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The Revised Paranormal Belief Scale (RPBS) is the most widely-used tool for measuring beliefs in paranormal phenomena, although it is not free from criticism. Lindeman and Aarnio (2006) proposed an extended version of the RPBS with some improvements and a second-order hierarchical model to explain the structure of the scale. Our objective was to analyze the goodness of fit of the model and measurement invariance by sex in a Spanish sample. A sample of 6,584 participants completed the extended RPBS. After reversed items were removed, the model demonstrated an adequate fit, significant factor loadings and invariance between sexes. The results suggest the possibility of generalizing the RPBS to other cultures. Nonetheless, further research is needed to agree a precise definition of the concept of paranormal beliefs.

Keywords: *paranormal beliefs, RPBS, construct validity, invariance of measurement, reversed items*

Beliefs are clearly intrinsic to human beings. While we have inherited the mechanism for its generation, its content, paranormal or not, is fundamentally context dependent (Lindeman & Aarnio, 2007). Therefore, we are all susceptible to paranormal beliefs according to our context.

Throughout our evolution as a species, paranormal beliefs have served adaptive functions that have favored individual (Foster & Kokko, 2009 and group (Díaz-Vilela, 2004) survival. The ability to establish, in such a hostile environment, patterns of unrelated elements constituted a psychic relief that shaped our thinking (Shermer, 2009). Irwin (2009) indicated that paranormal belief constitutes a cognitive bias that allows reality to be filtered without threatening the emotional balance by generating an "illusion of control". The proactive attitude that implies that the belief that our actions will have some positive outcome would bring relief. This would reinforce that belief, being more adaptive than skepticism that would lead to inactivity (Matute, 2019). Skinner's (1948) findings on superstition in pigeons were among the first empirical evidence for this idea.

While adaptive in an uncertain and dangerous evolutionary environment, these beliefs may be maladaptive in current civilization (Kahneman, 2012). Despite scientific, technological and social developments, paranormal beliefs are very common among current population. Surveys consistently show that about half of people have one or more paranormal beliefs, and about half of them claim to have had an actual paranormal experience (Irwin, 2009). Gershman (2022) collected and analyzed survey data from 80 countries and found that belief in witchcraft is very common around the world, averaging around 30% of the population. In Europe, the prevalence was lower with an average of 15%. In Spain, the results were similar with around 17% of the population.

Although paranormal beliefs are commonly defined as contrary to scientific knowledge, the use of the concept is ambiguous and there is no consensus as far as the name is concerned (Lindeman & Svedholm, 2012). The scientific literature contains a variety of terms such as false, pseudoscientific, supernatural, paranormal, magical, superstitious, irrational, and epistemically unwarranted beliefs.

Martin (1994) considered the paranormal to be related to time and culture. Following Braude, a phenomenon P is paranormal if it meets three requirements: (a) it cannot be explained by current scientific theory, (b) it cannot be explained without major revisions of scientific theory, and (c) it frustrates our familiar expectations as to what sort of things can happen to the objects involved in the phenomenon P. Goode (2000) understood science and the paranormal as social phenomena. What differentiated the two concepts was the collective consensus or the lack thereof, not intrinsic questions of belief. What is important for that author is not the differentiation between what is paranormal or not, but rather what the "beliefs of scientists" are at any given time. Irwin (2009) called the paranormal beliefs as scientifically unaccepted beliefs.

On the other hand, Lindeman and Svedholm (2012) understood paranormal, superstitious, magical and supernatural beliefs (PSMS) to be category mistakes, by attributing a characteristic from one ontological category to an element belonging to another. They stipulated that the scope of PSMS belief should be limited to confusions of ontological distinctions that are learnt in childhood with no explicit instruction, independently of culture, that is, basic, intuitive knowledge. This is a conceptualization that, according to those authors, enables these beliefs to be identified more accurately than the fact of defining them as contrary to scientific knowledge.

Revised Paranormal Belief Scale (RPBS)

The Revised Paranormal Belief Scale (RPBS) by Tobacyk (2004), a slightly improved version of the first scale (PBS, Tobacyk & Milford, 1983), is the most widely-used instrument for measuring the personal range of paranormal beliefs. Tobacyk (2004) proposed moving from a five-point Likert scale to a seven-point scale (1=strongly disagree and 7=strongly agree), extended to seven factors (religious beliefs, psychic powers, witchcraft, superstition, spiritualism, extraordinary life forms and precognition) and 26 items. These changes represented an improvement in the range restriction and an increase in reliability and validity regarding the original scale.

Several studies have reported different results about the metric properties of the RPBS. These studies have usually focused on the number of dimensions and indicated differences regarding the relationship between these dimensions. Some authors suggested that the factors were orthogonal and others concluded that they were oblique (Díaz-Vilela & Álvarez-González, 2004). According to Lange et al. (2000), the factor structure of the RPBS was significantly affected by age and sex, which suggested the existence of differential item functioning (DIF). The elimination of DIF items resulted in a structure with two factors, which were named "New Age Philosophy" and "Traditional Paranormal Beliefs."

Factor analyses in different countries have produced heterogeneous models of the scale, which indicates the influence of context in the study of these beliefs. Utinans et al. (2015) obtained a structure with six factors from a Latvian version. In Croatia, Mikloušić et al. (2012) showed three dimensions, while the scale translated into French by Bouvet et al. (2014) had seven factors, just like the original RPBS.

In a Spanish adaptation, Díaz-Vilela and Álvarez-González (2004) included four new items concerning the existence of ghosts, UFO sightings, extraterrestrial visits, and the incantation known as "mal de ojo" (evil eye). They eliminated the only reversed item, due to its very low correlation with the total scale. The scale, which they called "RPBS-Sp," ended up being composed of 29 items and 8 factors: seven similar to the original RPBS factors, plus another comprising the new items related to extraterrestrial life and its presence on Earth. They partially replicated the model from Lange et al. (2000)—eight factors were optimally regrouped in two second-order factors– even though they did not follow the exact same grouping.

Strikingly, despite the fact that prior to the creation of the original scale, Tobacyk and Wilson (1988) found that belief in lunar effects showed significant correlations with psi factors (extrasensory capabilities), extraordinary life forms, witchcraft, spiritualism, and precognition, the RPBS contains no statements referring to these beliefs. Wiseman and Watt (2004) indicated that it was an incomplete

measure since it needed to include items referring to positive superstitions, because it only contained, and contains, negative beliefs. According to Lindeman and Aarnio (2006), the scale had few items to assess belief in astrology. Nor did it contain any of the more common beliefs, such as amulets, rituals, ghosts, or spirits. Díaz-Vilela and Álvarez-González (2004) also pointed out the need to add some items and exclude items referring to little-known myths in non-English speaking cultural contexts (the Loch Ness Monster and the Abominable Snowman / Yeti). Drinkwater et al. (2017) criticized the omission of some important beliefs, for instance ghosts and "poltergeists," and the fact that others were underrepresented.

Given the lack of evidence for clear dimensionality of paranormal beliefs and the need to shed light on this question, based on the shortcomings observed in the original RPBS, Lindeman and Aarnio (2006) expanded the RPBS from Tobacyk (2004) with beliefs that had not been addressed, and added new items for underrepresented beliefs. Their goal was to analyze whether beliefs form independent subsets and to test a structural model of beliefs and their potential correlates. After psychometric analyses, they obtained four lower-order factors in addition to the higher-order factor. These were Agents, Signs, Vital Power, and Food. They had added the Magical Beliefs about Food and Health Scale (Lindeman, Keskivaara, & Roschier, 2000) to their analyses, however, they did not consider this scale as part of the expanded RPBS despite its inclusion in the analysis. The higher-order factor explained all of the variation in the Vital Power factor, indicating that it was a pure measure of the higher-order factor of paranormal beliefs. In addition, the higher-order factor explained two thirds of the variation in the Agents factor, and about half of the variation in the Signs factor and in the Food factor. The general trend of believing in paranormal phenomena was the strongest predictor of all the specific paranormal beliefs measured in that study.

