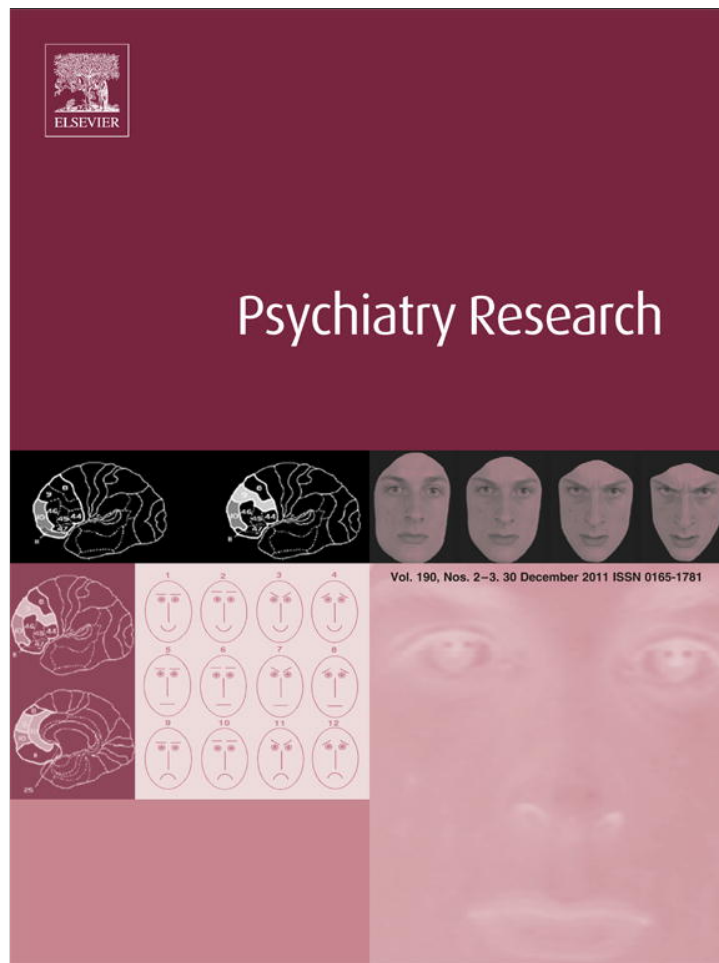


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Measurement invariance of the Schizotypal Personality Questionnaire-Brief across gender and age

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ABSTRACT

The purpose of this study was to examine the dimensional structure and measurement invariance of the Schizotypal Personality Questionnaire-Brief (SPQ-B) (Raine and Benishay, 1995) across sex and age in a representative sample of nonclinical adolescents and young adults. The sample consisted of 1789 adolescents and young adults (42.1% males), with a mean age of 17.1 years (S.D. = 2.9). The results indicated that the Likert version of the SPQ-B showed adequate psychometric properties (α total score 0.89). The schizotypal personality models that presented the best fit indices were Raine et al.'s (1994) three-factor model and Stefanis et al.'s (2004) four-factor model. In addition, the results support the measurement invariance of the SPQ-B across sex and age. When the latent means of the schizotypal dimensions were compared across sex and age, statistically significant differences were found. Consistent with previous literature, schizotypal personality is a multidimensional construct whose structure appears invariant across sex and age. Future studies should examine the invariance of schizotypal personality across cultures, as well as using the SPQ-B as a screening method in the general population to detect individuals at risk for schizophrenia-spectrum disorders, given its rapid and easy administration.

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1. Introduction

The study of schizotypal personality arouses great interest within the international scientific community, as it provides us with clues to the possible etiological mechanisms underlying schizophrenia and related conditions, and may allow us in the long run to improve the strategies for prevention and early detection of these disorders (Lenzenweger, 2010). This personality organization has been associated with schizophrenia at genetic, neurocognitive, neurobiological, neurochemical, affective and behavioral levels (Raine, 2006; Kwapil and Barrantes-Vidal, in press). Likewise, it is considered a risk factor for the development of schizophrenia-spectrum disorders, as shown by studies conducted in community samples (Poulton et al., 2000; Gooding et al., 2005; Welham et al., 2009; Dominguez et al., 2011), in the offspring of patients with schizophrenia (Miller et al., 2002), in participants with prodromal symptoms (Morrison et al., 2006) and in adolescents with Schizotypal Personality Disorder (Woods et al., 2009; Esterberg et al., 2010). For instance, Poulton et al. (2000), in a birth study cohort of children from Dunedin, showed that children who had reported hallucinations and delusions at 11 years of age had a more than 16-fold higher risk for developing a schizophreniform disorder by the age of 26.

