

Psychometric properties of the big five inventory in a Mexican sample

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SUMMARY

Introduction

One of the most researched theories of personality is the Five Factor Model, frequently evaluated through the Big Five Inventory. Even though there is a Spanish version, its psychometrical properties in Mexican population are yet unknown.

Methods

We evaluated 472 adults (217 male/255 female) from an open population from Mexico City.

Results

We obtained a total scale reliability score of $\alpha=0.72$. Principal Component Analysis using Velicer's Minimum Average Partial validated a 5 factor structure. We also found differences between subjects that had been diagnosed with a psychiatric or neurological disorder by a health professional in agreeableness, responsibility and neuroticism.

Conclusions

Our results suggest that the Big Five Inventory is useful to evaluate the personality in Mexican population. However, a review of the Agreeableness scale may be needed because its low reliability and poor item loadings.

Key words: Big Five Inventory Construct, Validity.

RESUMEN

Antecedentes

Una de las teorías de la personalidad más estudiadas es el modelo de los cinco factores, frecuentemente evaluado por medio del Inventario de los Cinco Grandes. A pesar de que existe una versión en español, aún se desconocen las características psicométricas de dicho instrumento en población mexicana.

Método

Se evaluaron 472 adultos (217 hombres/255 mujeres) de población abierta de la Ciudad de México.

Resultados

La confiabilidad fue de $\alpha=0.72$ para toda la escala. Por medio de un Análisis de Componentes Principales, replicamos la estructura de cinco factores de la prueba. También encontramos diferencias entre los sujetos que reportaron haber recibido alguna vez un diagnóstico psiquiátrico o neurológico por un profesional de la salud y los que no, en las escalas de agradabilidad, responsabilidad y neuroticismo.

Conclusiones

Nuestros resultados sugieren que el Inventario de los Cinco Factores es útil para evaluar la personalidad en población mexicana. Sin embargo, una revisión de la escala de agradabilidad puede ser necesaria dada su baja confiabilidad y mala carga factorial de los reactivos que la componen.

Palabras clave: Inventario de los Cinco Grandes, validez de constructo.

INTRODUCTION

Personality is a complex pattern of deeply embedded psychological characteristics that express themselves automatically in practically every domain of psychological functioning.¹ One of the most commonly used models to explain exactly what these psychological characteristics are is the Five Fac-

tor Model (FFM). There's a great amount of evidence about the validity of this model and it was one of two-dimensional models explored as an alternative to the current categorical diagnostic method used in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5).²

The most accepted form of the FFM was originally developed by McCrae and Costa,³ who proposed the following

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factors: 1. energy or extroversion, 2. emotional stability or neuroticism, 3. openness to experience, 4. agreeableness and 5. conscientiousness. These characteristics are considered universal and they can be found in many cultures.

Overall, extroversion refers to someone's preference to be alone or with others; agreeableness defines the tendency to be kind, gentle, trustworthy and warm towards others; conscientiousness is related to the way in which tasks are developed; neuroticism is associated with a person's emotional life and openness to experience modulates cognitive experiences.^{4,5}

The FFM has been studied extensively and its validity has been tested in different settings. Maybe one of the most thoroughly tested and studied correlations of the model is the association between neuroticism and psychopathology. The influence of this factor on mental health has been consistently reported and there is extensive research, specially on its correlation with depression and anxiety,⁶⁻¹⁴ but also with schizophrenia and psychotic disorders,¹⁵⁻¹⁷ substance abuse,^{18,19} internet gaming disorder,²⁰ the frequency in engaging in different risk behaviors,²¹ response to treatment^{13,22} and even health²³ and psychopathology in general.^{24,25}

Rodríguez de Díaz and Díaz Guerrero²⁶ evaluated the applicability of the FFM to the Mexican personality. These authors found a different model for Mexico of only four factors in which items were not grouped as they should according to theory. However, at least one important limitation of the Rodríguez de Díaz and Díaz Guerrero study should be considered, as they used an instrument designed for their study with unknown psychometric characteristics. So, in order to reevaluate the applicability of the FFM to the Mexican personality, it is still necessary to do it with a commonly used instrument such as the Big Five Inventory (BFI).