This study's contributions were fundamental to measuring a range of personal beliefs and paranormal phenomena, since they corrected some errors by adding items that improved the construct validity of the scale. However, testing of an extended RPBS scale has not been done with a Spanish population. Such a study would also provide an opportunity to replicate Lindeman and Aarnio's (2006) finding of gender invariance in responses to the extended RPBS.

Study

The main objective of our study was to test the extended RPBS of Lindeman and Aarnio (2006) with Spanish population. We did not include the Magical Beliefs about Food and Health Scale because they did not consider as part of the extended RPBS. Despite the existence of a Spanish adaptation of the RPBS (Díaz-Vilela and Álvarez-González, 2004), we used Aarnio and Lindeman's (2006) RPBS because these authors carried out a considerable extension and improvement of the scale of Tobacyk (2004).

Since the literature also shows significant differences between women's and men's paranormal beliefs (Aarnio & Lindeman, 2005; Andrews & Tyson, 2019; Drinkwater et al., 2017; Fox, 1992; Goode, 2000; MacDonald, 1995; Randall & Desrosiers, 1980; Rice, 2003; Richman & Bell, 2012; Utinans et al., 2015; Schulter & Papousek, 2008; Williams et al., 2007; Wiseman & Watt, 2004), our second objective was to analyze measurement invariance between sexes.

Method

This study used semi-probabilistic sampling that included self-selection to test the extended RPBS with a Spanish university student population, as well as test for sex diffrences in paranormal beliefs.

Participants and Recruitment

Participants were recruited from students enrolled at the University of the Balearic Islands (UIB). Each academic year between 2014 and 2018, the questionnaire was sent out individually to 100% of students enrolled in the first and fourth years through the UIB intranet. Participation was voluntary, and no compensation or reward was offered.

Measures

Marjaana Lindeman and Kia Aarnio granted permission to use the items from their extension (2006) of the original RPBS by Tobacyk (2004). We were given a 55-item scale made up of 22 items from the original RPBS plus 33 drawn up by these

authors, based on previous literature (Otis & Alcock, 1982; Carroll, 2003). They did not include the items from the Magical Beliefs about Food and Health Scale.

The 55 items in the Extended RPBS were translated into Catalan (the standard language at the University of the Balearic Islands). Since most of the items had very simple syntax and low semantic complexity (for instance, *I believe in God, There are actual cases of witchcraft, If you break a mirror, you will have bad luck*), a careful adaptation of meanings was carried out, going beyond mere literal translation or the use of the reverse translation method, which, in the opinion of Muñiz et al. (2013), is afforded too much weight.

Rather than the 5-point scale used by Lindeman and Aarnio (2006), following the proposal by Tobacyk (2004), we used a 7-point Likert scale (1 = *strongly disagree* and 7 = *strongly agree*). Tobacyk (2004) indicated that this enables respondents to describe their beliefs with greater precision.

Reliability analysis of the total scale gave a Cronbach's α of .97. As in the model of Lindeman and Aarnio (2006), the 55 items were grouped in 12 sub-scales. *Spiritualism* (α = .85) was assessed via four items referring to communication with the dead, reincarnation and the existence of the soul. Beliefs in *Ghosts* (α = .90) were measured with three items. Seven items measured beliefs in *Extraterrestrials* (α = .89). Six items referred to *PSI* (α = .76), three related to psychokinesis and three to telepathy. Beliefs in *Witchcraft* (α = .87) were measured with four items about its existence, spells, and black magic. *Religion* (α = .83) consisted of four items about God, the Devil, Heaven, Hell, and the immortality of the soul. Beliefs about luck were measured with three sub-scales concerning *Amulets* (α = .87), *Rituals* (α = .25) and *Superstition* (α = .84) with three items each. The belief in *Astrology* (α = .88) consisted of five items related to the ability to predict the future, personality traits and horoscopes. The sub-scale *Lunar Effects* (α = .84) included eight items about the impact of the moon on agriculture, health and people's behavior. Beliefs in *Feng Shui* (α = .83) were measured with five items about health, success, people's well-being, and energy influences.

Procedure

Once participants had read, understood and signed their informed consent, they could begin the survey. In order to minimize self-selection bias, no mention was made of paranormal beliefs in the survey presentation or instructions. Generic terms were used, stating that it was "a study of certain student beliefs at the UIB in relation to the degrees they were taking".

After consulting the UIB Legal Advice service, and according to current legislation, the study was not considered ethically sensitive. The survey was approved without needing to request additional approval from the UIB Research Ethics Committee.

Data Analysis

Since the sample was self-selected, tests were conducted to detect possible bias. For each academic year, we compared the ratio between population and sample in three variables: branch of knowledge, year, and sex. The results with the worst fit, in terms of ratio, were found with regard to year. In general, first year students were overrepresented compared to fourth year students. This was probably the result of first-year students being more enthusiastic about answering university surveys. As regards branch of knowledge, both the sample and the population showed similar ratios with a confidence interval with 0.95%. There were only some differences in Social and Legal Sciences with an underrepresentation of -6.1%, ($Z = -3.05$, $p < .01$) and in Sciences with an overrepresentation of 4.6% ($Z = 2.07$, $p < .01$) in the 2014–15 academic year. As for sex, both sample and population demonstrated suitable ratios ($p > .05$) in each academic year, except for 2017–18 with an overrepresentation of females 3.3% ($Z = 2.22$, $p = .01$). Given the small differences, the sample can be considered to be free of notable bias and, as such, representative of the university student population of the University of the Balearic Islands (UIB).

For analysis of participant responses we used AMOS v.21 software to assess the suitability of the hierarchical model from Lindeman and Aarnio (2006) and the factorial invariance by sex. Using structural equation modelling (SEM), we carried out second-order and multigroup confirmatory factor analyses (CFA). Beforehand, we analyzed the

internal consistency reliability of the full RPBS-E and the 12 sub-scales using SPSS 21.

After cleaning the items with poor corrected item-total correlation (Steenkamp & van Trijp, 1991), the remaining items were transformed to homogeneous groups of items or parcels as Lindeman and Aarnio (2006) did. Subsequently, the necessary unidimensionality of each plot was confirmed (Kline, 2016). The observed factors corresponded to the average of the items of the 12 sub-scales. As a general rule, Iacobucci recommends using the *Maximum Likelihood* (ML) method in SEM analyses. This method requires certain statistical assumptions to be met, such as having an adequate sample size (n>400; Boomsma & Hoogland, 2001).

We also used the Bootstrap technique. Instead of assuming a specific theoretical distribution, the Bootstrap generates an empirical distribution based on resampling with replacement. Inferences, such as confidence intervals, are performed on the approximation to the statistical sample distribution (Medrano & Muñoz-Navarro, 2017). The stability of the estimated parameters is examined and values are reported with higher accuracy (Byrne, 2001).

We tested measurement invariance related to the sex variable. These tests were carried out based on a series of hierarchically nested models to different levels of configuration, metrics, scale, and residual results.

Following analysis of the scales' reliability, we carried out three CFAs corresponding to the subsample shown in Table 2. The first CFA estimated the model with the first subsample (n=2,958). The second CFA was a replication and validation of the first one, but using the second subsample (n=3,381). The third CFA analyzed the factorial invariance about sex using the sample, after elimination of participants from the first academic of the first year of the study to avoid possible repeated measures (N=5,683). All the analyses were performed using ML, complemented by 1000 Bootstrap resamples (Cheung & Lau, 2008), a 95% confidence interval, and using data transformed to *Z* values and parcel items.

