity, fairness and modesty, respectively, of the HEXACO-PI-R— did not show factor loadings greater than .30 on those two factors in either of the two subsamples. In contrast, in both subsamples, straightforwardness, dutifulness, and modesty obtained factor loadings greater than .61 on the factors of agreeableness (straightforwardness and modesty) and conscientiousness (dutifulness).

In summary, from the point of view of its psychological interpretation, the five-factor solution, which corresponded to the dimensions of the Big Five, seemed the most appropriate, corroborating its good or adequate goodness-of-fit indices and its high factorial congruence with the five-factor solutions obtained in US and Spanish normative samples.

Internal Structure of the NEO PI-R Facets Common to the HEXACO Model

The Pearson's correlation matrices between the facets of the NEO PI-R common to the HEXACO model were suitable for factor analysis for the two subsamples of participants, since the results of Bartlett's sphericity tests were 1810.1 and 1990.6, both at $p < .0001$, and the KMOs were both adequate (.716 and .710).

The results of the five factor-determination procedures suggested four- or five-factor solutions, although the five-factor solution was indicated by four of the five indices both in subsample 1 and subsample 2 (Table 8 and Figure 2). Consequently, five factors were extracted in each subsample and, in addition, in line with the proposals of the HEXACO model, six factors were extracted to compare their goodness of fit indices and their psychological interpretation in the Big Five and HEXACO models.

Table 8

Figure 2

The goodness-of-fit indices of the five- and six-factor solutions for each subsample are shown in Table 9. In both subsamples, both solutions had good indices, as all general fit indices obtained acceptable or good values. However, the five-factor solutions again showed lower BIC than did the six-factor solutions (see Table 9).

Table 9

The rotated factor loading matrices of the five-factor solutions consistently indicated in the two subsamples that the five factors corresponded to the Big Five, as most of the facets of the NEO PI-R common to the HEXACO model (15 of the 16 facets) had factor loadings greater than .40 on their corresponding factor according to the Big Five model (Table 10). In addition, most facets (14 of 16) did not have secondary factor loadings greater than .40 on other factors and, of the two that did, in one of them, those secondary factor loadings were lower than the factor loadings on the corresponding factor (Table 10). The exception to this general pattern of factor loadings was the facet of assertiveness. Although it presented factor loadings greater than .30 on the corresponding factor —extraversion—, such loadings did not exceed the value of .40 and, in addition, it presented loadings greater than .40 on other factors, specifically, on the agreeableness factor (subsample 1) and the factors of agreeableness and neuroticism (subsample 2).

Table 10

The rotated factor loading matrices of the six-factor solutions consistently indicated in the two subsamples that four of the six factors corresponded to the dimensions of openness, agreeableness, conscientiousness, and neuroticism of the Big Five, as all their facets in the NEO PI-R common to the HEXACO model (12 of the 12 facets) had factor loadings greater than .40 on their corresponding factor according to the Big Five model (Table 11). In addition, most of these facets (9 out of 12) did not have secondary factor loadings greater than .40 on other factors and, of the three that did, in one of them, these secondary factor loadings were lower than the factor loadings on the corresponding factor (Table 11).

Table 11

Of the remaining two factors, one appeared to correspond to the extraversion

dimension of the Big Five, since three of the four facets of extraversion in the NEO PI-R common to the HEXACO model consistently showed factor loadings greater than .40 on that factor in the two subsamples. The other factor was defined by a single facet, angry hostility, with factor loadings greater than .40 in both subsamples and by two facets, compliance and deliberation, with factor loadings greater than .40 in only one of the subsamples. However, angry hostility, compliance, and deliberation also showed factor loadings greater than .40 on other factors (neuroticism, agreeableness, and conscientiousness, respectively) and, in some subsamples, their factor loadings were lower than those presented on these other factors (Table 11). In any case, neither of these two factors reflected the dimension of honesty-humility of the HEXACO model because the facets of straightforwardness, dutifulness, and modesty of the NEO PI-R—which resemble the facets of sincerity, fairness and modesty, respectively, of the HEXACO-PI-R—did not show factor loadings greater than .35 on those two factors in either of the two subsamples. In contrast, in both subsamples, straightforwardness, dutifulness, and modesty showed factor loadings greater than .58 on the factors of agreeableness (straightforwardness and modesty) and conscientiousness (dutifulness).

