

## RESEARCH ARTICLE

WILEY

# Popular epistemically unwarranted beliefs inventory (PEUBI): A psychometric instrument for assessing paranormal, pseudoscientific and conspiracy beliefs

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## Funding information

Spanish Government, Grant/Award Number: FPU20/03345

## Abstract

Studying epistemically unwarranted beliefs (EUB) is relevant at basic, applied, and social levels. However, EUB scales validated in Spain are scarce. Consequently, we aimed to develop and validate a scale of this kind. One thousand four hundred and sixty participants answered to a preliminary version of the questionnaire. Exploratory and confirmatory factor analyses revealed the final form of PEUBI: a 36-item instrument with five related factors (Superstitions, Occultism and Pseudoscience, Traditional Religion, Extraordinary Life Forms, and Conspiracy Theories). The results showed that the items were little affected by social desirability bias. PEUBI factor scores showed good internal consistency (estimates between .85 and .97), test-retest reliability (estimates between .75 and .93), and convergent-divergent validity. Sociodemographic differences were also explored, observing lower levels of EUB in men, elders, from pure sciences and technology, and atheists. In conclusion, PEUBI is a valid and reliable psychometric instrument to assess paranormal, pseudoscientific and conspiracy beliefs in Spanish adults.

## KEYWORDS

conspiracy, paranormal, pseudoscience, questionnaire, unwarranted beliefs

## 1 | INTRODUCTION

Human beings seem to have a natural tendency to explain the surrounding world, a fact that may lead to occasionally produce explanations that are insufficiently supported by the empirical evidence (e.g., Yong et al., 2021). There exist cases in which this phenomenon goes beyond idiosyncratic momentary explanations, fostering long-lasting socially widespread beliefs. Three instances of these socially widespread *epistemically unwarranted beliefs* (EUB; i.e., beliefs insufficiently supported by empirical evidence) are paranormal,

pseudoscientific and conspiracy beliefs (see Lobato et al., 2014; Rizeq et al., 2020).<sup>1</sup> These three types of EUB are progressively getting more attention from researchers and governments, probably due to the combination of their (1) high social prevalence and (2) negative implications. Regarding the first point, paranormal, pseudoscientific and conspiracy beliefs are common in the general population around the world (e.g., Höllinger & Smith, 2002; Imhoff et al., 2022; Majima et al., 2022), Spain being no exception (e.g., Díaz-Vilela & Álvarez-González, 2004; Imhoff et al., 2022; Torres et al., 2020). Regarding the second point, these three types of EUB are associated with

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negative outcomes such as interference with critical thinking, increased vulnerability to deception, rejection of science and objectivity, institutional distrust, decreased political and social engagement, social polarization and intolerance (e.g., increased prejudice, discrimination and intergroup violence), increased health risks (e.g., ignoring/rejecting health guidelines, opportunity costs of choosing ineffective treatments, iatrogeny) or failure to carry out constructive problem-solving behaviors (Fasce, 2018; Irwin, 2009; Jolley et al., 2020; Stone et al., 2018). Illustratively, the COVID-19 pandemic has shown how easily EUB spread through society and influence people (e.g., Escolà-Gascón et al., 2020; Jaiswal et al., 2020), for example, by fostering a lower adoption of preventive behaviors and other desirable measures to mitigate the pandemic (e.g., Romer & Jamieson, 2020; Teovanović et al., 2021). Therefore, an obvious relevant purpose for studying EUB is to prevent/counteract the adverse effects associated to this kind of beliefs. In addition to this social utility, the study of EUB is also of interest for basic research (e.g., it would reveal underlying cognitive biases of the human mind; Brugger & Mohr, 2008; French & Stone, 2014; Pierre, 2019) and clinical research (e.g., starting from a dimensional perspective of psychopathology, the study of EUB in the general population could provide some insight into delusional beliefs held by some clinical populations; Brugger & Mohr, 2008; Irwin et al., 2012; Pierre, 2019; Starcevic & Brakoulias, 2021).

Despite the potential value of research into EUB, in Spain there is the obstacle of having very few EUB validated scales: to the best of our knowledge, there is only the Spanish adaptation of the Revised Paranormal Belief Scale (RPBS-Sp; Díaz-Vilela & Álvarez-González, 2004), the Pseudoscientific Belief Scale (PSEUDO-RS; Fasce et al., 2021), the Pseudoscience Endorsement Scale (PES; Torres et al., 2020), the UFO Experiences Questionnaire (UFO-Q; Escolà-Gascón et al., 2021), some subscales of the Spanish adaptation of the Expressions of Spirituality Inventory (ESI-Sp; Muñoz-García, 2013), and the Spanish adaptation of the Generic Conspiracist Beliefs Scale (GCBS-Sp; Fasce et al., 2022). Despite the great advance brought by the existing psychometric instruments, there are some limitations that should be noted. First, all the previously commented measures focus on a single EUB type (i.e., paranormal in RPBS-Sp, UFO-Q and ESI-Sp, pseudoscience in PSEUDO-RS and PES, conspiracy in GCBS-Sp). Second, some relevant psychometric properties such as the temporal stability of scores (i.e., test-retest reliability) have not been assessed in Spanish EUB measures (with the notable exception of UFO-Q). Third, in the specific case of RPBS-Sp, although it addresses some limitations of the original version (e.g., adding items to appropriately evaluate the extraterrestrial/aliens' domain), other limitations summarized by Irwin (2009) are still unresolved (e.g., inadequacy of some items to evaluate paranormal beliefs, few items in some factors to appropriately measure the dimension). Given these limitations, we consider that there is a need for a new EUB questionnaire with adequate psychometric properties for its usage in Spain. One may wonder why a new instrument is needed if it is possible to simply use a translated version of any of the numerous EUB questionnaires available in English (e.g., Lobato et al., 2014; Stone et al., 2018). However, there may be some linguistic and/or cultural differences limiting the usefulness and

comprehensiveness of the resulting translated measure (e.g., see Beaton et al., 2000). In the case of EUB beliefs, there may be certain specificities in a particular culture that a questionnaire developed in another country renders impossible to assess. Consequently, the main aim of the present research was to develop and validate a new scale for assessing paranormal, pseudoscientific and conspiracy beliefs in the Spanish context: the *Popular Epistemically Unwarranted Beliefs Inventory* (PEUBI). As far as we know, in Spain there is no questionnaire that assesses these three types of EUB altogether. This would be a relevant contribution, since having a single unified measure to assess paranormal, pseudoscientific and conspiracy beliefs implies, at least, two advantages over using separate scales for each EUB type: a shorter administration time and an absence of overlap between measures. Concerning the first advantage, using a single multidimensional scale saves time and simplifies the process of answering the questionnaire, especially when the instructions and the response format are the same across the whole instrument, which in many cases is not possible when separate unidimensional scales are used. Additionally, the number of items per construct tends to be lower in multidimensional instruments. With respect to the second advantage, the items of a well-constructed multidimensional psychometric instrument usually substantially load only on one factor, which ensures no overlap between the different dimensions assessed by the questionnaire. Conversely, when different instruments are used, it is possible that there is some overlapping between the different factors assessed by these instruments, and there may be redundancies between some of their items, which can, therefore, make it difficult to interpret the results. Finally, since questionnaires may underestimate the level of EUB because of the effect of social desirability (see Genovese, 2005), another aim was to assess whether PEUBI items are affected by social desirability and to control for this bias if necessary.