Costa and McCrae⁴ developed the "NEO-PI". This is considered the gold standard in the evaluation of the FFM and has been translated and adapted into many languages of different linguistic families. Its factor structure, which has been replicated in many countries, constitutes one of the most solid evidences about the universality of the FFM. The NEO-PI has 240 questions, about daily behaviors and feelings, answered in a 5 point Likert scale. Nevertheless, the number of questions and the time needed to answer them make this test inadequate in several settings. The need for less time-consuming evaluations led John, Donahue and Kentle²⁷ to create the Big Five Inventory (BFI), a 44 item test, based on Goldberg's lexical hypothesis,^{28,29} that promptly evaluates the FFM. Each item is a short phrase that the person must use to evaluate how much it describes him/her through a 5 point Likert scale. It has been translated into at least 10 languages, including Spanish, and it takes less than 15 minutes to answer. Even though Benet-Martinez and John³⁰ translated the BFI with the goal of it being used in different Spanish speaking countries, there have been surprisingly few studies done with Mexican population.

The objective of this study was to evaluate the psychometric properties of the BFI and its factorial structure in a Mexican sample. In order to do that, we used the BFI to evaluate a sample from Mexico City and hypothesized that: 1. Cronbach's alpha will be >0.70 for the total test and every scale (reliability), 2. we would be able to replicate the five factor structure using Principal Component Analysis (validity), and 3. participants who reported that they had been diagnosed by a healthcare professional with a neurological or psychiatric illness would score significantly higher in the neuroticism factor (validity).

METHOD

Every conditions and procedures in our study were carried out according to the international guidelines for biomedical research involving humans of the Council for International Organizations of Medical Sciences, as well as the Helsinki declaration and the Psychologist Code of Ethics of the Mexican Psychological Society.

Sample size was determined according to Comrey and Lee,³¹ who urged researchers to obtain samples of 500 observations whenever possible in factor analytic studies. Since we believed our procedure allowed for false data to be collected, we added an extra 50 observations so those could be eliminated.

Participants

We evaluated 550 male and females, all adults between 18 and 60 years old. All subjects were inhabitants of Mexico City; Spanish was their first language and verbally expressed their acceptance to participate in the study. In addition to completing the BFI, every participant was asked whether he or she had ever been diagnosed by a healthcare professional with a neurological or mental illness. In no case we collected information that could allow the identification of a participant identity.

Procedure

Sample was collected through three different class projects done in two private universities in Mexico City. As class requisite, every student enrolled had to participate in a research project and the first author (ERZ) offered them the opportunity to incorporate in this one. A student could choose not to participate and lead his or her own research project; no student choose this second option. As part of their participation they had to contact and evaluate at least 20 participants. Every evaluation was coded according to the student that had performed the evaluation and, in order to avoid fake information entering the analysis, the following controls were implemented:

- At the end of the semester and once grades had been assigned, every student was asked to anonymously write

in a piece of paper whether they or anyone else they knew had falsified or made up data. The piece of paper was then deposited in a closed box that was opened two weeks later. All questionnaires from mentioned students were eliminated from the database (n=72).

- At least six months after the semester ended, we once more contacted the students through email and asked them again if they or anyone else they knew had falsified or made up data. All questionnaires mentioned this second time (n=34) had already been removed from the database in the previous step.

Every student was invited to participate in the preparation of this manuscript as authors. The ones who did not accept are mentioned in the Acknowledgments.

For BFI grading, we followed John, Robins & Pervin's³² and Soto, John & Gosling³³ instructions. Participants who failed to answer six or more questions (n=3) or who did not give their age or sex information (n=3) were eliminated from the database. Next, we replaced the remaining not answered items with the rounded average from the scale to which they belonged and calculated the acquiescence and extreme answers scores which we used to ipsatize every item answer. For reliability analysis we used crude data and for validity analysis, the ipsatized scores. Every statistical analysis was done using the R Project for Statistical Computing.³⁴ Significance level was established in $p < 0.05$.

RESULTS

The final sample (n=472) consisted of 255 (54.03%) women and 217 (45.97%) men. It is below the 500 we initially intended for, but it is still a "good" sample size for a factor analysis according to Comrey and Lee.³¹ Table 1 shows averages, standard deviations and comparisons between genders in main variables.

Statistically significant differences were found between men and women in extroversion, neuroticism and openness.