Schizotypal personality is a complex construct that can be understood as an attenuated form of schizophrenia, representing a premorbid or prodromic phase (Raine, 2006), or as a latent organization of the personality related to genetic vulnerability to schizophrenia (Meehl, 1962). Likewise, it is considered to be an organization of the personality composed of an aggregate of cognitive, behavioral and emotional traits and distributed within the population along a dynamic continuum (Claridge, 1997), ranging from psychological well-being to schizophrenia-spectrum personality disorders and full-blown schizophrenia. Along this continuum we might encounter “intermediate” phenotypic expressions of these sets of traits, which, though not reaching clinical levels, would be associated with greater current psychopathological intensity, severity and social impairment (Raine, 2006; Kwapil et al., 2008; van Os et al., 2009; Yung et al., 2009; Fonseca-Pedrero et al., 2011).

The aim of studies on the “psychometric high-risk” paradigm is the early detection of individuals at heightened risk for schizophrenia-spectrum disorders using their score profile on self-reports (Lenzenweger, 1994). At present, it is considered to be a feasible and useful approach boasting a series of advantages with respect to other assessment methods, as it is non-invasive, rapidly applied and easier to administer, score and interpret (Gooding et al., 2005; Kwapil et al., 2008; Fonseca-Pedrero et al., 2010b). In addition, it allows the study of individuals prior to the appearance of possible side effects of medication or hospitalization, which can complicate the study of patients with schizophrenia. The Schizotypal Personality Questionnaire (SPQ), in both

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its long and brief versions (SPQ-B) (Raine, 1991; Raine and Benishay, 1995), and the Wisconsin Psychosis Proneness scales (Chapman et al., 1995), are the most widely used instruments in this context. The psychometric properties of the SPQ and the SPQ-B are well documented with respect to their reliability and their test–retest reliability, as well as sources of validity evidence (Raine, 1991; Raine and Benishay, 1995; Fossati et al., 2003; Wuthrich and Bates, 2006; Fonseca-Pedrero et al., 2009; Cohen et al., 2010).

The literature consistently holds that schizotypal personality is a multidimensional construct (Kwapil and Barrantes-Vidal, in press), basically made up of three dimensions: Positive (or Cognitive-Perceptual), characterized by hallucinations, ideas of reference, magical thinking or paranoid ideation; Interpersonal (or Negative), referring to blunted affect, social anxiety or lack of close friends; and Disorganized, which refers to the presence of odd behavior and speech. Using Raine's (1991) SPQ scales, the Disorganized model, with or without modifications, has proved to be invariant across sex, age, culture and religious affiliation (Reynolds et al., 2000; Fossati et al., 2003; Badcock and Dragovic, 2006; Wuthrich and Bates, 2006; Bora and Arabaci, 2009). This dimensional model is similar to that found in patients with schizophrenia (Liddle, 1987). Other authors have found a four-factor model (Paranoid) (Stefanis et al., 2004), or even a five-factor model (Chmielewski and Watson, 2008) to be the most parsimonious solution. Likewise, the SPQ-B has enabled researchers to find dimensional solutions of two (Aycicegi et al., 2005), three (Axelrod et al., 2001; Mata et al., 2005; Compton et al., 2007; Compton et al., 2009; Fonseca-Pedrero et al., 2009) and four factors (Cohen et al., 2010; Fonseca-Pedrero et al., 2010a). For example, Fonseca-Pedrero et al. (2009), using the SPQ-B in a sample of non-clinical adolescents, found the Disorganized and Paranoid models to be those that best fit the data. However, although the dimensionality of schizotypal personality has been exhaustively analyzed, its structure and content, measured via SPQ-B, have yet to be delimited, and research has produced contradictory results (Aycicegi et al., 2005; Compton et al., 2007, 2009; Cohen et al., 2010). Furthermore, the question has not yet been examined in depth of whether or not the dimensional structure underlying the SPQ-B is invariant across sex and age in a representative sample of adolescents and young adults.