According to our main goal, we developed the questionnaire and evaluated its factorial structure, validity and reliability. Given the observed correlations between paranormal, pseudoscientific and conspiracy beliefs in the literature (e.g., Lobato et al., 2014; Rizeq et al., 2020) and the results of similar questionnaires in other languages (e.g., Stone et al., 2018), we hypothesized that it would be obtained a feasible factorial solution with multiple correlated factors. We also expected to have reliability estimates (both internal consistency and test-retest)  $\geq .70$  in each factor, which would allow us to consider scores' reliability as acceptable (see Cook & Beckman, 2006). With respect to the correlation of PEUBI with other measures (i.e., RPBS-Sp and a big five personality questionnaire) to assess convergent-divergent validity, we had several predictions. First, we expected most of the factors of PEUBI to be significantly correlated with RPBS-Sp factors, because previous studies have already reported significant correlations between different facets of paranormal beliefs (e.g., Díaz-Vilela & Álvarez-González, 2004) and significant correlations between paranormal, pseudoscientific and conspiracy beliefs (e.g., Lobato et al., 2014; Rizeq et al., 2020). Despite this general pattern of intercorrelations between PEUBI and RPBS-Sp factors, we hypothesized that the larger effect sizes between questionnaires would be observed between those factors that overlap in content

(e.g., the *Traditional religious beliefs* factor of RPBS-Sp with the PEUBI factor that includes items referring to religious beliefs). In relation to the big five personality questionnaire, the pattern of correlations between EUB and personality traits is partly inconsistent in the literature (see for instance, Lantian et al., 2020; French & Stone, 2014). However, what we expected in light of the results of previous studies is mostly non-significant correlations, with perhaps a few small-sized significant correlations (i.e.,  $r < .30$ ); see for instance Chauvin & Mullet, 2021; Fasce & Picó, 2019; Goreis & Voracek, 2019; Lobato et al., 2014). Finally, the validity of PEUBI was further analyzed by means of exploring sociodemographic differences (i.e., sex, age, academic field, and religious orientation) in relation to the level of EUB. Following previous research (e.g., see Morales-Vives et al., 2022), if sociodemographic differences in the level of the studied construct replicate the results obtained in the preexisting literature, it can be interpreted as an additional evidence of the validity of the psychometric instrument. Regarding sex, we expected women to believe more in paranormal and pseudoscience (e.g., Fasce et al., 2021; French & Stone, 2014; Majima, 2015), with the exception of beliefs related to extraordinary life forms and alien-related phenomena (French & Stone, 2014), where men are expected to believe more. The case of conspiracy beliefs is not clear enough, but there are some evidences which suggest that men may present higher endorsement (e.g., Cassese et al., 2020; Thiem, 2020). Concerning age, we expected most paranormal beliefs to decrease with age (e.g., French & Stone, 2014; Irwin, 2009), with the exception of religious beliefs, which were expected to increase with age (e.g., Irwin, 2009). The expected pattern of results for pseudoscientific and conspiracy beliefs is not clear (e.g., Majima, 2015; Smallpage et al., 2020). With respect to academic field, we expected individuals from arts/humanities, health sciences and social sciences to present higher EUB than those from pure sciences and technical studies (see for instance, Díaz-Vilela & Álvarez-González, 2004; Höllinger & Smith, 2002). Finally, for religious orientation we logically expected a gradation in the PEUBI factor that includes religious items (i.e., practicing religious more than non-practicing, non-practicing religious more than agnostics, and agnostics more than atheists). We had no specific predictions for the rest of PEUBI factors.

## 2 | METHOD

### 2.1 | Development of the PEUBI questionnaire: First steps and pilot study

To develop the 136-items preliminary version of PEUBI, the following steps were taken. First, the authors independently created paranormal,<sup>2</sup> pseudoscientific and conspiracy beliefs items both from scratch and from adaptations of previous EUB-related questionnaires (Dagnall et al., 2010; Díaz-Vilela & Álvarez-González, 2004; Granqvist & Hagekull, 2001; Jong et al., 2013; Lantian et al., 2016; Lobato et al., 2014; Maltby et al., 2008; Moral de la Rubia, 2010; Otis & Alcock, 1982; Peters et al., 1999; Preece & Baxter, 2000; Smits et al., 2009), resulting in an initial pool of 275 items. Second, three external judges assessed each item for the appropriateness of

content, wording and length, and the compatibility between response format and item statements. Once the experts' comments were available, the authors met and reduced the number of items to 154 (especially due to the presence of numerous redundant items). Third, considering the recommendations of Muñiz and Fonseca-Pedrero (2019) for test development, a pilot study was performed with these 154 items in a convenience volunteer sample of Spanish adults from the community ( $N = 171$ , 26.32% men, 73.68% women, between 18 and 80 years [ $M = 24.88$ ,  $SD = 9.30$ ]) to ensure their face validity and clarity with the intended recipients of the scale. Participants had to indicate their degree of agreement with each item on a 5-point scale (1 = Fully disagree, 5 = Fully agree), and they were allowed to add any comments/suggestions about the items (e.g., ambiguities, suggested changes, etc.). On the basis of the comments and suggestions of the participants, 18 items were removed and 23 were slightly rewritten.

### 2.2 | Participants

A convenience volunteer sample of 1520 adults participated in the study. However, 60 participants were removed from the analyses for different reasons (i.e., they were not from the target population [Spanish adults], they did not provide the information needed to determine whether they belonged to the target population, they did not complete the questionnaire, they showed an aberrant response pattern such as zigzagging, or they completed the questionnaire too quickly to answer properly). Thus, there were 1460 valid participants aged between 18 and 84 years ( $M = 32.16$ ,  $SD = 14.15$ ), of which 370 completed the paper-and-pencil version and the remaining 1090 the online version. This more than satisfies the minimum required sample of 200 participants to perform a factor analysis (Ferrando & Anguiano-Carrasco, 2010; Muñiz & Fonseca-Pedrero, 2019) and also the rule of thumb of having at least 5–10 people per item (Muñiz & Fonseca-Pedrero, 2019). A subsample of 143 participants was retested 2 months later to assess the test–retest reliability. Another two subsamples completed the RPBS-Sp ( $N = 170$ ) and the Overall Personality Assessment Scale (OPERAS; Vigil-Colet et al., 2013) ( $N = 108$ ) so that we could test convergent and divergent validities. Table 1 shows the sociodemographic characteristics of the total sample and the three subsamples.

Participants gave their consent to use their anonymous data for research purposes, and they voluntarily collaborated in the study without receiving any compensation. The study protocol was approved by the ethics committee of the Institut d'Investigació Sanitària Pere Virgili (CEIm-IISPV reference: 066/2019), and it was in accordance with the Declaration of Helsinki.

### 2.3 | Instruments

#### 2.3.1 | Spanish adaptation of the revised paranormal belief scale (RPBS-Sp)

The Spanish adaptation of this questionnaire was developed by Díaz-Vilela and Álvarez-González (2004). It assesses eight dimensions of

**TABLE 1** Participants' sociodemographic characteristics for the total sample and the subsamples

Variable	Total	Test-retest	RPBS-Sp	OPERAS
Number of participants	1460	143	170	108
Sex (%)				
Men	41.33	12.59	28.24	14.81
Women	58.67	87.41	71.76	85.19
Age (%)				
18–30 years	57.51	96.48	98.82	96.26
31–45 years	22.96	2.82	0.59	3.74
46–60 years	14.53	0.70	0.59	-
61–84 years	5.00	-	-	-
Academic level (%)				
No studies/Basic studies	2.40	-	-	-
Secondary studies	3.29	-	-	-
Medium post-secondary studies	9.24	-	-	-
Higher post-secondary studies	85.07	100.00	100.00	100.00
Academic field (%)				
Arts and humanities	4.52	-	-	-
Sciences	4.11	-	-	-
Health sciences	26.44	74.13	42.35	58.33
Social and legal sciences	26.78	25.87	57.65	41.67
Technology, engineering and architecture	10.20	-	-	-
Not applicable/No valid data	27.95	-	-	-
Religious orientation (%)				
Practicing	3.84	5.60	1.77	6.48
Non-practicing	15.62	18.18	15.29	18.52
Agnostic	38.42	38.46	42.94	38.89
Atheist	42.12	37.76	40.00	36.11
Political orientation (%)				
Extreme left	11.26	9.93	13.09	7.48
Left	50.76	53.19	57.74	54.21
Center left	19.64	17.73	16.07	16.82
Center	11.54	12.77	8.33	14.95
Center right	4.46	4.26	1.79	5.61
Right	1.72	1.42	1.79	0.93
Extreme right	0.62	0.70	1.19	-
Type of answer (%)				
Paper-based	25.34	100.00	100.00	100.00
Online	74.66	-	-	-

paranormal beliefs through 30 items on a 7-point scale (1 = Total disagreement, 7 = Total agreement). Item 23 was not considered in the calculation of any score (see Díaz-Vilela & Álvarez-González, 2004). Following previous studies using the RPBS-Sp (e.g., Torres et al., 2020), item 20 was slightly reworded to ask about *intelligent* life in other planets (instead of life in other planets). The estimated reliabilities in our study are: .95 for *Witchcraft*, .91 for *Psi*, .88 for *Traditional religious beliefs*, .87 for *Spiritualism*, .97 for *Extraterrestrial life and actual visits*, .90 for *Precognition*, .86 for *Superstition*, and .87 for *Extraordinary life forms*.