Results

A total of 6,584 students enrolled between 2014 and 2018 at the University of the Balearic Islands (UIB) participated in the study (Table 1). Of these, 60.4% were women, and 39.6% were men; 58.1% were enrolled in the first year of university, with an average age of 19.85 (*SD* 2.77), while 41.9% were in the fourth year with an average age of 23.37 (*SD* 2.31).

Knowledge Branch	Academic Year	Men		Women	
		n	%	*n*	%
Arts and Humanities	1st	119	33.1	241	66.9
	4th	119	37.8	196	62.2
Total		238	35.3	437	64.7
Social and Legal Science	1st	620	31.8	1332	68.2
	4th	519	32.9	1057	67.1
Total		1139	32.3	2389	67.7
Health Science	1st	135	24.9	407	75.1
	4th	82	26.8	224	73.2
Total		217	25.6	631	74.4
Sciences	1st	189	47.1	212	52.9
	4th	125	46.6	143	53.4
Total		314	46.9	355	53.1
Engineering and Architecture	1st	460	80.8	109	19.2
	4th	240	81.6	54	18.4
Total		700	81.1	163	18.9
Total		2608	39.6	3975	60.4

Table 1. Distribution of the initial sample according to knowledge branches, academic year and sex (N = 6,584)

Subsample	Academic year	Sex						
		Men		Women		Total	
		n	%	n	%	n	%
Estimation	1st (2014–2015)	464	40.7	676	59.3	1140	38.5
	3rd (2016–2017)	745	41.0	1073	59.0	1818	61.5
	Total	1209	40.9	1749	59.1	2958	100
Replication and Invariance	2nd (2014–2015)	681	39.8	1031	60.2	1712	50.6
	4th (2016–2017)	640	38.3	1029	61.7	1669	49.4
	Total	1321	39.1	2060	60.9	3381	100
Invariance analysis	Total	2267	39.9	3416	60.1	5683	100

Note: To generate the subsamples, from the total cleaned sample without the 244 outliers, participants were divided in such a way that students from the first academic year in the first year of the study did not coincide with students from the fourth academic year in the fourth year of the study, as they could be the same students. For this same reason, the students from the first academic year of the first year of the study were removed from the subsample to analyze invariance.

Table 2. Distribution of the subsamples by academic year and sex for each CFA

Since the sample was self-selected, we tested to what extent it might be biased. For each academic year we compared the ratio between population and sample in three variables: branch of knowledge, year, and sex. The results with the worst fit, in terms of ratio, were found with regard to year. In general, first year students were overrepresented compared to fourth year students. This was probably the result of first-year students being more enthusiastic about answering university surveys. As regards branch of knowledge, both the sample and the population showed similar ratios with a confidence interval with 0.95%. There were only some differences in Social and Legal Sciences with an underrepresentation of -6.1%, ($Z = -3.05$, $p < .01$) and in Sciences with an overrepresentation of 4.6% ($Z = 2.07$, $p < .01$) in the 2014–15 academic year. As for sex, both sample and population demonstrated suitable ratios ($p > .05$) in each academic year, except for 2017–18 with an overrepresentation of females 3.3% ($Z = 2.22$, $p = .01$). Given the small differences, the sample can be considered to be free of notable bias and, as such, representative of the university student population of the University of the Balearic Islands (UIB).

The values of the three reversed items (8, 21, and 24) were reversed. After the removal of the 1sr year participants from the 1st academic year of the study to avoid possible repeated measures (n = 5,683), a univariate normality analysis indicated that items 4, 11, 14, 19, 22 and 34 obtained skewness values between two and three. The rest of the items indicated values below two. In terms of kurtosis, none exceeded seven. Therefore, a distribution with univariate normality is given (Curran et al., 1996). In contrast, the Mardia coefficient (81.88) showed lack of normal multivariate distribution. Accordingly, the direct values were transformed into standard values and an analysis of multivariate atypical values was carried out. Using the Mahalanobis distance (D^2), we detected 244 cases with significant distances in relation to the centroids of the 12 variables. After removing these multivariate atypical cases, a Mardia coefficient of 58.53 was achieved. The ML method is considered robust with a coefficient lower than 70 (Rodríguez & Ruíz-Díaz, 2008).

Reliability and Unidimensionality of the Scales

With the cleaned sample (N = 5,683) and after the reliability analysis, four items were removed due to their low corrected item-total correlation: item 8 (-.05) from Lunar Effects, item 21 (-.07) from Rituals, item 24 (.05) from PSI, and item 51 (.24) from Extraterrestrials. The first three items (8, 21, and 24) are reverse items that can be called "skeptic" because they reject paranormal belief. The rest can be called "believer". There should be a negative correlation between the "skeptic" and "believer" items. Correlation analyses were carried out between the values of the "skeptic" items and the means of the "believer" items of the factor to which