In summary, from the point of view of its psychological interpretation, the solution of five factors, which corresponded to the dimensions of the Big Five, also seemed the most appropriate for the correlations shown by the 16 facets of the NEO PI-R common to the HEXACO model, which corroborated the good or adequate goodness-of-fit indices shown.

Discussion

The main objective of this study was to examine the internal structure of the NEO PI-R to determine whether it matches the HEXACO model better than the Big Five model. The results obtained suggest that, at least in the general Spanish population, the structure —both of its 30 facets and the 16 facets common to the HEXACO model— corresponds to the model

of the Big Five and its five dimensions of neuroticism, extraversion, openness to experience, agreeableness and conscientiousness, and, on the contrary, it does not correspond to the HEXACO model and its sixth dimension of honesty-humility. There are several reasons for this.

First, and consistently in two subsamples of the general Spanish population, the results of the five procedures used to determine the most appropriate number of factors for the matrix of correlations between the 30 or 16 facets of the NEO PI-R mostly suggested a five-factor solution but in no case did they recommend a six-factor solution.

Second, and consistently across two subsamples of the general population and 30- or 16-faceted analyses of the NEO PI-R, all goodness-of-fit indices for the five-factor solution were acceptable or good. Although those indices were also acceptable or good for the six-factor solution, this solution showed higher BIC than did the five-factor solution. Solutions with lower BIC are generally preferred for preventing overfactoring. In addition, the psychological interpretation of the six-factor solution did not conform to the HEXACO model, whereas the psychological interpretation of the five-factor solution did conform to the Big Five model.

Specifically, in the six-factor solutions, it was not possible to identify an honesty-humility factor, that is, a factor defined by the facets of straightforwardness, dutifulness, and modesty of the NEO PI-R, which resemble the facets of sincerity, fairness and modesty, respectively, of the honesty-humility dimension of the HEXACO model. On the contrary, in the solutions of six factors, these facets showed high factor loadings on the factor of agreeableness (straightforwardness and modesty) or on the factor of conscientiousness (dutifulness), as assumed by the Big Five model, and this occurred both when the 30 facets of the NEO PI-R were analyzed and when only the 16 facets of the NEO PI-R common to the HEXACO model were analyzed.

Furthermore, the sixth factor found in the present study was defined by impulsiveness and activity and, secondarily, by angry hostility, compliance, and deliberation. This definition is not consistent with the honesty-humility dimension of the HEXACO model, but is also not consistent with the proposals of other six-factor models of personality traits. For example, Jackson and Tremblay (2002) carried out several factor-analytic studies using the scales of the Personality Research Form (PRF), and their results revealed a six-factor solution (extraversion, agreeableness, independence, openness to experience, methodicalness, and industriousness), but none of those six factors is consistent with the sixth factor of the present study. In fact, Jackson's six-factor model is similar to the Big Five, but splits conscientiousness into two factors: methodicalness and industriousness. Drawing on lexical studies, Saucier (2009) also posited a six-factor model of personality traits. This model involves addition of negative valence dimension to the Big Five, but again this negative valence dimension is not consistent with the sixth factor of the present study.

In contrast, the five-factor solutions consistently indicated in the two subsamples and in the analyses with 30 or 16 facets of the NEO PI-R that the five factors corresponded to the Big Five, as most facets of the NEO PI-R had relevant factor loadings on their corresponding factor according to the Big Five model.

Thirdly, according to the factorial congruence indices obtained, the five-factor solutions of both subsamples for the 30 facets of the NEO PI-R were practically the same. Moreover, both solutions were practically equal to the five-factor solutions obtained in the US normative sample (Costa & McCrae, 1992) and the two Spanish samples of the studies of Aluja et al. (2008) and Costa and McCrae (1999), although the latter are different from those of the present study. The sample of the present study, like the US normative sample, was composed of volunteers from the general population, whereas that of Costa and McCrae (1999) was composed of people evaluated in personnel selection processes, and that of Aluja

et al. (2008), although it comprised volunteers, mainly included university students. As the solutions of five factors in all these samples of adults fit the Big Five model, the results of the present study support the generalization of this model to the Spanish adult population, at least, as measured by the NEO PI-R.