### 2.3.2 | Overall personality assessment scale (OPERAS)

This questionnaire was developed by Vigil-Colet et al. (2013). It assesses the Big Five personality traits. It consists of 40 items on a 5-point scale (1 = Fully disagree, 5 = Fully agree) and it controls two response biases (social desirability and acquiescence). The estimated factor reliabilities in our study are: .91 for *Extraversion*, .86 for *Emotional stability*, .84 for *Conscientiousness*, .77 for *Agreeableness*, and .86 for *Openness to experience*.

## 2.4 | Procedure

The 136-item preliminary version of PEUBI, together with four social desirability markers used in previous questionnaires (e.g., Vigil-Colet et al., 2013), were paper-and-pencil self-administered to university undergraduates. The rest of the sample answered an online version disseminated through social media (Whatsapp, Instagram, Twitter, Facebook, etc.) and other websites so that the sample was heterogeneous. We also used a non-probabilistic sampling procedure known as “snowball” (Snijders, 1992). In fact, once participants had finished the online questionnaire, the website allowed them to share it with their own contacts, which resulted in a progressively increasing sample size. In both paper-and-pencil and online versions, respondents had to read an informed consent form with all the relevant information (e.g., voluntary participation, right to drop out at any time), and they could only start answering the questionnaire if they gave their consent by checking the boxes of some predetermined statements. After the informed consent and before participants started responding, we included instructions for completing the questionnaire (see Appendix A). Answers were anonymous and data protection was guaranteed. Respondents also provided their sociodemographic data (sex, age, academic level, academic field, religious and political orientations, and nationality).

In the online administration, participants only completed PEUBI. In the first session of the paper-based administration, participants completed PEUBI and either RPBS-Sp or OPERAS. In the second session, 2 months later, they completed PEUBI again. For test–retest purposes, the paper-based administration allowed participants to generate a code similar to that described by Direnga et al. (2016). Participants had to use this code again in the second administration and, since it was only known to them, anonymity and confidentiality were guaranteed. The administration of RPBS-Sp and OPERAS allowed us to assess the convergent and discriminant validity of PEUBI, because these questionnaires include some subscales related to paranormal, pseudoscientific and conspiracy beliefs, and other subscales not expected to be related with these beliefs, according to the previous literature.

## 2.5 | Data analysis

The sample of 1460 individuals was randomly split in two halves. Exploratory Factor Analyses (EFA) were carried out with the first subsample to identify the poorly functioning items that had to be removed, and to determine the most appropriate number of factors underlying the data. We included four social desirability item markers in the questionnaire to control this response bias, following the procedure developed by Ferrando et al. (2009), which has been successfully implemented in several questionnaires (e.g., Morales-Vives et al., 2013; Vigil-Colet et al., 2013). This procedure consists of using these social desirability item markers to identify a factor related to social desirability, so that its effects can be removed from the individual scores on content factors. The results showed that the

items were little affected by this bias (none of the content items had loadings higher than .19 on the social desirability factor, and 81% of the items had loadings lower than .10). Therefore, we considered it preferable not to control this bias because it would involve an over-parametrization that would not substantially improve the questionnaire. For this reason, all the analyses explained in Section 3 were carried out without controlling for this bias. In fact, we carried out new EFAs in the first subsample, and a Confirmatory factor analysis (CFA) in the second subsample, without controlling for social desirability, to determine if the final solution obtained in the first subsample could be replicated in a different subsample. As both analyses led to the same conclusions, a final EFA was carried out with the overall sample to obtain the factorial weights required to compute the participants' factor scores. The EFA controlling for social desirability bias was carried out using the Psychological Test Toolbox (Navarro-González et al., 2019), and the other EFAs were carried out using FACTOR 10.10.03 (Lorenzo-Seva & Ferrando, 2006). CFA was carried out using MPlus v8. We used IBM SPSS 27 to compute the descriptive statistics and correlations.

The factor scores for each PEUBI dimension were computed considering the 36 items of the final version using FACTOR 10.10.03 (Lorenzo-Seva & Ferrando, 2006). These factor scores were transformed to T scale ( $M = 50$ ,  $SD = 10$ ) in order to ease interpretation. All the validity analyses were conducted with IBM SPSS 27 and JASP 0.16.1, being the critical level of significance  $\alpha = .05$ . Sex differences regarding the level of EUB were analyzed first by means of a MANOVA, in order to reduce type I errors. We report the Pillai's trace statistic ( $V$ ), the  $F$  statistic with its respective degrees of freedom, the significance  $p$ -value, and the eta-squared ( $\eta^2$ ) index of effect size. Considering that previous literature shows that sex differences can vary in function of the explored EUB dimension (e.g., see French & Stone, 2014), when the MANOVA was significant, it was deemed more appropriate to perform univariate pairwise comparisons instead of performing multivariate post-hoc analyses. More specifically, two-tailed independent  $t$ -tests were performed to analyze in more detail the effects on each PEUBI factor. We report means differences and its 95% confidence interval (CI), the  $t$  statistic with its respective degrees of freedom, the significance  $p$ -value, and Cohen's  $d$  index of effect size with its 95% CI. Age differences regarding the level of EUB were analyzed by means of Pearson correlation coefficients, and we report the correlation coefficient with its respective degrees of freedom and its 95% CI, and the significance  $p$  value. Differences due to academic field (only for those with higher post-secondary studies) and religious orientation in the level of EUB were analyzed first by means of a MANOVA, in order to reduce type I errors. We report the Pillai's trace statistic ( $V$ ), the  $F$  statistic with its respective degrees of freedom, the significance  $p$  value, and the eta-squared ( $\eta^2$ ) index of effect size. When the MANOVA was significant, similarly to the case of sex differences, instead of performing multivariate post-hoc analyses it was deemed more appropriate to perform univariate pairwise comparisons in order to explore whether a differential pattern of effects was found through PEUBI factors. More specifically, independent ANOVAs were performed (we report the  $F$  statistic with its respective

degrees of freedom, the significance  $p$  value, and the eta-squared [ $\eta^2$ ] index of effect size and its 95% CI) for later conducting Bonferroni corrected pairwise comparisons. Of note, Welch's  $t$ -tests/ANOVAs were used when the homoscedasticity assumption was not met. Given the lack of variability in academic level (most people with higher post-secondary studies) and political orientation (mostly center-left), these sociodemographic variables were not analyzed. Additionally, these traditional frequentist analyses were complemented with Bayesian analysis (the default priors of JASP were left unchanged). More specifically, we report the Bayes Factor ( $BF_{10}$ ). For an introduction to Bayesian analyses and JASP, see the special issue edited by Vandekerckhove et al. (2018).

### 3 | RESULTS AND DISCUSSION

#### 3.1 | Exploratory factor analysis

The EFA in the first subsample was fitted using Robust Unweighted Least Squares (RULS) estimation with second order (mean and variance) corrections. The factors were expected to be correlated, so the direct solution was obliquely rotated using Robust Promin Rotation (Lorenzo-Seva & Ferrando, 2019). We used polychoric correlations because many item scores had extreme distributions with skewness above 1 in absolute value. The Kaiser–Meyer–Olkin (KMO) index value was .93, which indicated that the correlation matrix was suitable for factor analysis. We computed Parallel analysis (Horn, 1965) as proposed by Lattin et al. (2003), and the results suggested that the data had six underlying factors. However, 33 items did not load on any factor (i.e.,  $\lambda < .30$ ) or were complex and loaded on several factors. Only 11 items loaded in the second factor, with loadings close to .30 in many cases, and some of these items also loaded in other factors. We removed the 33 items that were complex or did not load in any factor (i.e.,  $\lambda < .30$ ) and carried out another EFA with the remaining items. Then, the Parallel analysis suggested that the data had only five underlying factors. For this reason, in the subsequent EFAs that we carried out, we only extracted five factors, eliminating in each case those items that did not saturate on any factor (i.e.,  $\lambda < .30$ ) or that were complex. In each of these analyses, the Parallel analysis again suggested that the data had only five underlying factors. After this process, a total of 36 items remained, with all the items loading on only one factor. In fact, Bentler's Simplicity (S) index (Bentler, 1977) was .99 (Percentile 100) and the Loading Simplicity (LS) index (Lorenzo-Seva, 2003) was .69 (Percentile 100), which suggest that the factor simplicity is high. As before, the Parallel analysis suggested that the data had five underlying factors. The first factor was named *Superstitions* (PEUBI-S), and included items about good or bad luck omens and other kinds of superstitious idea such as “magical” causalities (e.g., the person who catches the bride's bouquet will be the next to get married). The second factor was named *Occultism and Pseudoscience* (PEUBI-OP), and it included items about precognition (divinatory arts, premonitions, etc.), contact with the dead, mind–body dualism (spirits, reincarnation, etc.) and pseudoscience (graphology, hands-on