- *Reliability.* Reliability analysis was done using Cronbach's alpha procedure. The following coefficients were obtained on each scale: extroversion $\alpha=0.76$; agreeableness $\alpha=0.62$; conscientiousness $\alpha=0.78$; neuroticism $\alpha=0.74$ and openness $\alpha=0.77$. For the complete scale we obtained a reliability of $\alpha=0.72$.
- *Validity.* In order to evaluate the five factor structure, we conducted a principal component analysis (PCA) with a Varimax rotation on the ipsatized data. According to the theoretical assumption, the number of components to retain was set on five. This criterion was confirmed through Velicer's Minimum Average Partial.³⁵ A five component solution explains 38% of the total variance and the Kaiser-Meyer Olkin measure of sample adequacy was $KMO=0.04$. Table 2 shows the item loadings on each factor after rotation.
- *Mental health.* Differences in the BFI between participants that had received any psychiatric or neurologic diagnosis by a healthcare professional and those who did not were evaluated through one-way ANOVA tests. Differences were found in the scales of agreeableness $F(1,470) = 6.04$ $MSE = 0.13$ $p = 0.01$ $\alpha^2 = 0.01$, conscientiousness $F(1,470) = 14.46$ $MSE = 0.20$ $p < 0.01$ $\alpha^2 = 0.03$ and neuroticism $F(1,470) = 35.26$ $MSE = 0.31$ $p < 0.01$ $\alpha^2 = 0.07$ (figure 1).

DISCUSSION

The first interesting result in our study was the difference between men and women in three of the five factors (extroversion, neuroticism, and openness) because gender differences in personality are an issue that has been studied at length. In their classic book about this, Maccoby and Jacklin³⁶ concluded that men were more assertive (dominant), aggressive and less anxious than women; this result was confirmed by subsequent meta-analysis.^{37,38} However, a later review of those firsts meta-analysis using new methods

Table 1. Age, diagnosis, means and standard deviation in BFI by gender

Variable	Women (n = 255)	Men (n = 217)	Differences	Total (n = 472)
Age	31.16 (12.38)	31.58 (13.20)	$t = -0.35$	31.35 (12.75)
¿Diagnosis? ^a	44	26	$\chi^2 = 5.81$	70
BFI				
• Extroversion	3.24 (0.75)	3.41 (0.70)	$t = -2.40^*$	3.32 (0.73)
• Agreeableness	3.60 (0.59)	3.59 (0.56)	$t = 0.08$	3.60 (0.58)
• Responsibility	3.52 (0.71)	3.51 (0.64)	$t = 0.09$	3.52 (0.68)
• Neuroticism	2.98 (0.70)	2.69 (0.65)	$t = 4.55^{**}$	2.85 (0.69)
• Openness	3.57 (0.66)	3.78 (0.56)	$t = -3.56^{**}$	3.67 (0.62)
• Acquiescence	3.39 (0.32)	3.38 (0.29)	$t = -0.64$	3.39 (0.31)

^a Number of participants that reported having been diagnosed with a psychiatric or neurological disorder by a health professional.

* $p < 0.05$

** $p < 0.01$

Table 2. Rotated component loads of the BFI

Question	I	II	III	IV	V
Extraversion					
• Es extrovertido, sociable	-0.20	0.03	0.69	-0.17	0.10
• Es bien hablador	0.12	0.00	0.55	-0.05	-0.06
• Tiende a ser callado	-0.26	-0.05	0.54	-0.27	-0.35
• Está lleno de energía	-0.21	0.20	0.46	0.09	0.11
• Es a veces tímido, inhibido	-0.37	-0.04	0.43	-0.17	-0.41
• Es reservado	-0.11	-0.11	0.42	-0.41	-0.31
• Irradia entusiasmo	-0.33	0.15	0.42	-0.06	0.20
• Es asertivo, no teme expresar lo que quiere	-0.15	0.33	0.25	0.19	0.01
Agreeableness					
• Es considerado y amable con casi todo el mundo	-0.25	0.04	-0.04	0.00	0.62
• Es generoso y ayuda a los demás	-0.02	0.03	0.08	0.04	0.58
• Le gusta cooperar con los demás	-0.16	0.01	0.01	0.16	0.52
• Es indulgente, no le cuesta perdonar	0.13	0.08	-0.08	0.00	0.28
• Es a veces mal educado con los demás	-0.30	-0.23	-0.34	-0.19	0.26
• Es generalmente confiado	0.01	0.25	0.19	-0.04	0.18
• Tiende a ser criticón	-0.29	-0.07	-0.43	-0.10	0.10
• Inicia disputas con los demás	-0.27	-0.04	-0.44	-0.12	0.11
• Es a veces frío y distante	-0.42	-0.15	-0.07	-0.33	0.05
Responsibility					
• Es minucioso en el trabajo	0.16	-0.01	-0.02	0.63	-0.11
• Persevera hasta terminar el trabajo	-0.05	0.06	-0.07	0.63	0.04
• Hace las cosas de manera eficiente	-0.09	0.08	0.05	0.60	0.11
• Hace planes y los sigue cuidadosamente	-0.11	0.02	-0.15	0.51	0.04
• Es trabajador cumplidor, digno de confianza	0.00	-0.04	0.06	0.49	0.11
• Se distrae con facilidad	-0.13	-0.06	-0.47	0.42	-0.29
• Tiende a ser flojo, vago	-0.22	-0.24	-0.28	0.39	-0.17
• Tiende a ser desorganizado	-0.16	-0.23	-0.34	0.30	-0.28
• Puede a veces ser algo descuidado	-0.18	-0.19	-0.31	0.25	-0.35
Neuroticism					
• Con frecuencia se pone tenso	0.70	0.01	0.01	0.02	0.08
• Es temperamental, de humor cambiante	0.66	0.05	0.20	-0.08	-0.14
• Es depresivo, melancólico	0.63	0.10	-0.04	0.03	0.10
• Se pone nervioso con facilidad	0.59	-0.01	-0.11	-0.16	0.34
• Es emocionalmente estable, difícil de alterar	0.55	-0.09	-0.08	-0.33	-0.22
• Es calmado, controla bien el estrés	0.52	-0.18	0.03	-0.29	-0.17
• Mantiene la calma en situaciones difíciles	0.47	-0.20	-0.10	-0.39	-0.19
• Se preocupa mucho por las cosas	0.39	-0.12	-0.04	0.25	0.35
Openness					
• Es inventivo	-0.04	0.68	0.15	0.00	-0.05
• Tiene una imaginación muy activa	-0.05	0.65	0.26	-0.04	0.09
• Es ingenioso, analítico	0.01	0.59	0.02	0.32	0.01
• Le gusta reflexionar, jugar con las ideas	0.01	0.58	-0.03	0.25	0.08
• Es original, se le ocurren ideas nuevas	-0.05	0.55	0.23	-0.03	0.05
• Valora lo artístico, lo estético	0.11	0.55	-0.17	-0.05	0.09
• Es educado en arte, música o literatura	-0.01	0.54	-0.23	-0.07	0.04
• Tiene intereses muy diversos	0.10	0.46	0.25	0.00	-0.01
• Tiene pocos intereses artísticos	-0.04	0.37	-0.26	-0.22	-0.06
• Prefiere trabajos que son rutinarios	-0.01	0.25	0.01	-0.24	-0.24