The results of this study do not exclude the possibility that there may be important personality traits that are not reflected in the Big Five model. This is an issue open to empirical research, but does not yet have a consensual and empirically sound answer (Feher & Vernon, 2021). However, the results do cast doubt on the HEXACO model's proposal that the traits of sincerity, fairness or modesty cannot be integrated into the Big Five model, namely in its dimensions of agreeableness and conscientiousness, and therefore a basic sixth dimension should be added to this model, that of honesty-humility.

This conclusion, as well as the results and other conclusions mentioned above, should be considered in light of the limitations of the present study. Among these, one limitation has to do with the assessment instrument chosen to measure personality traits. Although the NEO PI-R measures 30 specific traits or facets of personality and 16 of these facets resemble 16 of the 24 facets of the HEXACO model—that is, 66.7% of the facets of this model—, it would have been desirable to have measurements of the remaining eight facets of the HEXACO model to better determine the validity of this model in the general Spanish population. Moreover, future research should jointly examine the 30 facets of the NEO PI-R and the 24 facets of the HEXACO-PI-R, as this would cover a wide range of personality traits and better contrast the breadth and validity of the two models, the Big Five and the HEXACO.

The use of a “snowball” technique for selecting the sample of participants is other limitation of the present study. This type of non-probability sampling is common in the research of both the internal structure of the NEO PI-R (e.g., Aluja et al., 2008) and the internal structure of the HEXACO-PI-R (e.g., Romero et al., 2015), but, given its inherent

limitations, one might question the extent to which the sample of participants thus obtained is representative of the Spanish adult population. Nonetheless, in terms of sex and age, the profile of the sample of participants in this study was very similar to that of Spanish adult population (see Table 2). In anycase, the use of a random sampling for participant recruitment would have greatly improved sample representativeness and, hence, result generalization. The recruitment of participants in the present study was undertook in 2002-2004 and, consequently, the participant sample could be considered old. However, the reference studies with which the results of this study were compared had been also carried out with old samples (approximately 2003-2005 for Aluja et al., 2008, and 1997-1998 for Costa & McCrae, 1999). These reference studies are the only studies carried out on the internal structure of the NEO PI-R in Spanish samples until the completion of the present study. Therefore, using data from a sample recruited in 2002-2004 would allow, in a certain way, to control the influence of time of sample recruitment on comparisons between Spanish studies. However, future research should replicate the results of the present study with more recently recruited samples.

Despite these limitations, the results of the present study suggest that, at least in Spain, the model of the five personality factors or Big Five remains the most valid taxonomy of personality traits in adults, at least compared to the HEXACO model. In addition, the results of the present study suggest that the NEO PI-R is an instrument that offers valid measures of the dimensions and facets of the Big Five model, at least with regard to the internal structure of those measures.

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Table 1. Correspondence of the dimensions and facets of the HEXACO model measured with the HEXACO-PI-R with the dimensions and facets of the Big Five model measured by the NEO PI-R

HEXACO-PI-R		NEO PI-R	
Dimension	Facet	Facet	Dimension
Honesty-Humility (H)	Sincerity	Straightforwardness	Agreeableness
	Fairness	Dutifulness	Conscientiousness
	Modesty	Modesty	Agreeableness
Emotionality (E)	Fearfulness	Anxiety	Neuroticism
	Anxiety	Anxiety	
	Dependence	Vulnerability	
Extraversion (X)	Social boldness	Asertiveness	Extraversion
	Sociability	Warmth	
		Gregariousness	
	Liveliness	Positive emotions	
Agreeableness (A)	Flexibility	Compliance	Agreeableness
	Patience	Angry hostility (-)	Neuroticism
Conscientiousness (C)	Organization	Order	Conscientiousness
	Diligence	Achievement striving	
	Prudence	Deliberation	
Openness to experience (O)	Aesthetic	Aesthetics	Openness to experience
	Unconventionality	Ideas	

Table 2. Comparison of the distribution by sex and age of the sample of participants with the distribution of the Spanish population (Sanz & García-Vera, 2009, p. 134)

Age	Sample of participants		Population in Spain*	
	Men (n = 292)	Women (n = 390)	Men (N = 16,243,472)	Women (N = 17,262,495)
18 to 29 years	12.2 %	15.2 %	11.8 %	11.3 %
30 to 49 years	12.5 %	19.8 %	18.4 %	18.3 %
50 years or more	18.2 %	22.1 %	18.2 %	21.9 %
Subtotal	42.8 %	57.2 %	48.5%	51.5%

Note. *Instituto Nacional de Estadística (2004).