healing, etc.). This factor includes more items because it is a broad factor that covers different kinds of facets, while the other factors are more specific. The third factor was named *Traditional Religion* (PEUBI-TR), and it included items about traditional religious beliefs (e.g., that Heaven and Hell exist). The fourth factor was named *Extraordinary Life Forms* (PEUBI-ELF), and it included items about legendary creatures (e.g., Loch Ness monster, vampires, dragons, etc.) and alien-related phenomena. Finally, the fifth factor was named *Conspiracy Theories* (PEUBI-CT), and it included items about secret plots of governments or other entities for which there is no evidence (e.g., that the USA government knew in advance that the 9/11 terrorist attack would occur). Therefore, while the PEUBI-S factor mainly refers to different behaviors related to superstition (breaking mirrors, walking under ladders, crossing one's fingers, etc.), the rest of factors directly refer to the beliefs of the participants, and not so much to their behaviors. The Comparative Fit Index (CFI) was .99, the Goodness of Fit Index (GFI) was .99 and the Root Mean Square Error of Approximation (RMSEA) was .001. A CFI and a GFI equal to or higher than .95, and a RMSEA lower than .050, are considered to be good so these indices suggest that the model has a good fit.

#### 3.2 | Confirmatory factor analysis

A CFA was performed in the second subsample to validate the final 5-factor, 36-item solution obtained in the first subsample. The proposed solution consisted of five correlated factors with a full Independent-Clusters (IC) structure, in which each item had only a non-zero loading on one factor. In order to evaluate the adequacy of this model to the data, we examined two comparative measures of fit in relation to the null model (CFI and TLI) and a measure of relative fit per degree of freedom (RMSEA). Both CFI and TLI were .97, and RMSEA was .048. As CFI and TLI were higher than .95, and RMSEA was lower than .050, these indices suggest that the model has a good fit.

#### 3.3 | Final exploratory factor analysis

As the results of CFA led to the same conclusions as the EFA, we carried out a final EFA on the overall sample because a larger sample leads to better estimations of the factor loadings and the factorial weights required to compute the participants' factor scores. Table 2 shows the loading values after rotation. As can be seen, all the loadings are substantial. Regarding simplicity indexes, the S index was .99 (Percentile 100) and the LS index was .68 (Percentile 100), which suggests that the factor simplicity is high.

Furthermore, we carried out a multiple-group factor analysis with the administration format (paper-and-pencil or online administration) as a grouping variable. More specifically, we aimed to determine if the measurement properties of the questionnaire remained invariant across both groups. The strong invariance model was

**TABLE 2** Loading matrix and factor reliabilities obtained in the exploratory factor analysis with the whole sample

Number of item (I)	PEUBI-S	PEUBI-OP	PEUBI-TR	PEUBI-ELF	PEUBI-CT
4. I say "fingers crossed" or I directly cross my fingers to bring me luck.	.65	.03	-.02	-.12	.08
6. If you break a mirror you'll be unlucky.	.73	.06	.01	.11	-.01
13. I try not to open an umbrella indoors because it brings bad luck.	.98	-.05	-.04	-.14	.04
17. I try not to walk under a ladder because it brings bad luck.	.94	-.06	-.01	-.16	.02
22. At a wedding, if you catch the bride's bouquet it means you will be the next one to get married.	.62	-.10	.11	.12	-.02
34. If I blow out all the candles on my birthday cake at once, all my wishes will be granted.	.65	.07	.06	.15	-.06
35. If your ears are ringing, someone is talking bad about you.	.72	.13	-.04	.12	-.05
5. It is a coincidence if a premonition comes true.	-.05	-.60	.02	.02	-.08
9. It is possible to contact the dead with the help of a medium.	-.01	.80	.03	.07	.01
12. Many alternative therapies (Reiki, Bioenergy, etc.) are just passing fashions with no real power to cure.	.05	-.74	-.03	.11	-.07
14. When dreams seem to predict the future, it is mere coincidence.	-.05	-.70	.01	-.01	-.05
16. Suggesting that someone can be cured just by placing your hands on them or thinking about them is a con.	.12	-.73	-.08	-.08	.07
21. Some people can see the spirits of the dead.	.00	.85	-.02	.05	.03
25. I doubt that there are clairvoyants who can predict the future of others.	-.13	-.80	.04	-.04	.07
27. Graphology (determining personality by examining handwriting) has no scientific basis.	-.05	-.41	.04	.09	-.10
28. It is impossible for a dead relative to communicate with us.	.05	-.86	.00	.01	.00
30. Nobody can see the future.	-.06	-.80	.02	-.09	.11
33. I doubt that it is possible to be reincarnated.	.03	-.74	-.03	-.06	.03
3. I believe in God.	-.11	.12	.98	-.19	.00
15. When we pray to God, he listens to us and gives us protection.	-.04	.15	.97	-.16	.02
19. Heaven and Hell exist.	.09	.03	.70	.11	.03
20. If we follow the principles of our religion, God will reward us.	.02	-.06	.94	-.03	.02
23. The Virgin Mary conceived Jesus by the power of the Holy Spirit.	.06	-.23	.87	.17	-.03
32. Nowadays, God, the virgins and the saints are still performing miracles.	.04	-.01	.84	.15	-.03
2. Dragons and unicorns only exist in fantasies.	.02	-.00	-.02	-.66	.06
7. I believe in vampires.	.07	-.10	-.02	.85	-.06
8. Human beings are not the result of an experiment by aliens.	.14	-.10	.07	-.52	-.12
11. The Loch Ness Monster is just an urban legend.	-.05	-.09	.04	-.66	-.01
24. There is evidence that proves the existence of the Yeti and Big Foot.	.05	-.01	.02	.75	.04
26. Some human beings have alien implants.	-.11	.03	.04	.79	.12
1. The most influential and powerful people in the world plotted to cause the economic crisis.	.01	-.07	-.02	.09	.65

TABLE 2 (Continued)

Number of item (I)	PEUBI-S	PEUBI-OP	PEUBI-TR	PEUBI-ELF	PEUBI-CT
10. The cure for cancer has already been found but it is being kept a secret so that pharmaceutical companies can get richer.	.07	.12	-.04	.11	<b>.54</b>
18. The United States government knew beforehand about the terrorist attack on the Twin Towers on 11 September.	-.09	-.07	-.04	.15	<b>.71</b>
29. President Kennedy was the victim of a government plot to assassinate him.	-.05	-.01	.06	.01	<b>.65</b>
31. The official version given by the authorities tends to conceal the truth.	.08	.02	.02	-.05	<b>.62</b>
36. Google and the CIA cooperate to control Internet users.	.05	-.06	.02	-.10	<b>.73</b>
Reliabilities	.93	.96	.97	.91	.85
Ordinal coefficient of fidelity	.92	.96	.90	.91	.97
Test-retest reliabilities	.86	.91	.93	.77	.75

Note: The items have been translated into English for purposes of the scientific publication only. The items were administered in Spanish (see Appendix C). Loadings greater or equal to .30 in absolute value are highlighted in boldface, as they are considered salient loadings.

Abbreviations: PEUBI-S, Superstitions; PEUBI-OP, Occultism and Pseudoscience; PEUBI-TR, Traditional Religion; PEUBI-ELF, Extraordinary Life Forms; PEUBI-CT, Conspiracy Theories.

found to fit the data quite well: CFI = .92, TLI = .91, RMSEA = .045 and SRMR = .053. Therefore, it can be assumed that the administration format does not affect the measurement properties of the questionnaire.

### 3.4 | Item and scale analyses

The means of the items ranged between 1.41 and 4.51, and the standard deviations ranged between 0.84 and 1.41, as can be seen in Table 3. The reliabilities of the factor score estimates (see e.g., Mellenbergh, 1994) are shown in Table 2. They ranged between .85 and .97 and, considering the relatively small number of items in some factors, can be considered to be adequate. Table 2 also shows test-retest reliabilities. The values ranged between .75 and .93, which suggests that the PEUBI factors have temporal stability, especially keeping in mind the considerable amount of time between test and retest (2 months). Table 4 shows the correlations between factors. As can be seen, all the factors were correlated with the others, and the correlations ranged between .22 and .75.