Note. Component loads > 0.30 in bold. Spanish Items from Benet-Martínez & John (1998).

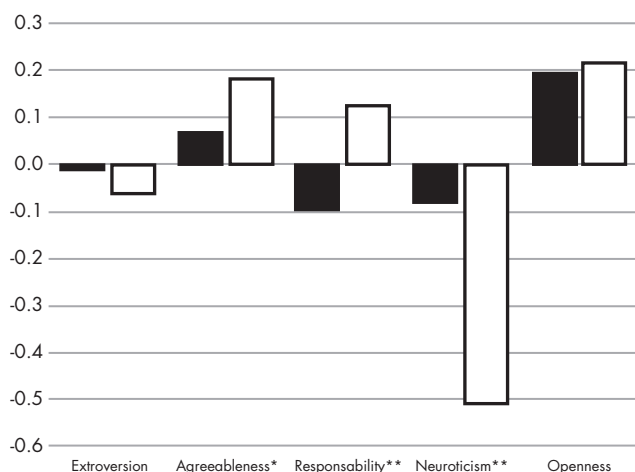


Figure 1. Differences in BFI scales among participants with and without psychiatric or neurological disorders.

Note: Participants who reported having been diagnosed with a psychiatric or neurological disorder are in the dark bar, those who didn't are in the white one. * $p < 0.05$; ** $p < 0.01$

showed that women are more extroverted and have higher levels of anxiety than men,³⁹ which is consistent with our result of higher levels of neuroticism in women, because anxiety is one of the central characteristics of neuroticism.³²

Most of the early research exploring gender differences in the FFM suggested that these tended to be either non-existent or very small.³⁰ However, further studies have continued to evaluate this issue and now it seems a well-known fact that women tend to score higher on neuroticism and agreeableness.⁴⁰ This finding has been thoroughly replicated in different countries: United States of America (USA),⁴¹ United Kingdom and Germany;⁴² multinational samples;^{43,44} also in different age groups: college students,⁴⁵ elderly,⁴⁰ across the life span;⁴² again using different FFM measures: BFI,⁴³ 15 item BFI,⁴² NEO-PI-R⁴³ and NEO-FFI⁴⁰ and even with samples from different decades.⁴⁵

Similar to all research available to date, in our study women scored higher in neuroticism. The effect size we found ($d=0.42$) was lower than that reported by Costa et al.,⁴³ but was well within the range of those obtained by Donnellan and Lucas⁴¹ in several age groups (d from .30 to .64) and very similar to that reported ($d=0.44$) by the International Sexuality Description Project (ISDP) study in a Mexican sample.⁴⁴