Table 3. Recommended number of factors to be extracted for the 30 facets of the NEO PI-R in the two subsamples of participants

Index	Subsample 1	Subsample 2
Cattell's scree test	5	5
Optimal parallel analysis	4	5
Classical parallel analysis	5	5
Hull's method	5	4
Bayesian Information Criterion (BIC)	5	5

Table 4. Goodness-of-fit indices of the factor solutions for the 30 facets of the NEO PI-R in the two subsamples of participants (ULS factor extraction method)

Index	Subsample 1		Subsample 2	
	5 factors	6 factors	5 factors	6 factors
% of explained variance	59.1%	62.8%	60.3%	64.0%
χ^2 / degrees of freedom	1.00*	0.56*	0.79*	0.37*
GFI: goodness of fit index	.985*	.989*	.987*	.991*
CFI: Bentler comparative fit index	.999*	.999*	.999*	.999*
NNFI: non-normed fit index	1.000*	1.016*	1.011*	1.032*
RMSEA	.004*	.000*	.000*	.000*
WRMR	0.039*	0.033*	0.036*	0.029*
BIC	1346.54	1413.53	1283.09	1325.66

Note. BIC: Schwarz's Bayesian Information Criterion. RMSEA: root mean square error of approximation. WRMR: weighted root mean square residual. *Acceptable or good fit indices according to conventional criteria: $\chi 2$ / df ≤ 5; GFI, CFI and NNFI $\geq .95$; RMSEA $\leq .08$; WRMR $< .90$.

Table 5. Rotated matrix of factor loadings of the five-factor solutions of the 30 facets of the NEO PI-R obtained in each subsample of participants using the ULS method of factor extraction and the varimax method of factor rotation

NEO-PI-R facet	Subsample 1					Subsample 2				
	1	2	3	4	5	1	2	3	4	5
Neuroticism										
Anxiety				**.761**					**.746**	
Angry hostility		**-.468**		**.534**			**-.575**		**.559**	
Depression				**.806**					**.834**	
Self-consciousness				**.645**					**.649**	
Impulsiveness	-.330		.335	**.410**			-.324	.331	**.435**	
Vulnerability	-.310			**.708**		-.332			**.754**	
Extraversion										
Warmth			**.710**				**.428**	**.688**		
Gregariousness			**.633**					**.564**		
Assertiveness		**-.435**	.350	-.344			-.399	.389	**-.542**	
Activity			**.564**					**.578**		
Excitement-seeking		**-.401**	.334				-.375	.328		.301
Positive emotions			**.727**		.303			**.694**		
Openness										
Fantasy	-.360		.320		**.500**					**.519**
Aesthetics					**.711**					**.704**
Feelingss			**.493**		**.444**			**.560**		**.476**
Actions					**.553**					**.520**
Ideas					**.775**					**.770**
Values					**.431**					**.478**
Agreeablesness										
Trust		**.543**	.321				**.585**			

NEO-PI-R facet	Subsample 1					Subsample 2				
	1	2	3	4	5	1	2	3	4	5
Straightforwardness		**.604**					**.662**			
Altruism		**.552**	**.512**				**.647**	**.418**		
Compliance		**.657**					**.707**			
Modesty		**.591**					**.478**		.393	
Tender-mindedness		**.578**					**.571**			
Conscientiousness										
Competence	**.719**					**.652**			-.325	
Order	**.659**					**.595**				
Dutifulness	**.675**	.320				**.689**	.306			
Achievement striving	**.723**					**.723**				
Self-discipline	**.778**					**.749**				
Deliberation	**.564**					**.472**		-.345		

Note. For clarity, factor loadings lower than .30 are not presented, and those equal to or greater than .40 are presented in bold.