As explained above, we decided to use polychoric correlations, treating the items as ordered-categorical, because some item scores had extreme distributions. Therefore, the most consistent approach to obtain score estimates in this case is the use of factor scores rather than raw scores. However, as can be seen in Table 2, the Ordinal Coefficient of Fidelity (O-COF) corrected for attenuation is equal or higher than .90 in each subscale, which suggests that, for most practical purposes, the raw scores are already good proxies for the latent scores (Ferrando & Lorenzo-Seva, 2021). Therefore, both the raw scores and the factor scores can be validly used for assessment purposes or for collecting validity evidence, although in our study we have used factor scores.

### 3.5 | Convergent and divergent validity

The pattern of correlations between PEUBI and RPBS-Sp, and between PEUBI and OPERAS can be seen in Table 5.

#### 3.5.1 | Correlations with RPBS-Sp

As expected, most of PEUBI factors were significantly correlated with RPBS-Sp factors. More importantly, the larger effect sizes were observed between content-congruent factors. The PEUBI-S factor has the highest correlation with the *Superstition* factor, with a large effect size. Likewise, the PEUBI-TR factor has the highest correlation with the *Traditional religious beliefs* factor, with a large effect size. The PEUBI-ELF factor has the highest correlation with the *Extraordinary life forms* factor, with a large effect size. As was expected, this factor is also correlated with the *Extraterrestrial life and actual visits* factor, with a medium effect size. PEUBI-OP factor has the highest correlations with the factors *Witchcraft*, *Psi*, *Spiritualism* and *Precognition*, with large effect sizes. As the RPBS-Sp does not include a conspiracy factor, the PEUBI-CT factor does not have large correlations with any factor of RPBS-Sp.

#### 3.5.2 | Correlations with OPERAS

As expected, PEUBI factors were little correlated with OPERAS factors. However, four small-sized significant correlations were observed. First, a positive correlation between PEUBI-S and *Conscientiousness* factor. This result does not fit the pattern of effects observed in past research, since there have been reports of negative (e.g., Chauvin & Mullet, 2021; Swami et al., 2011; Williams & Roberts, 2016) and null (e.g., Anyaegbunam et al., 2021; Swami et al., 2011) relationships

**TABLE 3** Means and standard deviations for PEUBI items

Number of item (I)	M	SD
1. The most influential and powerful people in the world plotted to cause the economic crisis.	3.05	1.15
2. Dragons and unicorns only exist in fantasies.	4.51	0.98
3. I believe in God.	2.09	1.35
4. I say "fingers crossed" or I directly cross my fingers to bring me luck.	2.81	1.41
5. It is a coincidence if a premonition comes true.	3.31	1.28
6. If you break a mirror you'll be unlucky.	1.56	0.92
7. I believe in vampires.	1.41	0.84
8. Human beings are not the result of an experiment by aliens.	4.12	1.24
9. It is possible to contact the dead with the help of a medium.	2.08	1.27
10. The cure for cancer has already been found but it is being kept a secret so that pharmaceutical companies can get richer.	2.59	1.41
11. The Loch Ness Monster is just an urban legend.	4.10	1.07
12. Many alternative therapies (Reiki, Bioenergy, etc.) are just passing fashions with no real power to cure.	3.50	1.32
13. I try not to open an umbrella indoors because it brings bad luck.	1.91	1.30
14. When dreams seem to predict the future, it is mere coincidence.	3.57	1.28
15. When we pray to God, he listens to us and gives us protection.	1.81	1.20
16. Suggesting that someone can be cured just by placing your hands on them or thinking about them is a con.	4.03	1.24
17. I try not to walk under a ladder because it brings bad luck.	1.91	1.27
18. The United States government knew beforehand about the terrorist attack on the Twin Towers on 11 September.	2.89	1.24
19. Heaven and Hell exist.	1.92	1.25
20. If we follow the principles of our religion, God will reward us.	1.67	1.08
21. Some people can see the spirits of the dead.	2.31	1.37
22. At a wedding, if you catch the bride's bouquet it means you will be the next one to get married.	1.92	1.17
23. The Virgin Mary conceived Jesus by the power of the Holy Spirit.	1.60	1.14
24. There is evidence that proves the existence of the Yeti and Big Foot.	1.85	1.04
25. I doubt that there are clairvoyants who can predict the future of others.	3.96	1.26
26. Some human beings have alien implants.	1.60	0.95
27. Graphology (determining personality by examining handwriting) has no scientific basis.	3.02	1.20
28. It is impossible for a dead relative to communicate with us.	3.62	1.40
29. President Kennedy was the victim of a government plot to assassinate him.	3.36	1.05
30. Nobody can see the future.	3.82	1.33
31. The official version given by the authorities tends to conceal the truth.	3.65	1.04
32. Nowadays, God, the virgins and the saints are still performing miracles.	1.58	1.01
33. I doubt that it is possible to be reincarnated.	3.74	1.33
34. If I blow out all the candles on my birthday cake at once, all my wishes will be granted.	1.64	0.99
35. If your ears are ringing, someone is talking bad about you.	1.72	1.06
36. Google and the CIA cooperate to control Internet users.	3.65	1.12

Note: The items have been translated into English for purposes of the scientific publication only. The items were administered in Spanish (see Appendix C).

between superstitions and conscientiousness. Second, a negative correlation between PEUBI-S and *Openness to experience* factor. This partially replicates the observed pattern of effects in past research, since there have been reports of positive (e.g., Anyaegbunam et al., 2021), negative (e.g., Williams & Roberts, 2016) and null (e.g., Chauvin & Mullet, 2021; Swami et al., 2011) relationships between superstitions and openness to experience. Third, a positive correlation between PEUBI-TR and *Emotional stability* factor. This partially replicates the observed pattern of effects in past

research, since there have been reports of positive (e.g., Abdel-Khalek, 2010; Saroglou, 2002), negative (e.g., Saroglou, 2002), and null (e.g., Chauvin & Mullet, 2021; Williams & Roberts, 2016) relationships between religious beliefs and emotional stability.<sup>3</sup> Fourth, a negative correlation between PEUBI-CT and *Agreeableness* factor. This partially replicates the observed pattern of effects in past research, since there have been reports of both negative and null relationships between conspiracy beliefs and agreeableness (see Goreis & Voracek, 2019; Lantian et al., 2020).

**TABLE 4** Interfactor correlation matrix

Factor	PEUBI-S	PEUBI-OP	PEUBI-TR	PEUBI-ELF	PEUBI-CT
PEUBI-S	–				
PEUBI-OP	.67***	–			
PEUBI-TR	.48***	.52***	–		
PEUBI-ELF	.62***	.75***	.48***	–	
PEUBI-CT	.39***	.55***	.22***	.54***	–

Abbreviations: PEUBI-S, Superstitions; PEUBI-OP, Occultism and Pseudoscience; PEUBI-TR, Traditional Religion; PEUBI-ELF, Extraordinary Life Forms; PEUBI-CT, Conspiracy Theories.

\*\*\**p* < .001.

**TABLE 5** Correlations between PEUBI and RPBS-Sp and OPERAS questionnaires

Questionnaires	PEUBI				
	-S	-OP	-TR	-ELF	-CT
RPBS-Sp					
Witchcraft	.56***	.79***	.49***	.73***	.32***
Psi	.45***	.71***	.39***	.69***	.27***
Traditional religious beliefs	.63***	.54***	.79***	.58***	.12
Spiritualism	.36***	.75***	.27***	.46***	.33***
Extraterrestrial life and actual visits	.07	.45***	.11	.46***	.36***
Precognition	.64***	.75***	.44***	.58***	.24**
Superstition	.76***	.45***	.52***	.53***	.11
Extraordinary life forms	.46***	.65***	.49***	.80***	.20**
OPERAS					
Extraversion	.09	.18	.04	.16	-.06
Emotional stability	.03	.03	.21*	.02	-.17
Conscientiousness	.22*	.03	.17	-.07	-.08
Agreeableness	-.19	-.13	.14	-.18	-.23*
Openness to experience	-.20*	-.10	-.10	-.07	-.04

Abbreviations: PEUBI-S, Superstitions; PEUBI-OP, Occultism and Pseudoscience; PEUBI-TR, Traditional Religion; PEUBI-ELF, Extraordinary Life Forms; PEUBI-CT, Conspiracy Theories.