	M	SD	Skew g¹	Skew C.R.	Kurtosis g².	Kurtosis C.R.
			g^1	C.R.	g^2.	C.R.
1. The soul continues to exist though the body may die.*	3.56	2.11	0.16	4.94	-1.3	-20.32
2. Some individuals are able to levitate (lift) objects through mental forces.*	1.92	1.50	1.7	53.39	2.11	33.1
3. By using a lucky charm people can protect themselves against illnesses.	2.08	1.56	1.36	42.55	0.87	13.59
4. Black cats can bring bad luck.*	1.54	1.25	2.58	80.72	6.23	97.57
5. Knowledge about an individual's personality can be achieved through astrology.	2.43	1.74	0.95	29.7	-0.28	-4.33
6. Astrology is a way to accurately predict the future.*	1.78	1.33	1.75	54.79	2.37	37.09
7. You should not have a TV in the bedroom because the screen superimposes too strong life energy to make peaceful sleep possible.	2.17	1.72	1.33	41.52	0.61	9.49
8. Moon's gravitational forces cannot affect a person's mental well-being. (R)	4.74	2.01	-0.49	-15.31	-0.93	-14.52
9. Psychokinesis, the movement of objects through psychic powers, does exist.*	1.97	1.49	1.57	49.28	1.7	26.68
10. Reincarnation does occur.*	2.57	1.80	0.84	26.41	-0.41	-6.36
11. If you break a mirror, you will have bad luck.*	1.69	1.36	2.13	66.74	3.93	61.55
12. During altered states, such as sleep or trances, the spirit can leave the body.*	2.04	1.64	1.5	47	1.19	18.65
13. Some of the light phenomena of the sky cannot be explained by anything else than the over flight of spacecrafts.	2.46	1.79	1	31.48	-0.1	-1.59
14. A horoscope carefully devised by a professional describes a person's future reliably.	1.65	1.23	2.1	65.77	3.98	62.34
15. Moon's position may influence people's behavior	3.22	2.00	0.39	12.25	-1.11	-17.44
16. Some UFOs (Unidentified Flying Objects) are probably spaceships of aliens.	2.67	1.87	0.83	26.02	-0.48	-7.49
17. A person's thoughts can influence the movement of a physical object.*	1.80	1.39	1.87	58.61	2.92	45.75
18. Through the use of formulas and incantations, it is possible to cast spells on persons.*	1.88	1.48	1.72	53.91	2.12	33.21
19. The number "13" is unlucky.*	1.54	1.23	2.58	80.74	6.31	98.93
20. Witches do exist.*	2.14	1.77	1.47	46.09	1.02	15.93
21. I don't believe that rituals have an influence on success. (R)	4.34	2.53	-0.23	-7.34	-1.65	-25.82
22. A horoscope carefully devised by a professional describes a person's future reliably.	1.70	1.28	2	62.66	3.52	55.14
23. There is a heaven and a hell.*	2.21	1.77	1.35	42.31	0.72	11.25
24. Mind reading is not possible (R).*	4.48	2.23	-0.38	-12.02	-1.28	-19.99
25. Amulets, for instance a specific piece of jewel, bring good luck.	2.51	1.82	0.89	27.87	-0.44	-6.88
26. It is possible to communicate with the dead *	2.49	1.88	0.97	30.31	-0.32	-4.96
27. I believe in God.*	2.66	2.09	0.92	28.84	-0.57	-8.95
28. UFO abductions, in which aliens abduct a human, have happened.	1.79	1.41	1.89	59.08	2.97	46.54
29. Some people are capable of transferring thoughts telepathically.	2.26	1.68	1.16	36.45	0.3	4.64
30. Full moon deteriorates some people's mental health.	2.24	1.67	1.19	37.43	0.42	6.61
31. Going through some rituals before an exciting event can bring good luck.	2.27	1.70	1.14	35.7	0.16	2.57
32. The moon has an influence on how farming pans out	4.43	2.14	-0.34	-10.55	-1.19	-18.65
33. The position of the stars at the time of birth influences personality.	2.54	1.87	0.92	28.73	-0.4	-6.22
34. You should not place cactuses at home or at your office because they may bring about imbalance.	1.60	1.20	2.18	68.37	4.54	71.17
35. Some people have an ability to perceive hidden objects without physical (known) senses.	3.31	2.10	0.35	11.04	-1.22	-19.13
36. Alien visits on Earth have been able to be proved by the objects the aliens left and which include material unknown on the Earth.	2.24	1.68	1.19	37.29	0.39	6.14
37. Moon's position (e.g., full moon) affects fertility	3.03	1.99	0.51	15.88	-0,99	-15.54
38. There is a devil.*	2.05	1.77	1.62	50.86	1.46	22.93
39. Furnishing according to the principles of Feng Shui balances your environment and thus effects your health and success in a positive way.	2.85	1.94	0.63	19.68	-0.84	-13.2
40. Ghosts exist.	2.57	1.96	0.93	29.06	-0.45	-7.11
41. It is useful to carry some lucky charms in exciting situations to guarantee success.	2.43	1.80	0.99	31.09	-0.24	-3.71
42. The northern side of the housing is the side of the water element; therefore blue and black as well as a fountain and a fish pool balance the energy of this area.	2.06	1.50	1.22	38.29	0.55	8.59
43. Crop circles, which have appeared in fields, are traces left by spacecrafts.	1.93	1.46	1.55	48.7	1.61	25.27
44. There are actual cases of witchcraft.*	2.32	1.78	1.17	36.75	0.25	3.97
45. There should not be items in front of the outer door that hinder the flow of life energy inside the house.	1.95	1.48	1.49	46.81	1.36	21.3
46. Some sightings suggest that there are humanlike creatures in space.	2.20	1.64	1.18	37.03	0.39	6.18
47. Lunar madness does exist.	2.18	1.65	1.23	38.52	0.53	8.23
48. Your mind or soul can leave your body and travel (astral projection).*	2.33	1.83	1.18	37.04	0.21	3.23
49. People are more active than usual during the full moon.	2.74	1.83	0.66	20.68	-0.66	-10.31
50. Those who have died a violent death return as ghosts to their place of death.	1.96	1.50	1.46	45.74	1.16	18.2
51. There is life on other planets.*	4.78	2.03	-0.53	-16.64	-0.87	-13.57
52. When talking about luck, it is useful to knock on wood so that the luck doesn't turn away.	2.34	1.82	1.12	35.14	0.04	0.68
53. People are more violent than usual during the full moon	2.23	1.65	1.16	36.22	0.34	5.33
54. Black magic really exists.*	2.33	1.82	1.17	36.63	0.19	3
55. It haunts in some places.	2.38	1.88	1.12	35.15	-0.01	-0.23

Note: *From Tobacyk's (2004) Revised Paranormal Belief Scale; (R) = reverse scored; *M* = mean; *SD* = standard deviation; C.R. = critical ratio; factor composition: Spiritualism (10, 12, 26, 48), Extraterrestrials (13, 16, 28, 36, 43, 46, 51), Ghost (40, 50, 55), PSI (2, 9, 17, 24, 29, 35), Witchcraft (18, 20, 44, 54), Religion (1, 23, 27, 38), Amulets (3, 25, 41), Rituals (21, 31, 52), Superstition (4, 11, 19), Astrology (5, 6, 14, 22, 33), Lunars effects (8, 15, 30, 32, 37, 47, 49, 53), Feng Shui (7, 34, 39, 42, 45).

Table 3. Descriptive statistics: Means and standard deviations, skew and kurtosis of RPBS-E items (N= 5891), from Tobacyk (2004)

the "skeptic" item belonged. There was a negative correlation only for PSI beliefs, but non-significant, $r^2 = -.059$, $p < .001$. The correlations were slightly positive and non-significant for beliefs about Rituals ($r^2 = .053$, $p < .001$) and Lunar Effects ($r^2 = .056$, $p < .001$).

After cleaning the four aforementioned items (8, 21, 24 and 51), Cronbach's α for these four subscales improved: Lunar Effects from .84 to .90, Rituals from .25 to .72, Psi from .76 to .87, and Extraterrestrials from .88 to .91. As Table 3 shows, the only items with a negative skewness were those four items.

Subsequently, we analyzed the unidimensionality of the scales, a requirement to use parcel items in structural equation models (Kline, 2023). The analyses of the 12 subscales showed

sampling adequacy measures (KMO) above 0.50, which supports the analysis using the Maximum Likelihood extraction method. The results revealed evidence of unidimensionality in all the scales, with an explained variance above 40%, value proposed by Carmines and Zeller (1979) to consider a set of items as unidimensional (see Table 6).

Confirmatory Factor Analysis (CFA)

A second-order factorial model was applied with the higher factor (Paranormal Beliefs) and three lower factors: Agents (Spiritualism, Extraterrestrials, Ghost, PSI, Witchcraft and Religion), Signs (Amulets, Rituals and Superstition) and Vital Power (Astrology, Lunar Effects and Feng Shui).