Table 6. Rotated matrix of factor loadings of the six-factor solutions of the 30 facets of the NEO PI-R obtained in each subsample of participants using the ULS method of factor extraction and the varimax method of factor rotation

NEO-PI-R facets	Submuestra 1						Submuestra 2					
	1	2	3	4	5	6	1	2	3	4	5	6
Neuroticism												
Anxiety				**.759**						**.757**		
Angry hostility				**.460**	**.435**	-.322				**.473**	**.555**	-.344
Depression				**.798**						**.860**		
Self-consciousness				**.674**						**.660**		
Impulsiveness		-.339		.340	**.454**					.348	**.508**	
Vulnerability				**.745**						**.747**		
Extraversion												
Warmth			**.738**						**.813**			
Gregariousness			**.666**						**.630**			
Assertiveness				-.368		**-.431**				**-.526**		**-.472**
Activity			**.446**		**.449**				.398		**.456**	
Excitement-seeking			.309			**-.500**						**-.501**
Positive emotions	.319		**.706**						**.645**			
Openness												
Fantasy	**.509**	-.344					**.493**					-.342
Aesthetics	**.712**						**.697**					
Feelingss	**.458**		.449				**.478**		**.486**			
Actions	**.558**						**.554**					
Ideas	**.773**						**.739**					
Values	**.440**						**.529**					
Agreeablesness												
Trust			**.413**			**.465**			.391			**.478**

NEO-PI-R facets	Submuestra 1						Submuestra 2					
	1	2	3	4	5	6	1	2	3	4	5	6
Straightforwardness						**.673**						**.688**
Altruism			**.598**			**.449**			**.564**			**.516**
Compliance					-.349	**.550**					**-.450**	**.563**
Modesty						**.645**				.315		**.618**
Tender-mindedness						**.573**			.301			**.540**
Conscientiousness												
Competence		**.721**						**.663**				
Order		**.676**						**.594**				
Dutifulness		**.657**				.370		**.680**				
Achievement striving		**.716**						**.726**				
Self-discipline		**.765**						**.748**				
Deliberation		**.604**			**-.421**			**.487**			**-.408**	

Note. For clarity, factor loadings lower than .30 are not presented, and those equal to or greater than .40 are presented in bold.

Table 7. Factorial congruence coefficients of the five-factor solutions of the two subsamples of this study with the five-factor solutions of the original American normative sample, the Spanish normative sample (personnel selection), and the Spanish sample (university students + general population) of Aluja et al. (2008)

NEO PI-R dimensions	Comparison sample						
	Subsample of this study	American normative sample (general population)		Spanish normative sample (personnel selection)		Aluja et al. (2008) (university students + general population)	
Subsample of this study	2	1	2	1	2	1	2
Neuroticism	**.978**	**.973**	**.967**	.946	**.974**	**.985**	**.975**
Extraversion	**.984**	**.970**	**.961**	.949	.946	**.978**	**.973**
Openness	**.981**	**.968**	**.968**	**.961**	.948	**.970**	**.964**
Agreeableness	**.980**	**.975**	**.972**	**.971**	.949	**.973**	**.982**
Conscientiousness	**.982**	**.971**	**.963**	**.963**	.932	**.979**	**.974**
Global	**.980**	**.971**	**.965**	**.957**	.948	**.977**	**.973**

Note. All values indicate that the two factors (or both factor solutions) are similar ($C \geq .85$). The ≥ .95 values indicating that the two factors (or the two factor solutions) are virtually identical appear in bold.

Table 8. Recommended number of factors to be extracted for the 16 facets of the NEO PI-R common to the HEXACO model in the two subsamples of participants

Index	Subsample 1	Subsample 2
Cattell's scree test	5	5
Optimal parallel analysis	4	4
Classical parallel analysis	5	5
Hull's method	5	5
Bayesian Information Criterion (BIC)	5	5

Table 9. Fit indices of the 16 facets of the NEO PI-R factor solutions common to the HEXACO model in the two subsamples of participants (ULS factor extraction method)

Index	Subsample 1		Subsample 2	
	5 factors	6 factors	5 factors	6 factors
% of explained variance	68.2%	73.3%	69.6%	74.7%
χ^2 / degrees of freedom	1.89*	0.93*	1.62*	0.98*
GFI: goodness of fit index	.993*	.997*	.994*	.997*
CFI: Bentler comparative fit index	.978*	.999*	.986*	.999*
NNFI: non-normed fit index	.958*	1.00*	.966*	1.00*
RMSEA	.051*	.000*	.043*	.000*
WRMR	.028*	.017*	.027*	.018*
BIC	654.54	689.47	640.99	691.42

Note. BIC: Schwarz's Bayesian Information Criterion. RMSEA: root mean square error of approximation. WRMR: weighted root mean square residual. *Acceptable or good fit indices according to conventional criteria: $\chi 2$ / df ≤ 5; GFI, CFI and NNFI $\geq .95$; RMSEA $\leq .08$; WRMR $< .90$.