\**p* < .050; \*\**p* < .010; \*\*\**p* < .001.

### 3.6 | Sociodemographic correlates

#### 3.6.1 | Sex

MANOVA revealed a significant main effect of sex on PEUBI,  $V = .15$ ,  $F(5, 1453) = 52.58$ ,  $p < .001$ ,  $\eta^2 = .15$ . Going further, univariate *t*-tests revealed that women presented a significant higher level of EUB endorsement in all PEUBI factors (see Table 6). This replicates the observed pattern of effects in past research in paranormal and pseudoscientific beliefs (e.g., Fasce et al., 2021; French & Stone, 2014; Majima, 2015). However, in the cases of PEUBI-ELF and PEUBI-CT, it contrasts with previous literature, where men tended to believe more than women (e.g., Cassese et al., 2020; French & Stone, 2014; Thiem, 2020).

#### 3.6.2 | Age

Pearson correlation coefficients revealed that age was significantly negatively correlated with PEUBI-S, PEUBI-OP, PEUBI-ELF and

PEUBI-CT, and significantly positively correlated with PEUBI-TR (see Table 7). Although the effect sizes of these relationships are small and should be interpreted with caution (especially regarding the relationship with PEUBI-TR, case in which the  $BF_{10}$  indicates that the degree of evidence from the data is rather inconclusive regarding the alternative and null hypotheses), these results partly replicate the pattern of effects observed in past research (e.g., French & Stone, 2014; Irwin, 2009; Majima, 2015; Smallpage et al., 2020).

#### 3.6.3 | Academic field

Appendix B shows which studies were included in each category of academic field. MANOVA revealed a significant main effect of academic field on PEUBI,  $V = .14$ ,  $F(20, 4060) = 7.48$ ,  $p < .001$ ,  $\eta^2 = .04$ . In general terms, univariate Bonferroni corrected pairwise comparisons (see Figure 1; see also Table 8 for details of ANOVAs) revealed that people from Sciences and Technology, Engineering and Architecture are the ones with lesser EUB endorsement. In

**TABLE 6** Sex differences over PEUBI scores (independent t-tests)

	Means difference		t-Test			Effect size		BF <sub>10</sub>
	Value	95% CI	Df	t	p	d	95% CI	
PEUBI-S	5.85	[5.02, 6.68]	1453.86	13.83	<.001	0.72	[0.61, 0.82]	8.28 × 10 <sup>33</sup>
PEUBI-OP	6.01	[5.12, 6.90]	1365.26	13.26	<.001	0.70	[0.59, 0.81]	2.83 × 10 <sup>33</sup>
PEUBI-TR	2.35	[1.40, 3.30]	1347.61	4.86	<.001	0.26	[0.15, 0.36]	5.03 × 10 <sup>3</sup>
PEUBI-ELF	2.96	[2.09, 3.83]	1326.07	6.67	<.001	0.35	[0.25, 0.46]	1.19 × 10 <sup>8</sup>
PEUBI-CT	3.85	[2.94, 4.76]	1222.43	8.30	<.001	0.45	[0.34, 0.55]	5.07 × 10 <sup>13</sup>

Abbreviations: PEUBI-S, Superstitions; PEUBI-OP, Occultism and Pseudoscience; PEUBI-TR, Traditional Religion; PEUBI-ELF, Extraordinary Life Forms; PEUBI-CT, Conspiracy Theories.

**TABLE 7** Age differences over PEUBI scores (Pearson correlation)

	Df	r	95% CI	p	BF <sub>10</sub>
PEUBI-S	1458	-.22	[-.17, -.27]	<.001	5.19 × 10 <sup>14</sup>
PEUBI-OP	1458	-.18	[-.13, -.23]	<.001	1.85 × 10 <sup>9</sup>
PEUBI-TR	1458	.07	[.02, .12]	.006	1.48
PEUBI-ELF	1458	-.12	[-.07, -.17]	<.001	598.72
PEUBI-CT	1458	-.16	[-.11, -.21]	<.001	1.49 × 10 <sup>7</sup>

Abbreviations: PEUBI-S, Superstitions; PEUBI-OP, Occultism and Pseudoscience; PEUBI-TR, Traditional Religion; PEUBI-ELF, Extraordinary Life Forms; PEUBI-CT, Conspiracy Theories.

contrast, those from Social and Legal Sciences are the ones with higher EUB endorsement. Finally, those from Arts and Humanities and Health Sciences have an intermediate degree of EUB endorsement, even though the latter ones seem to slightly believe more. This is in line with our predictions, congruently with results of previous studies (e.g., Díaz-Vilela & Álvarez-González, 2004; Höllinger & Smith, 2002).

### 3.6.4 | Religious orientation

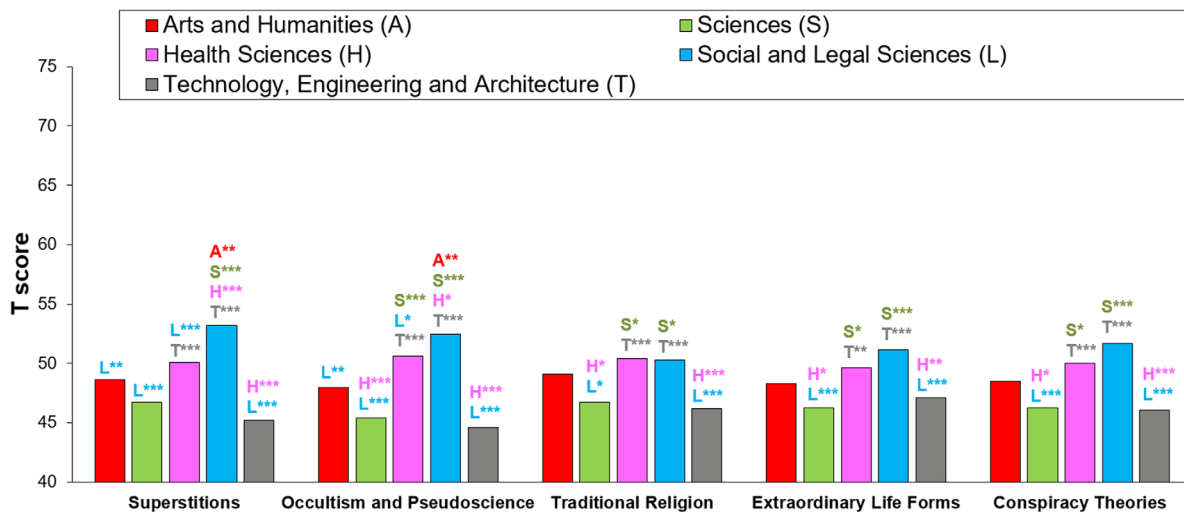
MANOVA revealed a significant main effect of religious orientation on PEUBI,  $V = .74$ ,  $F(15, 4362) = 95.18$ ,  $p < .001$ ,  $\eta^2 = .25$ . Univariate Bonferroni corrected pairwise comparisons (see Figure 2; see also Table 9 for details of ANOVAs) showed the expected gradation in PEUBI-TR (i.e., a linear decrease from more religious to less religious), while in the other PEUBI factors atheists are the ones that consistently believe less (differences between the rest of groups are small and non-significant in many cases).

## 4 | GENERAL DISCUSSION

As mentioned in the introduction, the study of EUB can be of great relevance to both basic and applied research, as well as at the social level. Paranormal, pseudoscientific and conspiracy beliefs seem to form part of this broader common category (Lobato et al., 2014; Rizeq et al., 2020). However, psychometric instruments

for assessing all three types of beliefs are scarce in Spain. In fact, the few scales available focus on only one of them. In the present research, we have developed PEUBI, a 36-item psychometric instrument for assessing paranormal, pseudoscientific and conspiracy beliefs in the Spanish adult population. The results show that these items are grouped into five correlated factors/dimensions: (1) Superstitions, (2) Occultism and Pseudoscience, (3) Traditional Religion, (4) Extraordinary Life Forms, and (5) Conspiracy Theories. PEUBI has proved to be sufficiently reliable in terms of both internal consistency (estimates between .85 and .97) and temporal stability (two-month test-retest estimates between .75 and .93). It has also shown strong evidence of convergent and divergent validity (as evidenced by the pattern of correlations with RPBS-Sp and OPERAS). It also should be mentioned that, despite the concern raised by Genovese (2005), social desirability seems not to affect PEUBI factor scores, and for this reason, we decided not to control this bias. The partial replication of sociodemographic differences found in the literature provided additional evidences of the validity of PEUBI.