It is an overidentified model ($df > 0$). Therefore, it is susceptible to being estimated. The results from the first subsample ($X^2[N=2,958,$
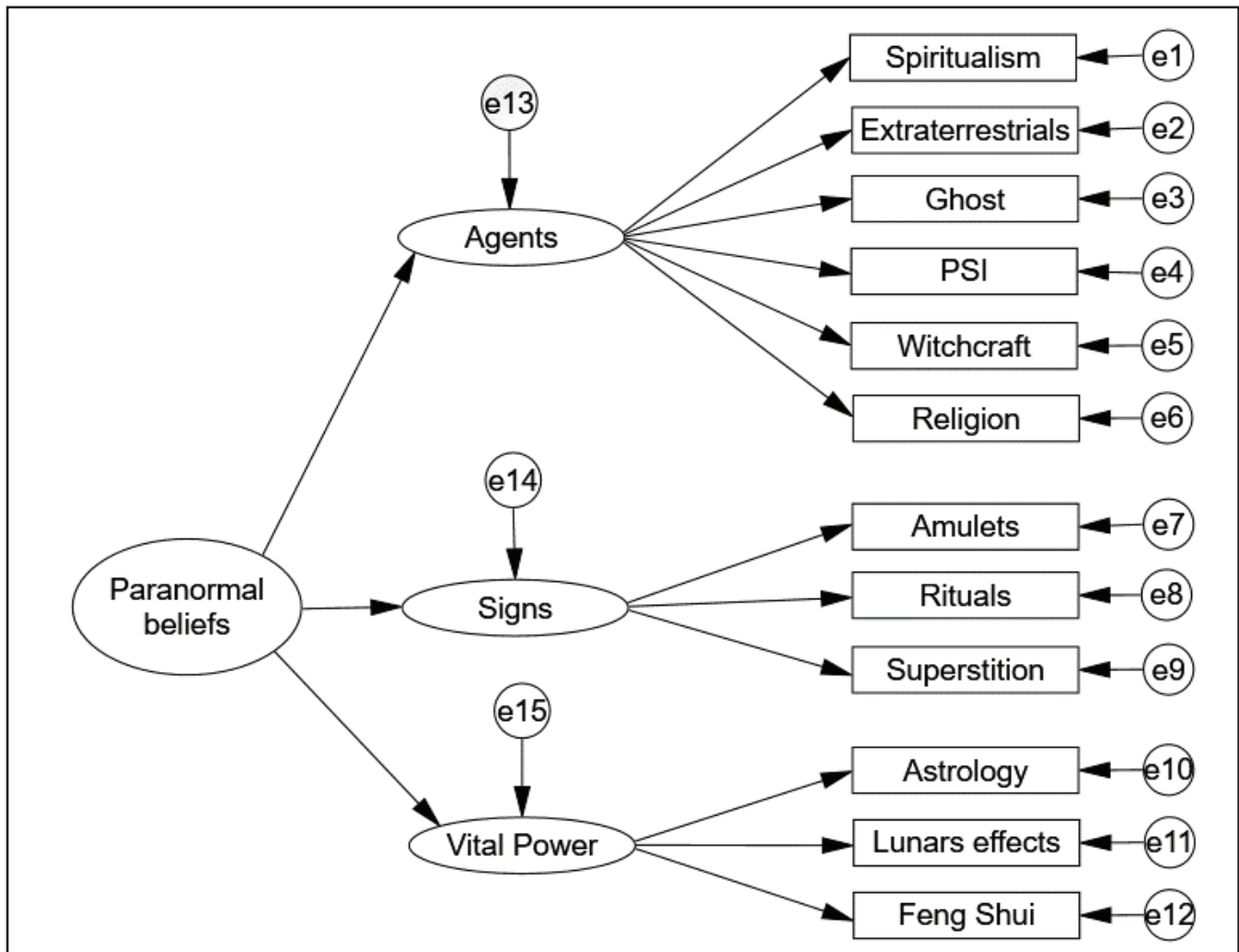

Figure 1. Second-order factor model

df=51]=1,346.33, *p*<.01; *CFI*=.95; *TLI*=.94; *GFI*=.93; *RMSEA* = .09, 95% CI [.09;.10], *p* < .01; *SRMR* = .04) and the replication and validation with the data from the second subsample (*X²*[*N*=3,381, *df* = 51] = 1,444.96, *p* < .01; *CFI* = .96; *TLI* = .94; *GFI* = .993; *RMSEA* = .09 95% CI [.09,.09], *p* <.01; *SRMR* = .03) were acceptable except for the value of *RMSEA*. This value is a little high, but its upper limit with a 90% confidence interval is also acceptable.

Regarding the possibility of re-specifying the model, after reviewing the modification indexes, we did not find any significant improvement in goodness of fit. On the other hand, a review of the residual results indicated inappropriate functioning between pairs of variables with high values. After testing the removal of some of those indicators, the goodness of fit of the model, contrary to expectations, worsened. Because of the possibility of adjusting the model artificially, that is adjusting to the sample and not to the population, we did not re-specify the model, avoiding producing a tailor-made model instead of a useful theory (Medrano & Muñoz-Navarro, 2017).

Based on the hierarchical model, the subsequent analyses were performed using the full sample, except for outliers and the participants from the first academic year in the first year of the study, as they could be the same participants from the fourth academic year in the fourth year of the study.

Table 4 shows the correlations between the 12 variables in the final model with acceptable adjustment [*X²*(*N* = 5,683, 51) = 2,392.43, *p* < .01; *CFI* = .96; *TLI* = .94; *GFI* = .93; *RMSEA* = .09 95% CI (.09,.09), *p* < .01; *SRMR* = .04]. All the standardized factor loadings were statistically significant (*p*s < .001) with a 95% confidence level and values between .65 and .91. Means, standard deviations and standardized factor loadings are shown in Table 5. The second-order standardized factor loadings in the first-order factor were: Vital Power .97, 95% CI (.96,.98), Agents .89 95% CI (.88,.90), and Signs .88 95% CI (.86,.89), all three were significant with a 95% confidence level.

Multigroup Confirmatory Factor Analysis (MGCFA)

We carried out a multigroup CFA to analyze the measurement invariance of the final model according to sex. Configural invariance or base line (M1), metric invariance (M2), scalar or strong

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
F1 Spiritualism											
F2 Extraterrestrials	.65										
F3 Ghost	.79	.66									
F4 PSI	.76	.68	.68								
F5 Witchcraft	.75	.61	.75	.73							
F6 Religion	.58	.42	.56	.52	.59						
F7 Amulets	.65	.47	.58	.60	.66	.53					
F8 Rituals	.61	.48	.57	.59	.64	.51	.82				
F9 Superstition	.44	.35	.41	.42	.47	.42	.61	.62			
F10 Astrology	.66	.50	.56	.66	.65	.48	.71	.68	.58		
F11 Lunars Effects	.62	.52	.53	.65	.60	.40	.55	.57	.34	.65	
F12 Feng Shui	.66	.55	.57	.68	.64	.45	.64	.63	.48	.70	.70

Table 4. Correlations between variables (M=5,683). ***Note:*** results are based on bootstrap samples with 95% CI; *p* < .001 for all results

invariance (M3) and residual or strict invariance (M4) were progressively assessed.

First, we analyzed the configural invariance model (M1) with a hierarchical structure with three first-order factors and one second-order factor. The factor loadings, the intercepts and the error variances were freely estimated. The indexes indicated the model fit, $CFI = .95$, SRMR = .03 and $RMSEA = .06$, 90% CI (.06,.06), $p < .01$ and significant factor loadings ($p < .001$). The results showed that the model fits appropriately to both groups. The construct of paranormal beliefs is conceptualized in the same way in both men and women.

Second, we analyzed the metric invariance model (M2) in which factor loadings were restricted in men and women to be similar. The indexes showed good fit: $CFI = .94$, SRMR = .03, and $RMSEA = .07$, 90% CI [.06, .07], $p < .01$. Comparison with M1 did not show significant changes, $\Delta CFI < .01$ and $\Delta RMSEA < .015$. These findings suggest that the factor loadings are invariant according to sex, showing that the relationship between the indicators of each variable with its latent factor is the same between sexes.

The factor loadings and intercepts in the scalar invariance model (M3) were restricted to be similar between sexes. The model showed appropriate fit ($CFI = .94$, SRMR = .04 and $RMSEA = .07$, 90% CI [.06,.07], $p < .01$). When compared to M2, there were no significant changes in CFI and RMSEA, so the hypothesis that the intercepts are invariant between groups is accepted. Finally, the residual invariance model (M4), in which factor loadings, intercepts and error variances were restricted, also showed a positive fit ($CFI = .93$, SRMR = .05 and $RMSEA = .07$, 90% CI [.07,.07], $p < .01$). Again, the changes were not significant, supporting the hypothesis of strict invariance. In summary, the results suggest confirmation of measurement invariance of the Extended RPBS between men and women.