In a similar way to what occurs when schizophrenic symptomatology is analyzed as a function of sex and age, several studies have found statistically significant differences in mean scores of schizotypal traits when these are compared as a function of sex and age (Fossati et al., 2003; Kwapil et al., 2008; Bora and Arabaci, 2009; Miettunen and Jääskeläinen, 2010). In overall terms, women score higher than men in the Positive dimension (Cognitive-Perceptual), whereas men score higher in the Negative (Interpersonal) and Disorganized dimensions (Raine, 1992; Fossati et al., 2003; Kwapil et al., 2008; Bora and Arabaci, 2009). Similar results are found in adolescent populations with regard to sex (Venables and Bailes, 1994; Fonseca-Pedrero et al., 2008a, 2008b). As regards age, adolescents score higher than older people in schizotypal traits (Venables and Bailes, 1994; Chen et al., 1997; Fossati et al., 2003; Bora and Arabaci, 2009), though other studies have found, on analyzing only homogeneous groups of adolescents, that the younger ones tend to score lower than the older ones (Fonseca-Pedrero et al., 2008a, 2008b). Nevertheless, most of these comparisons in relation to sex and age have been conducted on the basis of raw scores on the schizotypal subscales (i.e., the sum of the items), and not on the latent means derived from the multigroup comparisons performed within the measurement models of structural equation modeling.

Within research framework, the main objective of the present work was to analyze the dimensional structure and measurement invariance of the SPQ-B across sex and age in a representative sample of nonclinical adolescents and young adults. The present study's relevance derives from the complexity of schizotypal diagnosis and the potential usefulness of this measurement instrument in identifying subjects at high risk of psychosis without the confounding effects

of medication and stigmatization that are frequently associated with clinical samples. It also helps us to understand whether the underlying structure of the SPQ-B remains stable or invariant throughout adolescence and early adulthood, which may provide clues as to the course and nature of this construct in the general population. Consistent with previous studies, we hypothesized that a three-factor solution (Disorganized model) and a four-factor solution (Paranoid model) would provide the best fit with the data. Also, previous studies conducted with the SPQ indicate that the dimensions of schizotypal personality are invariant across age, gender, culture, religion and psychopathology (Reynolds et al., 2000; Fossati et al., 2003), we also hypothesized that the factor structure underlying the SPQ-B would be invariant across sex and age.

2. Method

2.1. Participants

A total of 1904 secondary school students (12 schools) and university undergraduates on various courses (Psychology, Education, Computer Sciences, Law, Industrial Engineering, Nursing, Speech Therapy, and Physiotherapy) participated in the study. Those participants who failed to provide the sociodemographic data (sex and age) ($n=20$) were eliminated from the final sample, as were those who did not complete the self-report ($n=45$) and those who were over 25 years of age ($n=50$). The final sample was made up of 1789 participants, with 754 males (42.1%). Mean age was 17.1 years (S.D.=2.9), with a range of 12 to 25. The sample of adolescents was selected to cover different geographical areas (urban, rural, mining and coastal) and socioeconomic levels (low, medium and high) to ensure the representativeness of the sample. Data from the previous research ($n=508$ adolescents) (Fonseca-Pedrero et al., 2010a) have been used in the current study. Based on the Spanish educational system (compulsory, post-compulsory and university education), the sample was divided into three age groups: ≤ 15 years ($n=549$), 16–18 years ($n=782$) and ≥ 19 years ($n=459$).