From the summary provided above, it seems clear that PEUBI is a valid and reliable psychometric instrument to assess paranormal, pseudoscientific and conspiracy beliefs in Spanish adults. Furthermore, if we retrieve the advantages of multidimensional instruments over separate unidimensional scales, PEUBI constitutes the first multidimensional EUB psychometric instrument for usage in Spain. In addition, it arises as a better alternative than using multidimensional scales translated from English, since PEUBI is adapted to Spanish contexts. For instance, in the questionnaire developed by Lobato et al. (2014) there is an item mentioning the Chupacabra, which is not very well known by most Spanish citizens. On the other hand, there are EUB that are specific of Spain, such as the conspiracy theories about alternative authorships to the 2004 jihadist terrorist attack on the Atocha train station. For this reason, this and other Spanish-specific EUB items were included in the 136-item preliminary version of PEUBI, although they were removed on the basis of the results obtained on the factor analyses, and therefore they do not form a part of the questionnaire's final version. Due to this, the final 36 items do not appear to be exclusively specific to a Spanish context. Consequently, we consider that PEUBI could be easily adapted both to Spanish-speaking countries and other countries with a similar cultural background.

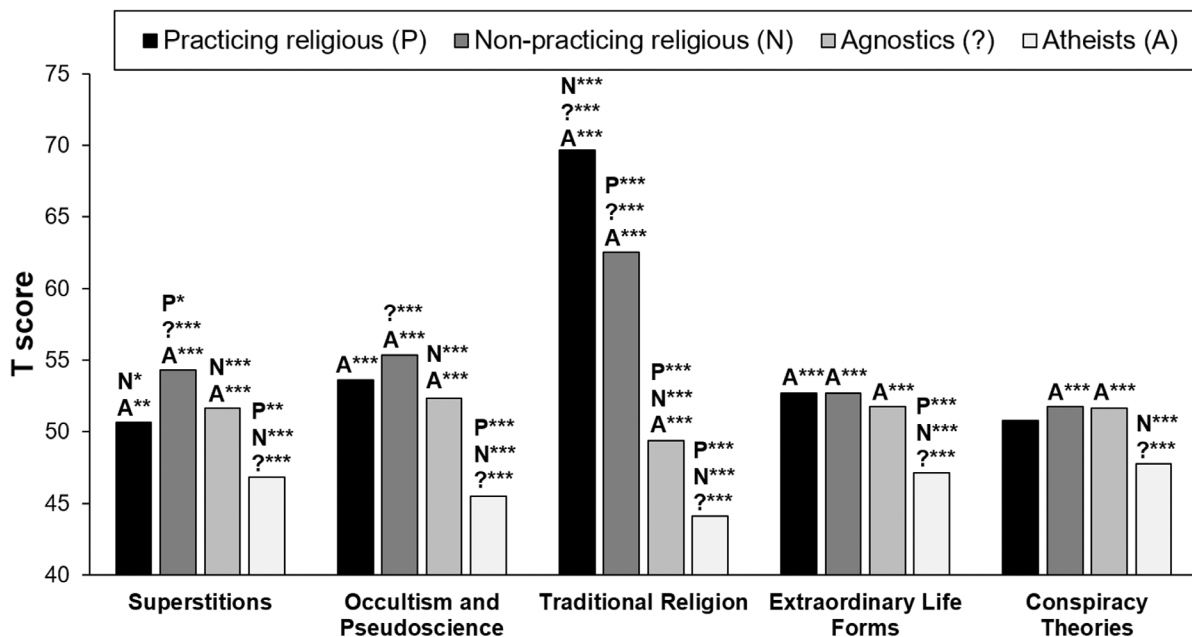


**FIGURE 1** Mean PEUBI factor scores (in *T* scale) by academic field. The letters above each bar indicate with which other categories the differences were significant. Post-hoc pairwise comparisons are Bonferroni corrected. \**p* < .050; \*\**p* < .010; \*\*\**p* < .001

**TABLE 8** Academic field differences over PEUBI scores (independent ANOVAs)

	ANOVA				Effect size		
	<i>Df</i> num	<i>Df</i> den	<i>F</i>	<i>p</i>	$\eta^2$	95% CI	BF <sub>10</sub>
PEUBI-S	4	217.45	34.61	<.001	.09	[.06, .12]	2.36 × 10 <sup>17</sup>
PEUBI-OP	4	211.69	28.88	<.001	.10	[.06, .13]	2.18 × 10 <sup>18</sup>
PEUBI-TR	4	220.63	12.22	<.001	.03	[.01, .05]	4.08 × 10 <sup>3</sup>
PEUBI-ELF	4	213.16	10.77	<.001	.04	[.02, .06]	3.37 × 10 <sup>5</sup>
PEUBI-CT	4	1016	14.07	<.001	.05	[.03, .08]	2.78 × 10 <sup>8</sup>

Abbreviations: PEUBI-S, Superstitions; PEUBI-OP, Occultism and Pseudoscience; PEUBI-TR, Traditional Religion; PEUBI-ELF, Extraordinary Life Forms; PEUBI-CT, Conspiracy Theories.



**FIGURE 2** Mean PEUBI factor scores (in *T* scale) by religious orientation. The letters above each bar indicate with which other categories the differences were significant. Post-hoc pairwise comparisons are Bonferroni corrected. \**p* < .050; \*\**p* < .010; \*\*\**p* < .001

	ANOVA			Effect size			
	Df num	Df den	F	p	$\eta^2$	95% CI	BF <sub>10</sub>
PEUBI-S	3	230.92	56.74	<.001	.10	[.08, .13]	$8.29 \times 10^{31}$
PEUBI-OP	3	233.95	114.38	<.001	.19	[.15, .22]	$2.18 \times 10^{61}$
PEUBI-TR	3	215.86	613.67	<.001	.63	[.60, .65]	$3.74 \times 10^{305}$
PEUBI-ELF	3	227.03	47.10	<.001	.08	[.06, .11]	$2.16 \times 10^{24}$
PEUBI-CT	3	236.58	22.94	<.001	.05	[.03, .07]	$1.99 \times 10^{12}$

Abbreviations: PEUBI-S, Superstitions; PEUBI-OP, Occultism and Pseudoscience; PEUBI-TR, Traditional Religion; PEUBI-ELF, Extraordinary Life Forms; PEUBI-CT, Conspiracy Theories.

However, as mentioned above, a simple translation would not be sufficient: a cultural adaptation and validation process must necessarily be carried out in order to ensure its validity in any other country (e.g., see Beaton et al., 2000).

Sociodemographic differences found here may not necessarily have to be interpreted as a predisposition to EUB per se. Firstly, EUB sex differences may be explained by factors such as differential tendencies toward analytical-intuitive thinking, gender roles, or gender-biased exposure to EUB and science (see French & Stone, 2014; Irwin, 2009; Majima, 2015; Thiem, 2020). Secondly, age differences could be explained, at least partially, by cohort effects (French & Stone, 2014; Irwin, 2009): while older Spanish people were raised in a strongly Catholic society without much exposure to other EUB instances apart from some traditional paranormal beliefs (such as superstitions and ghosts), younger Spanish generations are growing in a context where both traditional religion has lost much of its presence and paranormal (with broader scope of topics), pseudoscience and conspiracy are widespread. Thirdly, academic differences could be explained by means of field-biased differential tendencies toward scientific and critical thinking, a mechanistic understanding about the physical-biological world and ontological confusions (French & Stone, 2014; Irwin, 2009; Lindeman & Svedholm-Häkkinen, 2016). Although this rationale would not fit with the relative high degree of EUB endorsement in the Health Sciences field, it should be noted that health-related pseudoscientific practices have even crept into Spanish universities on occasion (see Benavente, 2016). Fourthly, regarding religious orientation, it does not seem unreasonable that atheists, who are consistent in their rejection of the existence of any kind of divinity, are more prone to reject all EUB types in general; whereas other religious orientations would be more open to the acceptance of other types of EUB.