Discussion

The objective of this study was to test the RPBS model (Tobacyk, 2004) extended by Lindeman and Aarnio (2006) with the Spanish population. In this version, a second-order hierarchical model

Measure	M	(95% CI)	SD	Factor loading	(95% CI)
Agents (F1)					
Spiritualism	2.29	(2.26 / 2.33)	1.43	.90	(.89 / .90)
Extraterrestrials	2.18	(2.14 / 2.21)	1.33	.74	(.72 / .75)
Ghost	2.24	(2.20 / 2.28)	1.58	.85	(.84 / .86)
PSI	2.20	(2.17 / 2.23)	1.29	.85	(.84 / .86)
Witchcraft	2.10	(2.06 / 2.13)	1.41	.86	(.85 / .87)
Religion	2.56	(2.53 / 2.61)	1.55	.65	(.63 / .67)
Signs (F2)					
Amulets	2.31	(2.27 / 2.34)	1.50	.91	(.90 / .92)
Rituals	2.28	(2.23 / 2.32)	1.52	.90	(.89 / .91)
Superstition	1.56	(1.54 / 1.59)	1.07	.68	(.66 / .69)
Vital power (F3)					
Astrology	1.99	(1.96 / 2.20)	1.22	.85	(.84 / .86)
Lunar effects	2.82	(2.78 / 2.86)	1.43	.78	(.77 / .79)
Feng shui	2.10	(2.06 / 2.13)	1.19	.85	(.84 / .86)

Table 5. Means (M) and standard deviations (SD) for the paranormal belief variables and parameter estimates (standardized forms) in the final higher-order factor model (N = 5,683). ***Note:*** results are based on bootstrap samples with 95% CI; $p < .001$ for all results

is proposed. Secondly, measurement invariance (configurational, metric, scalar and residual) by sex were analyzed.

Initially, we carried out a reliability analysis of the internal consistency of the 12 subscales of paranormal beliefs. The results indicated removal of the reversed items and Item 51 from the Extraterrestrials subscale because of the low corrected item-total correlation coefficients and evidence of poor performance of the reversed items. Once these items were removed, the results showed improvement in Cronbach's α for the involved subscales and a high internal consistency in the total scale. These results support the possibility of using the Extended RPBS with the Spanish population.

Subsequently, the Lindeman and Aarnio (2006) model was tested using a second-order CFA. The results showed acceptable goodness-of-fit indexes and high factor loadings except for Religion (α=.65) and Superstition (α=.68). Even then, given cultural differences between the two samples, one Finnish the other Spanish -with notable differences in lifestyle, economy, languages, and religion-, we expected to improve the goodness of fit through re-specifying the model. However, we were unable to improve the model significantly.

The results indicated that the latent structure of paranormal beliefs consists of one high-level factor and three low-level factors. The low-level factors are Agents —which includes Extraterrestrials, Ghosts, PSI, Witchcraft and Religion, Signs —which includes Amulets, Rituals and Superstition, and Vital Power —which includes Astrology, Lunar effects and Feng Shui. The high-level factor explained 95% of variance of the Vital Power factor, 77% of the Signs factor and 79% of the Agents factor. Similarly to Lindeman and Aarnio (2006), a general trend of belief in paranormal phenomena leads to specific beliefs, and the specific beliefs represent the general belief with varying accuracy. As Drinkwater et al. (2017) suggested, paranormal beliefs are better characterized by a unique general construction that supports the use of the total value and, to a lesser extent, the use of the subscale values. Given the multidimensional nature of paranormal beliefs, in previous studies unidimensional analysis has been considered a failure (Irwin, 1993; Grimmer & White, 1992). However, as Lindeman and Aarnio (2006) indicated, the scale can be used according to researchers' needs. If a study is focused on a specific belief, hypotheses, analyses and conclusions should be developed according to that specific belief. In contrast, if attention is focused on general issues, a study about several factors or the unidimensional model would be more appropriate.

The results reflect the need to improve the scale in some aspects. The use of only three reversed items out of 55 could lead participants to overlook the reversed composition and incorrectly interpret item content. That leads to biased answers (Díaz-Vilela & Álvarez-González, 2004)(2 and calls into question some aspects of the validity

	p	X^2 (df)*	CFI	RMSA (90% CI)	ΔX^2 (df)	ΔCF*	$\Delta RMSEA$*
Configurational invariance (M1)	$p<000$	2,568.01 (111)	.954	.062 (.060; .065)			
Metric invariance (M2)	$p<000$	3,146.81 (123)	.944	.066 (.064; .068)	578.80 (12)	-.010	.004
Scalar invariance (M3)	$p<000$	3,163.09 (126)	.944	.065 (.063; .067)	16.28 (3)	.000	-.001
Residual invariance (M4)	$p<000$	3,825.69 (141)	.932	.068 (.066; .070)	662.6 (15)	-.012	.003

The comparisons are with the previous model: M2 with M1, M3 with M2, and M4 with M3.
* Chi-square (χ^2) is very sensitive to sample size, so it must be combined with other indices. According to Cheung and Rensvold (2002), assuming multivariate normal distributions, strong invariance occurs when ΔCFI ≤ .01 and ΔRMSEA ≤ .015.

Table 6. Measurement invariance by sex

of the scale (Drinkwater et al., 2017). Therefore, future studies should pay more attention to the use of reversed items. However, this aspect is not without controversy. While some authors propose increasing the number of these items (Baumgartner & Steenkamp, 2001), others suggest removing them (Suárez-Alvarez et al., 2018).

Regarding removal of Item 51 ("There is life on other planets"), some studies have indicated its lack of statistical reliability. It has been suggested that this belief may not be really paranormal. Most people, regardless of their levels of paranormal beliefs, would agree to the possible existence of some kind of life on other planets (Drinkwater et al., 2017; Lange et al., 2000; Mikloušić et al., 2012).

This argument of lacking "paranormality" has also been used in other psychometric studies as an explanation of the negative impact on construct validity and the need to remove two other items: belief in the Tibetan Yeti and belief in the Loch Ness Monster (Bouvet et al., 2014; Díaz-Vilela & Álvarez-González, 2004; Drinkwater et al., 2017; Mikloušić et al., 2012; Shiah et al., 2001). In his revision of the original PBS scale, Tobacyk (2004) replaced a similar item, belief in Bigfoot. He argued that familiarity with Bigfoot was largely limited to the United States. The scale demonstrated improved intercultural validity without that item (Tobacyk, 2004). Given that the version from Lindeman and Aarnio (2006) did not include items about the Yeti or the Loch Ness Monster, we assumed that it would have a certain intercultural validity that was reflected in our results.

The previous point leads us to the possibility of creating a scale with some degree of globalization based on a composition of items with global impact. According to our results about the dimensionality of the scale, specific paranormal beliefs would be better described by a high-level factor. It proves a general pattern of believing in paranormal phenomena. Thus, if it were proved that local beliefs were strongly correlated with other general beliefs, the removal of local beliefs would not mean losing important information, designing a culturally invariant scale would be an important step.

However, our results are provisional in terms of generalization. The Finnish and Spanish samples consisted exclusively of university students.

This could attenuate possible differences between populations. The means of both samples showed that most participants did not believe in paranormal phenomena. This also leads to the observed equivalences and, consequently, we wonder whether the same results would be found with a sample that was balanced between believers and skeptics. Accordingly, it would be more effective to test cultural invariance with a sample that was more representative of the general population and an equivalent proportion of believers and skeptics.

Our results confirmed that measurement invariance between men and women can be assumed. The construct of paranormal beliefs may be conceptualized in the same way in both sexes. The structure of a hierarchical model made up of a first-order latent factor and three second-order latent factors, and the relationship between them, is similar in women and men. Drinkwater (2004) found similar results that indicated a low likelihood that the differences between means were artifacts of measurement bias and they were truly differences between the two sexes.