2.2. Measure

The Schizotypal Personality Questionnaire-Brief (SPQ-B) (Raine and Benishay, 1995) is a 22-item (true/false) self-report based on the SPQ (Raine, 1991) for the assessment of schizotypal personality disorder according to DSM-III-R diagnostic criteria (American Psychiatric Association, 1987). The SPQ-B consists of three subscales: Cognitive-Perceptual (eight items which measure ideas of reference, paranoid ideation, magical thinking and unusual perceptual experiences), Interpersonal (made up of eight items assessing aspects such as social anxiety, no close friends, blunted affect and paranoid ideation) and Disorganized (six items which assess odd speech and behavior). The SPQ-B's psychometric properties have been examined previously. The internal consistency indices ranged from 0.75 to 0.83 (from 0.58 to 0.83 for the subscales) and the test–retest reliability from 0.82 to 0.90 (Fonseca-Pedrero et al., 2008b). This self-report has been used with relatives of patients with schizophrenia-spectrum disorders (Compton et al., 2007), nonclinical adolescents (Fonseca-Pedrero et al., 2009), outpatient adolescents (Axelrod et al., 2001), and university students (Compton et al., 2009). A Spanish version previously validated in adolescents was used in this research, with a five-point Likert type response format (1 = "completely disagree"; 5 = "completely agree") (Fonseca-Pedrero et al., 2010a). The internal consistency for the SPQ-B subscales found in Spanish populations ranges from 0.61 to 0.69, whereas for the total score it ranges from 0.81 to 0.88 (Fonseca-Pedrero et al., 2009; Fonseca-Pedrero et al., 2010a).

2.3. Procedure

This study is part of a wider research project whose objective is the early detection of individuals at heightened risk for schizophrenia-spectrum disorders (prevention program for psychosis, P3; www.p3-info.es). The questionnaire was collectively administered in groups of 15 to 40 participants, in the classrooms and within the school timetable. For subjects under 18, parents were asked to provide written informed consent for their child to participate in the study. Participants were informed of the confidentiality of their responses and the voluntary nature of the study, and no incentive was provided for their collaboration. The administration took place under the supervision of the researchers. The study was approved by the research and ethics committees at the University of Oviedo and by the Department of Education of the Principality of Asturias.

2.4. Data analysis

First, descriptive statistics were calculated for the items and subscales proposed by Raine and Benishay (1995). Second, with the aim of studying the structure of schizotypal personality, several confirmatory factorial analyses (CFAs) were conducted at the item level, different factorial models being tested (Table 1). It should be

mentioned that these hypothesized factorial models do not derive specifically from factorial studies carried out with the SPQ-B, but rather with the SPQ (at the level of scales) or with structured interviews. Thus, and given the complexity of the syntax and the small number of items making up the SPQ-B, there are factorial models that cannot be tested (e.g., five-factor model). To perform the CFAs, the variance and covariance matrix was used with the Robust Maximum Likelihood estimation method (Jöreskog and Sörbom, 1993). The goodness-of-fit indices employed were: Satorra-Bentler scaled statistic ($S-B\chi^2$), Comparative Fit Index (CFI), Root Means Square Error of Approximation (RMSEA) (and its confidence interval), Standardized Root Mean Square Residual (SRMR) and Akaike Information Criterion (AIC).

Third, with the aim of studying measurement invariance (MI), successive multi-group CFAs were conducted. MI is frequently tested by multigroup comparisons using structural equation modeling within the framework of a CFA model. When comparisons between groups are made (e.g., male/female; young people/adults), it is typically assumed that the measurement instrument and the underlying psychological construct behave in the same manner and have the same significance across the groups being compared (Byrne and Stewart, 2006; Byrne, 2008); however, this assumption must be tested from a psychometric point of view. Therefore, it is crucial to examine the MI of the assessment tool so that findings based on comparisons of the groups can be valid. Thus, it would be inappropriate to make comparisons with respect to schizotypal traits if, for example, males and females interpret the content of the items differently or if the construct does not behave in the same way across groups. If MI does not hold, the validity of the inferences and interpretations drawn from the data may be erroneous or unfounded (Byrne, 2008; Rusticus et al., 2008).

Basically, a hierarchical set of steps are followed when testing MI, typically starting with the determination of a well-fitting multigroup baseline model and continuing with the establishment of successive equivalence constraints in the model parameters across groups (Meredith, 1993; Byrne and Stewart, 2006; Byrne, 2008). The baseline model is called the configural model, which is the first and least restrictive model specified, and is important because it represents the baseline model against which all subsequent specified invariance models are compared. The configural model is established by specifying and testing the CFA model for each group, separately. Once the theoretical model has been validated in both groups, configural invariance is then examined, requiring that the pattern of fixed and freely estimated model parameters is equivalent across groups; however, other than the referent item that is used to establish the scale of each latent variable, no equality constraints are imposed on the model parameters between groups. Configural invariance is tested by assessing the model fit. When configural invariance is met (i.e., the model fits the data), the suggestion is that the general factor structure is at least similar, though not necessarily equivalent, across groups. The next step is to impose equality constraints on the factor loadings across the groups to test metric or weak invariance. If the model fit with the constrained parameters is significantly and practically poorer than the baseline or configural model, then weak invariance is not supported. When metric invariance is met, the suggestion is that the same metric is being used and that the participants interpret and respond to the measure in a similar manner. The final step is to impose constraints on the item intercepts and factor loadings to test strong or scalar invariance across groups. The confirmation of the invariance of the intercepts permits comparison of the latent means in both groups.