Finally, some limitations of the present study must be noted. The first limitation, previously mentioned, is that our sample is biased with respect to academic level (i.e., most people with higher post-secondary studies) and political orientation (i.e., most people politically aligned to center-left). We have no reason to believe that this fact would have altered the content/construct validity of PEUBI, however future studies should explore whether the factor structure of PEUBI substantially changes with new samples in which there are more participants with lower academic levels and/or right-wing political opinions. Apart from that, the pilot study conducted provides a control

check to ensure that item comprehension will not be difficult in individuals with low academic level. A second limitation is that pseudoscience is the least represented EUB type in PEUBI. Fortunately, it can be complemented with either PSEUDO-RS (Fasce et al., 2021) or PES (Torres et al., 2020). A third limitation is that, as Torres et al. (2020) mention, EUB scales may need to be revised in the future, since they are sociocultural and historically dependent (Irwin, 2009): the degree to which the beliefs in PEUBI are endorsed by the general Spanish adult population may vary, just as the evidence for or against them may vary, too.

#### AUTHOR CONTRIBUTIONS

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#### ACKNOWLEDGMENTS

We would like to thank Antoni Masip for his assistance in the virtual implementation of the questionnaire. We would also like to thank Harry Price for the linguistic revision of the manuscript.

#### CONFLICT OF INTEREST

We have no conflicts of interest to disclosure. Parts of this work were presented as a poster at the International APPE—SEPEX Meeting (5–7 May 2022) and the 2022 JASP Annual Workshop (29–30 August 2022).

#### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## ENDNOTES

<sup>1</sup> In the context of paranormal, pseudoscientific and conspiracy beliefs, alternative nomenclatures to EUB have also been used, such as epistemically suspect beliefs (e.g., Majima et al., 2022), scientifically unsubstantiated beliefs (e.g., Stone et al., 2018), scientifically unaccepted beliefs (e.g., Irwin & Marks, 2013), and contaminated mindware (e.g., Rizeq et al., 2020).

<sup>2</sup> In the creation of paranormal beliefs items, the authors faced the great variability of topics considered under the 'paranormal' umbrella term (see French & Stone, 2014; Irwin, 2009). To cover the main paranormal topics exhaustively, we considered the categories described by Irwin (2009): superstitions, psi processes, divinatory arts, esoteric systems of magic, New Age therapies, spiritism, eastern mystico-religious beliefs, Judeo-Christian religious beliefs, extraterrestrial aliens, cryptozoological creatures and traditional folkloric beliefs. We also considered many other topics mentioned by French and Stone (2014), such as spontaneous combustion, destiny, near-death experiences, myths about hypnosis, the sense of a presence, cosmic energies and synchronicity with the universe.

<sup>3</sup> Emotional stability is often referred to as neuroticism, which is its inverse.

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**How to cite this article:** Huete-Pérez, D., Morales-Vives, F., Gavilán, J. M., Boada, R., & Haro, J. (2022). Popular epistemically unwarranted beliefs inventory (PEUBI): A psychometric instrument for assessing paranormal, pseudoscientific and conspiracy beliefs. *Applied Cognitive Psychology*, 36(6), 1260–1276. <https://doi.org/10.1002/acp.4010>

## APPENDIX A

### A.1 | PEUBI instructions

#### A.1.1. | Spanish (original)

A continuación se presentan un conjunto de frases en relación a tus intereses, actitudes y opiniones. No hay respuestas correctas ni incorrectas, ni tampoco respuestas buenas o malas. Debes decidir hasta qué punto cada frase describe tu forma de pensar. Las alternativas de respuesta para cada frase son:

1. Completamente en desacuerdo
2. Bastante en desacuerdo
3. Ni de acuerdo ni en desacuerdo
4. Bastante de acuerdo
5. Completamente de acuerdo

Ejemplo: *Evito pisar las rayas de las baldosas.*

En esta afirmación, una persona que conteste *Bastante de acuerdo* consideraría que en general evita pisar las rayas de las baldosas, aunque no siempre.

#### A.1.2. | English (translation)

Below there is a set of statements regarding your interests, attitudes and opinions. There are no right or wrong answers, neither good or bad answers. You must decide to what extent each statement describes the way you think. The response alternatives for each statement are:

1. Fully disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Fully agree

Example: *I avoid stepping on the stripes on the tiles.*

In this statement, a person who answers *Agree* would consider that in general he/she avoids stepping on tile stripes, although not always.

## APPENDIX B

### B.1 | Studies included in each academic field category

- *Arts and Humanities:* archeology, art history, design, film studies, fine arts, graphic design, history, illustration, languages, linguistics, literature, make-up and character design, performing arts and audiovisual interpretation, philology, philosophy, translation and interpreting.
- *Sciences:* biochemistry, biology, chemistry, enology, environmental health, genetics, geology, mathematics, physics.
- *Health Sciences:* biomedicine, clinical diagnostic laboratory, diagnostic imaging studies, human nutrition and dietetics, medicine, nursing, occupational therapy, odontology, oral and dental hygiene, pathological anatomy and cytodiagnosis, pharmacology, physical activity and sports sciences, physiotherapy, psychology, speech therapy.
- *Social and Legal Sciences:* administration, advertising and public relations, anthropology, audiovisual communication, business management and administration, business sciences, commerce management and distribution, criminology, early childhood education, economy, educational sciences, gender studies, geography, human resources, information sciences, journalism, labor relations, law, leadership and entrepreneurship, librarianship and documentation, management assistance, marketing, pedagogy, political and administration sciences, primary education, sanitary documentation, social education, social integration, social work, sociology, tourism.
- *Technology, Engineering and Architecture:* aerospace engineering, agri-food engineering, architecture, artificial intelligence, automatic control and regulation systems, biological systems engineering, biomedical engineering, chemical engineering, computational linguistics, computer engineering, computer systems management, electrical engineering, electronic engineering, forest engineering, industrial and automatic electronics engineering, industrial design, mechanical engineering, mechatronics, mining engineering,

multimedia engineering, road, canal and port engineering, software development, technical and computer systems engineering, telecommunication engineering, videogames development.

## APPENDIX C

### C.1 | PEUBI final items

1. Los más influyentes y poderosos del mundo pactaron generar la crisis económica.
2. Los dragones y los unicornios únicamente existen en la fantasía.
3. Creo en Dios.
4. Digo “crucemos los dedos” o directamente cruzo los dedos para tener buena suerte.
5. Es una casualidad que un presentimiento se haga realidad.
6. Si rompes un espejo te irán mal las cosas.
7. Creo en la existencia de los vampiros.
8. Los humanos no somos un experimento alienígena.
9. Con la ayuda de un médium es posible contactar con los muertos.
10. Ya se sabe cuál es la cura del cáncer, pero se mantiene en secreto para enriquecer a las farmacéuticas.
11. El monstruo del Lago Ness es tan solo una leyenda urbana.
12. Muchas terapias alternativas (Reiki, Bioenergía, etc.) son una moda sin propiedades curativas reales.
13. Evito abrir los paraguas en sitios cerrados porque da mal fario.
14. Cuando parece que los sueños predicen el futuro, solo es una coincidencia.
15. Cuando rezamos a Dios él nos escucha y nos protege.
16. La idea de curar a alguien solo con poner las manos encima o con sus pensamientos es una estafa.
17. Evito pasar por debajo de una escalera porque trae mala suerte.
18. El gobierno estadounidense conocía de antemano que se produciría el atentado de las Torres Gemelas del 11-S.
19. El cielo y el infierno existen.
20. Si cumplimos con los principios de nuestra religión Dios nos recompensará.
21. Algunas personas pueden ver los espíritus de los muertos.
22. En una boda, si coges el ramo de la novia significa que serás el/la siguiente en casarte.
23. La Virgen María concibió a Jesús por obra del Espíritu Santo.
24. Hay evidencias que muestran la existencia de seres como el Yeti o el Big Foot.
25. Dudo que haya videntes que puedan predecir el futuro de los demás.
26. Existen humanos con implantes alienígenas.
27. La grafología (evaluación de la personalidad a través del análisis de la escritura manuscrita) no tiene validez científica.
28. Es imposible que un familiar fallecido se comunique con nosotros.
29. El presidente Kennedy fue víctima de una conspiración gubernamental para asesinarlo.
30. Nadie tiene la capacidad de ver el futuro.
31. La versión oficial de las autoridades suele esconder la verdad.
32. Hoy en día Dios, las Vírgenes y los Santos aún siguen haciendo milagros.
33. Dudo que sea posible reencarnarse.
34. Si apago todas las velas de una vez en mi tarta de cumpleaños se cumplirán mis deseos.
35. Si te pitan los oídos, alguien está hablando mal de ti.
36. Google y la CIA cooperan para controlar a los usuarios de internet.