These results contradict conclusions about Differential Item Functioning (DIF) reported by Lange et al. (2000) with regard to sex. Nonetheless, the existence of DIF does not necessarily mean a bias. Determining a bias requires us to know why some specific items show different behavior, otherwise it is inferred that there are differences between participants or groups (Gómez-Benito et al., 2010) or some of their items, has had great relevance in psychometric research for the last 30 years and it will probably continue to be an important focus of interest for professionals and researchers involved in psychological and educational testing. The aim of this paper is providing to the applied psychologist the background about bias, differential functioning and impact concepts, item or tests bias detection procedures and evaluation of its possible causes and, therefore, for improving the validity of psychological measurement. Thus, the consequences of cleaning the scale based on a simple DIF might be counter-productive in terms of instrument validity, due to the removal of items with important information about real differences between the sexes.

In summary, our results are not conclusive and need to be replicated with samples that are more representative of the general population and more balanced between believers and skeptics. Further research is needed to assess the intercultural validity of the scale based on the comparison of local and general paranormal beliefs.

However, an appropriate construction or adaptation and assessment of this or any other scale will only be possible based on agreement about the definition of the central concept, paranormal beliefs. They need to have effective, valid characterization from a scientific point of view (Lindeman & Svedholm, 2012; Muñiz & Fonseca-Pedrero, 2019; Perez-Gil et al., 2000). It is essential to have a construct that establishes the properties of paranormal belief. According to Goode (2000) and Martin (1994), paranormal beliefs have a dynamic component associated with their content and with scientific knowledge, both evolve and can be in contradiction. This contradiction can define a specific phenomenon as paranormal. However, it is not sufficient that a belief contradicts current scientific knowledge for it to be paranormal.

It is possible that the dichotomy between paranormal and non-paranormal is insufficient, and we should leave binary logic to one side for fuzzy logic. It goes beyond the concept of belongingness to a group based on specific criteria. We should talk about "several degrees of belongingness" (Ballester Brage & Colom Cañellas, 2012). Although some authors use the terms paranormal and pseudo-scientific interchangeably and Lindeman and Svedholm (2012) concluded that they meant the same thing, they are not always used in the same way as paranormal (Morier & Keeports, 1994). It seems reasonable to establish a progression of scientifically unaccepted beliefs that allow paranormal beliefs to be placed on a continuous scale from the least sophisticated to the most sophisticated beliefs. This proposal of progression from the simplest beliefs (paranormal) to the most sophisticated (pseudoscientific) has to do with the etymological origin of each term, both from old Greek. The prefix "para" means "apart from" and "pseudo" means "false", an imitation. Beyond the etymological origin, the importance of this difference lies in the fact that classifying a participant as a believer will be fundamental to determining whether the origin of the belief is based on false information that leads to belief it is true. In this case, pseudoscientific arguments change the participant to someone who is deceived, but not a believer.

The degree of belonging and the dynamic characteristics make it difficult to agree a definition which would allow establishment of the necessary issues which have to be represented in the scale (Viladrich et al., 2005). In order to improve and clean the scale, it would be useful to analyze and differentiate the items based on pseudoscientific sources, such as Feng Shui. Some items refer to beliefs induced by pseudoscientific arguments used at a specific time and in a certain cultural context.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Informed Consent

The questionnaire was distributed through an intranet system together with an informed consent to each participant. Participants could not begin the survey before completing the informed consent.

Ethical Approval

We declare that we has complied fully with APA ethical standards and will have data available for examination for up to 5 years past the date of publication. In April 2015, after consulting the Legal Department of the University of the Balearic Islands (UIB) and according to the legislation in force at that time, the study was considered as not ethically sensitive. Therefore, the survey was approved without consulting the Research Ethics Committee (CER) of the UIB.

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References

Aarnio, K., & Lindeman, M. (2005). Paranormal beliefs, education, and thinking styles. *Personality and Individual Differences*, *39*(7), 1227–1236. https://doi.org/10.1016/j.paid.2005.04.009

Andrews, R. A. F., & Tyson, P. (2019). The superstitious scholar: Paranormal belief within a student population and its relationship to academic ability and discipline. *Journal of Applied Research in Higher Education*, *11*(3), 415–427. https://doi.org/10.1108/JARHE-08-2018-0178

Arias Martínez, B. (2008). Desarrollo de un ejemplo de análisis factorial confirmatorio con LISREL, AMOS y SAS. *Metodología en la Investigación Sobre Discapacidad. Introducción al Uso de Las Ecuaciones Estructurales*, 75–120.

Ballester Brage, L., & Colom Cañellas, A. J. (2012). *Epistemología de las Ciencias Sociales y de la educación*. Tirant Humanidades. https://encore.uib.es/iii/encore/record/C__Rb1992659__Sparte__Orightresult__X6?lang=cat

Baumgartner, H., & Steenkamp, J. B. E. M. (2001). Response styles in marketing research: A cross-national investigation. *Journal of Marketing Research*, *38*(2), 143–156. https://doi.org/10.1509/jmkr.38.2.143.18840

Boomsma, A., & Hoogland, J. J. (2001). The robustness of LISREL modeling revisited. *Structural Equation Modeling Present and Future*, 139–168.

Bouvet, R., Djeriouat, H., Goutaudier, N., Py, J., & Chabrol, H. (2014). Validation française de la Revised Paranormal Belief Scale. *Encephale*, *40*(4), 308–314. https://doi.org/10.1016/j.encep.2014.01.004

Byrne, B. M. (2001). Structural equation modeling with AMOS, EQS, and LISREL: Comparative approaches to testing for the factorial validity of a measuring instrument. *International Journal of Testing*, *1*(1), 55–86. https://doi.org/10.1207/S15327574IJT0101_4

Carmines, E. G., & Zeller, R. A. (1979). *Reliability and validity assessment*. SAGE. https://doi.org/10.4135/9781412985642

Cheung, G. W., & Lau, R. S. (2008). Testing mediation and suppression effects of latent variables: Bootstrapping with structural equation models. *Organizational Research Methods*, *11*(852), 1–30. https://doi.org/10.1177/1094428107300343

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, *9*(2), 233–255. https://doi.org/10.1207/S15328007SEM0902_5

Cochran, W. G., Mosteller, F., & Tukey, J. W. (1954). Principles of sampling. *Journal of the American Statistical Association*, *49*(265), 13–35. https://doi.org/10.1080/01621459.1954.10501212

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods*, *1*(1), 16–29. https://doi.org/10.1037/1082-989X.1.1.16

Díaz-Vilela, L. (2004). Por qué creemos lo que creemos: Un enfoque psico-social. In I. R. Hidalgo, L. D. Viela, C. J. Alvarez Gonzalez, & J. Mª Riol Cimas (Eds.), *Ciencia y pseudociencias: Realidades y mitos* (pp. 339–350).

Díaz-Vilela, L., & Álvarez-González, C. J. (2004). Differences in paranormal beliefs across fields of study from a Spanish adaptation of Tobacyk's RPBS. *Journal of Parapsychology*, *68*(2), 405–421.

Drinkwater, K., Denovan, A., Dagnall, N., & Parker, A. (2017). An assessment of the dimensionality and factorial structure of the Revised Paranormal Belief Scale. *Frontiers in Psychology*, *8*, 1693. https://doi.org/10.3389/fpsyg.2017.01693

Foster, K. R., & Kokko, H. (2009). The evolution of superstitious and superstition-like behaviour. *Proceedings of the Royal Society B: Biological Sciences*, *276*(1654), 31–37. https://doi.org/10.1098/rspb.2008.0981

Fox, J. W. (1992). The structure, stability, and social antecedents of reported paranormal experiences. *Sociological Analysis*, *53*(4), 417–431. https://doi.org/10.2307/3711436

Gershman, B. (2022). Witchcraft beliefs around the world: An exploratory analysis. *SSRN Electronic Journal*, 1–19. https://doi.org/10.2139/ssrn.4114883

Gómez-Benito, J., Dolores Hidalgo, M., & Guilera, G. (2010). El sesgo de los instrumentos de medición. Tests justos. *Papeles del Psicologo*, *31*(1), 75–84.