Differences have also been found in other factors but they are not as robust. For example Costa, Terracciano and McCrae⁴³ reported differences in openness (women higher than men) in USA and other countries, but not Donnellan and Lucas, neither in a British nor a German sample.⁴² The ISDP also found mixed results in openness across countries. In 18 of the nations evaluated, women scored higher than men, while in the other 37 (included Mexico) openness was higher in men.⁴⁴ The effect size we found is almost three times that of the ISDP study (-0.33 vs. -0.12). However, it

should be noted that, while we used ipzitized data (as suggested in John et al.³²), Schmitt et al did not report making such adjustment to their data.⁴⁴

Concerning the reliability analysis, the Cronbach's α obtained in our study for the complete scale ($\alpha=0.72$) could be considered acceptable.⁴⁶ This result is similar to the one obtained in the original Benet Martínez & John³⁰ study of the Spanish version using different Spanish-speaking samples, the reported by the ISDP in their Mexican sample⁴⁴ and is higher than Rodríguez & Cruch's⁴⁷ study of college students from the north of Mexico. It should be noted that the reliability value obtained in our study is below that reported for the BFI in other languages; for example Dutch $\alpha=0.79$,⁴⁸ Italian $\alpha=0.79$ ⁴⁹ or English $\alpha=0.82$ ³⁰.

In the reliability analysis of each scale, only agreeableness obtained an internal consistency value that could be considered questionable ($\alpha=0.62$). This scale was also the one that obtained the lower reliability in the original validation study³⁰ and in the study by Rodríguez and Church.⁴⁷

The finding of lower reliability in a Mexican sample seems to be consistent across personality research, because not only was it reported by other studies using the BFI in Mexican samples,^{47,50} it was also found in several validation studies of other personality tests for example: the Millon Index of Personality Styles,^{51,52} the Eysenck Personality Questionnaire,^{53,54} or the Cloninger's Temperament and Character Inventory.⁵⁵ Ortiz⁵⁶ first noticed this tendency but as of today there is no hypothesis to explain it, further research on this area is surely needed.

The five-component solution from the PCA is consistent with both the FFM theory and the gross of BFI research. The percentage of total variance explained by this solution is similar to that reported by Rodríguez and Church.⁴⁷ However, in contrast to our study, those authors could not replicate the FFM using a Varimax rotation, but we were able to do so, using an oblique one. It should be noted that Rodríguez and Church used raw data since the acquiescence correction was not available at the time.

Perhaps the most noteworthy finding of the PCA is that only three of the nine questions that evaluate the agreeableness factor obtained factorial loads above 0.30. This result explains the low reliability of that scale in ours and other studies, and suggests that the design and translation of those items should be reviewed.

Finally, in our study, 14.83% ($n=70$) of the sample reported that they had received a psychiatric or neurologic diagnose by a healthcare professional. This prevalence is lower than the 28.6% ICD-10 psychiatric disorders reported in the National Epidemiology Psychiatric Survey done in Metropolitan Areas of Mexico.⁵⁷ However, it should be noted that this survey used a structured interview to establish diagnoses, so their estimation, unlike our own, also includes those subjects who, in spite of being highly likely to have a psychopathology, have never been evaluated by

a health professional. It is also possible that subjects either did not remember getting a diagnosis or chose to hide such information because of the stigma of psychiatric disorders and the enrollment method (i.e. an student inviting a close friend to participate in the study). If that was the case, differences in neuroticism may be greater than those observed.

As can be seen in figure 1, and as we hypothesized, differences were found in neuroticism scores of participants that reported they had received a psychiatric or neurologic diagnose and the ones that did not. This result is coherent with the extensive literature that associates this factor with mental health disorders. Similarly to the results of our study, another common finding in the validation studies is that the neuroticism scale is the one with the lowest score (for example: Denissen et al.⁴⁸; Srivastava et al.⁵⁸).

The main limitation in this study was the way the sample was contacted. Since no criterion (other than inclusion criteria) was specified, students enrolled subjects with no particular order. This is hardly an ideal situation, but since reliability and validity were the main goal of this study and not normative data, this limitation may be less important. It is to be noted that averages and standard deviations for each scale in our study are not that different from those reported by Benet-Martínez and John.³⁰ Normative data from an open population stratified random sample is still needed.

In conclusion, evidence from our study supports the use of the BFI to measure the FFM in Mexican population. It is a valid and reliable tool. However the reliability data and the factorial analysis suggest that the translation of the agreeableness scale should be evaluated more carefully in future studies in order to improve its internal consistency.

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