Table 10. Rotated matrix of factor loadings of the five-factor solutions of the 16 facets of the NEO PI-R common to the HEXACO model obtained in each subsample of participants using the ULS method of factor extraction and the varimax method of factor rotation

NEO-PI-R dimensions and facets*	Subsample 1					Subsample 2				
	1	2	3	4	5	1	2	3	4	5
Neuroticism										
Anxiety (E)					**.730**					**.694**
Angry hostility (A)			-.348		**.511**			**-.518**		**.592**
Vulnerability (E)		-.300			**.749**		-.301			**.801**
Extraversion										
Warmth (X)	**.778**					**.816**				
Gregariouness (X)	**.717**					**.679**				
Asertiveness (X)	.318		**-.569**			.330		**-.576**		**-.484**
Positive emotions (X)	**.724**					**.681**				
Openness										
Aesthetics (O)				**.619**					**.661**	
Ideas (O)				**.938**					**.844**	
Agreeableness										
Straightforwardness (H)			**.651**					**.668**		
Compliance (A)			**.703**					**.752**		
Modesty (H)			**.620**					**.534**		.354
Conscientiousness										
Order (C)		**.673**					**.608**			
Dutifulness (H)		**.680**					**.694**			
Achievement striving (C)		**.688**					**.745**			
Deliberation (C)		**.564**					**.442**			

Note. For clarity, factor loadings lower than .30 are not presented, and those equal to or greater than .40 are presented in bold. *In parentheses is

the first letter of the dimension of the HEXACO model to which the facet of the NEO PI-R would correspond: H = Honesty-Humility; E = Emotionality; X = Extraversion; A = Agreeableness; C = Conscientiousness; O = Openness.

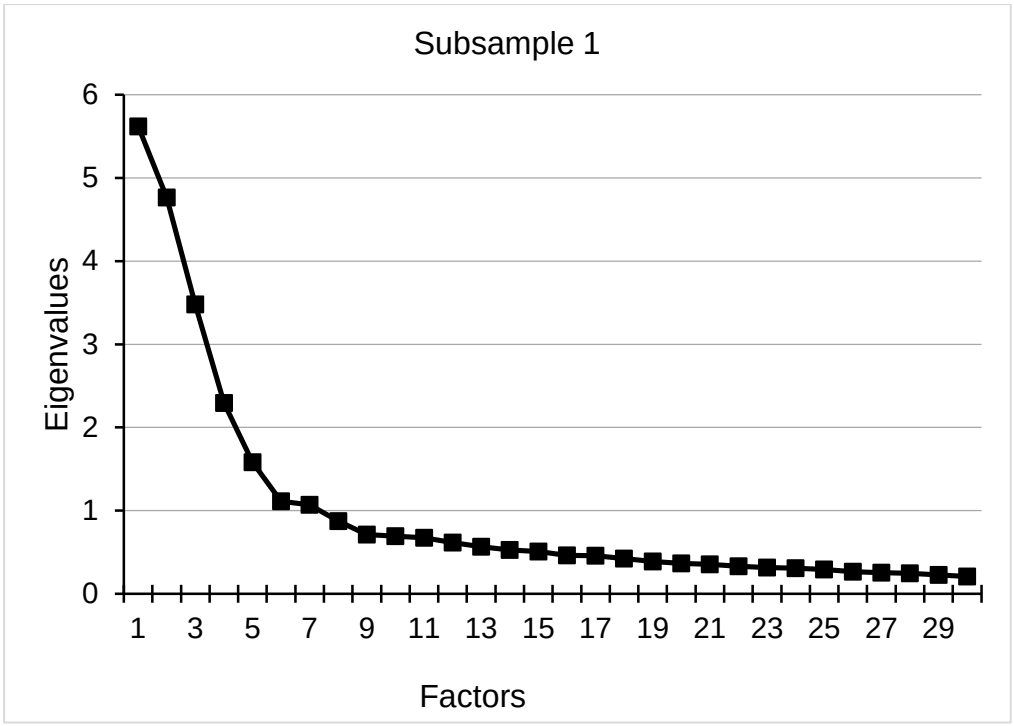
Table 11. Rotated matrix of factor loadings of the six-factor solutions of the 16 facets of the NEO PI-R common to the HEXACO model obtained in each subsample of participants using the ULS method of factor extraction and the varimax method of factor rotation