Goode, E. (2000). *Paranormal beliefs: A sociological introduction*. Waveland Press.

Grimmer, M. R., & White, K. D. (1992). Non-conventional beliefs among Australian science and nonscience students. In *Journal of Psychology: Interdisciplinary and Applied*, *126*(5), 521–528. https://doi.org/10.1080/00223980.1992.10543385

Iacobucci, D. (2010). Structural equations modeling: Fit indices, sample size, and advanced topics. *Journal of Consumer Psychology*, *20*(1), 90–98. https://doi.org/10.1016/j.jcps.2009.09.003

Irwin, H. (1993). Belief in the paranormal: A review of the empirical literature. *Journal of the American Society for Psychical Research*, *87*(1), 1–39.

Irwin, H. J. (2009). *The psychology of paranormal belief: A researcher's handbook*. University of Hertfordshire Press.

Kahneman, D. (2012). *Pensar rápido, pensar despacio*. Debate.

Kline, R. B. (2023). *Principles and practice of structural equation modeling*. Guilford Publications.

Lange, R., Irwin, H. J., & Houran, J. (2000). Top-down purification of Tobacyk's revised paranormal belief scale. *Personality and Individual Differences*, *29*(1), 131–156. https://doi.org/10.1016/S0191-8869(99)00183-X

Lindeman, M., & Aarnio, K. (2006). Paranormal beliefs: Their dimensionality and correlates. *European Journal of Personality*, *20*(7), 585–602. https://doi.org/10.1002/per.608

Lindeman, M., & Aarnio, K. (2007). Superstitious, magical, and paranormal beliefs: An integrative model. *Journal of Research in Personality*, *41*(4), 731–744. https://doi.org/10.1016/j.jrp.2006.06.009

Lindeman, M., & Svedholm, A. M. (2012). What's in a term? Paranormal, superstitious, magical and supernatural beliefs by any other name would mean the same. *Review of General Psychology*, *16*(3), 241–255. https://doi.org/10.1037/a0027158

MacDonald, W. L. (1995). The effects of religiosity and structural strain on reported paranormal experiences. *Journal for the Scientific Study of Religion*, *34*(3), 366. https://doi.org/10.2307/1386885

Martin, M. (1994). Pseudoscience, the paranormal, and science education. *Science and Education*, *3*(4), 357–371. https://doi.org/10.1007/BF00488452

Matute, H. (2019). *Nuestra mente nos engaña: Sesgos y errores cognitivos que todos cometemos*. Shackleton Books.

Medrano, L. A., & Muñoz-Navarro, R. (2017). (2017). Aproximación conceptual y práctica a los modelos de ecuaciones estructurales. *Revista Digital de Investigación En Docencia Universitaria*, *11*(1), 219–239. https://doi.org/10.19083/ridu.11.486

Mikloušić, I., Mlačić, B., & Milas, G. (2012). Paranormalna vjerovanja i osobine li□nosti u Hrvatskoj. *Drustvena Istrazivanja*, *21*(1), 181–201. https://doi.org/10.5559/di.21.1.10

Morier, D., & Keeports, D. (1994). Normal science and the paranormal: The effect of a scientific method course on students' beliefs. *Research in Higher Education*, *35*(4), 443–453. https://doi.org/10.1007/BF02496382

Muñiz, J., Elosua, P., & Hambleton, R. K. (2013). Directrices para la traducción y adaptación de los tests: Segunda edición. *Psicothema*, *25*(2), 151–157. https://doi.org/10.7334/psicothema2013.24

Muñiz, J., & Fonseca-Pedrero, E. (2019). Ten steps for test development. *Psicothema*, *31*(1), 7–16. https://doi.org/10.7334/psicothema2018.291

Pérez-Gil, J. A., Chacón Moscoso, S., & Moreno Rodríguez, R. (2000). Validez de constructo: El uso de análisis factorial exploratorio-confirmatorio para obtener evidencias de validez. *Psicothema*, *12*(SUPPL. 2), 442–446.

Randall, T. M., & Desrosiers, M. (1980). Measurement of supernatural belief: Sex differences and locus of control. *Journal of Personality Assessment*, *44*(5), 493–498. https://doi.org/10.1207/s15327752jpa4405_9

Richman, H., & Bell, C. (2012). Paranormal beliefs then and now. *North American Journal of Psychology*, *14*(1), 197–206.

Rodríguez, M. N., & Ruíz-Díaz, M. A. (2008). Atenuación de la asimetría y de la curtosis de las puntuaciones observadas mediante transformaciones de variables: Incidencia sobre la estructura factorial. *Psicologica*, *29*(2), 205–227.

Shermer, M. (2009). *Por qué creemos en cosas raras. Pseudociencia, superstición y otras confusiones de nuestro tiempo*. Alba Editorial.

Shiah, Y. J., Tam, W. C. C., Wu, M. H., & Chang, F. (2010). Paranormal beliefs and religiosity: Chinese version of the revised paranormal belief scale. *Psychological Reports*, *107*(2), 367–382. https://doi.org/10.2466/08.09.17.PR0.107.5.367-382

Skinner, B. F. (1948). Superstition in pigeon. *Journal of Experimental Psychology*, *38*, 168–172. https://doi.org/10.1037/h0055873

Steenkamp, J. B. E. M., & van Trijp, H. C. M. (1991). The use of LISREL in validating marketing constructs. *International Journal of Research in Marketing*, *8*(4), 283–299. https://doi.org/10.1016/0167-8116(91)90027-5

Suárez-Alvarez, J., Pedrosa, I., Lozano, L. M., García-Cueto, E., Cuesta, M., & Muñiz, J. (2018). Using reversed items in Likert scales: A questionable practice. *Psicothema*, *30*(2), 149–158. https://doi.org/10.7334/psicothema2018.33

Tobacyk, J. J. (2004). A Revised Paranormal Belief Scale. *International Journal of Transpersonal Studies*, *23*(3), 94–98. https://doi.org/10.24972/ijts.2004.23.1.94

Tobacyk, J. J., & Wilson, J. E. (1988). Paranormal beliefs and beliefs about lunar effects. *Psychological Reports*, *63*(3), 993–994. https://doi.org/10.2466/pr0.1988.63.3.993

Utinans, A., Ancane, G., Tobacyk, J. J., Boyraz, G., Livingston, M. M., & Tobacyk, J. S. (2015). Paranormal beliefs of Latvian college students: A Latvian version of the revised paranormal belief scale. *Psychological Reports*, *116*(1), 116–126. https://doi.org/10.2466/08.17.PR0.116k14w9

Viladrich, M. C., Doval, E., Prat, R., & Vall-llovera, M. (2005). *Psicometria*. UOC.

Williams, E., Francis, L. J., & Robbins, M. (2007). Personality and paranormal belief: A study among adolescents. *Pastoral Psychology*, *56*(1), 9–14. https://doi.org/10.1007/s11089-007-0094-x

Wiseman, R., & Watt, C. (2004). Measuring superstitious belief: Why lucky charms matter. *Personality and Individual Differences*, *37*(8), 1533–1541. https://doi.org/10.1016/j.paid.2004.02.009

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Handbook of International Prevention Science. New York: Cambridge University Press.

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