NEO-PI-R dimensions and facets*	Submuestra 1						Submuestra 2					
	1	2	3	4	5	6	1	2	3	4	5	6
Neuroticism												
Anxiety (E)					**.709**						**.710**	
Angry hostility (A)				**.545**	**.418**			-.366		**-.494**	**.534**	
Vulnerability (E)					**.800**						**.821**	
Extraversion												
Warmth (X)						**.784**						**.804**
Gregariouness (X)						**.709**						**.709**
Asertiveness (X)		**-.456**			-.382	.342		**-.571**			**-.470**	.310
Positive emotions (X)						**.724**						**.669**
Openness												
Aesthetics (O)	**.594**						**.668**					
Ideas (O)	**.980**						**.843**					
Agreeableness												
Straightforwardness (H)		**.804**						**.742**				
Compliance (A)		**.546**		**-.489**				**.648**		.363		
Modesty (H)		**.623**						**.588**				
Conscientiousness												
Order (C)			**.720**						**.614**			
Dutifulness (H)		.302	**.640**					.338	**.664**			
Achievement striving (C)			**.650**						**.749**			
Deliberation (C)			**.624**						**.457**	**.463**		

Note. For clarity, factor loadings lower than .30 are not presented, and those equal to or greater than .40 are presented in bold. *In parentheses is

the first letter of the dimension of the HEXACO model to which the facet of the NEO PI-R would correspond: H = Honesty-Humility; E = Emotionality; X = Extraversion; A = Agreeableness; C = Conscientiousness; O = Openness.

Figure 1. Cattell's scree test on Pearson's correlation matrices between the 30 facets of the NEO PI-R and obtained in the two subsamples of participants



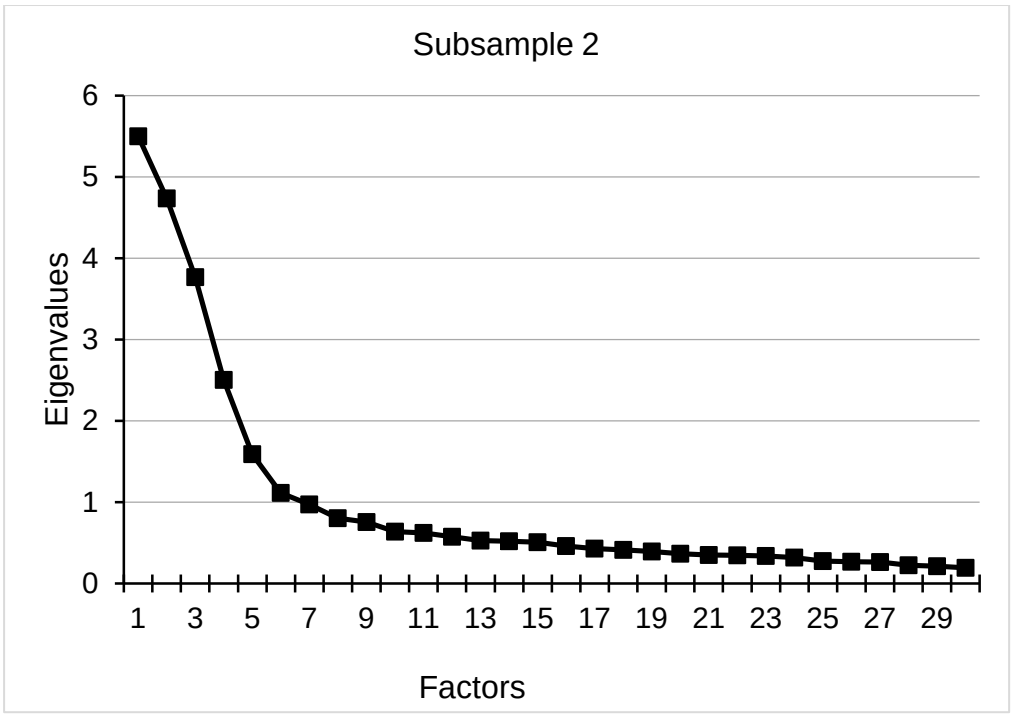


Figure 2. Cattell's scree test on Pearson's correlation matrices between the 16 facets of the NEO PI-R common to the HEXACO model and obtained in the two subsamples of participants