The analyzed models are nested, in that the imposed constraints are progressively added. The fit of nested models can be assessed by comparing the respective chi-square fit statistics or goodness-of-fit indices between the model with additional constraints and the less restricted model (Cheung and Rensvold, 2002; Byrne and Stewart, 2006). Both criteria have been extensively used in the literature. However, when they are used in conjunction they are often in disagreement, leading researchers to reach contradictory conclusions (Rusticus et al., 2008). Given the limitations of the $\Delta\chi^2$ regarding its sensitivity to sample size, Cheung and Rensvold (2002) have proposed a more practical criterion, the ΔCFI , to determine whether nested models are practically equivalent. In this study, when ΔCFI is greater than .01 between two nested models, the more constrained model is rejected, since the additional constraints have produced a practically poorer fit. However, if the change in CFI is less than or equal to .01, it is considered that all specified equal constraints are tenable, and therefore we can proceed to the next step in the analysis of MI. SPSS 15.0 and LISREL 8.73 (Jöreskog and Sörbom, 1993) were used for all the data analyses.

3. Results

3.1. Descriptive statistics

The descriptive statistics for each item are presented in Table 2. The mean and standard deviation for the SPQ-B total score and subscales according to sex and age are shown in Table 3. The asymmetry and kurtosis levels fell within the normality range. The SPQ-B Likert total scores ranged from 22 to 97 points, whereas for the Positive and Interpersonal subscales they ranged from 8 to 40 points and 6 to 29 points, respectively. The internal consistency for the SPQ-B total and subscales scores in the total sample was 0.76 (Positive), 0.80 (Interpersonal), 0.77 (Disorganized) and 0.89 (total score). The discrimination indices for the items making up the three subscales in the SPQ-B were higher than 0.42.

3.2. Confirmatory factor analysis of the SPQ-B

The fit indices for the proposed models are presented in Table 4. As can be seen, the models which showed the best fit were Raine et al.'s (1994) three-factor model and Stefanis et al.'s (2004) four-factor model. In both, the CFI value was higher than 0.95, the RMSEA was lower than 0.06 and the AIC value was the lowest in comparison to the rest of the proposed models. In the case of Raine et al.'s (1994) Disorganized model, where the items measuring paranoid ideation saturate in both the Cognitive-Perceptual and the Interpersonal

Table 1
Proposed models for the confirmatory factor analysis of the items of the Schizotypal Personality Questionnaire-Brief.

Model	Factor	IREF	MgT	UPE	PA	SA	NCF	BA	OB	OS
One-factor (Siever and Gunderson, 1983)	General ^a	5,10	4,12	2,16	7,9,14,17	11,21	15,18	1,22	3,6,19	8,13,20
	Positive	X	X	X	X				X	X
(Raine and Benishay, 1995) ^b	Negative					X	X	X		
	Positive	X	X	X	9,17					X
(Raine et al., 1994)	Interpersonal				7,14	X	X	X		
	Disorganized								X	X
(Battaglia et al., 1997)	Positive	X	X	X	X					
	Interpersonal				X	X	X	X		
(Bergman et al., 1996)	Disorganized								X	X
	Positive	X	X	X	X					
(Stefanis, et al., 2004) ^c	Negative					X	X	X		
	Paranoid	X			X	X				
	Positive		X	X						
	Negative				X	X	X	X		
	Disorganized								X	X
	Paranoid	X			X					

IREF: Ideas of Reference; MgT: Magical thinking; UPE: Unusual Perceptual Experiences; PA: Paranoia; SA: Social Anxiety; NCF: No close friends; BA: Blunted affect; OB: Odd behavior; OS: Odd speech.

^a The items corresponding to each factor are shown.

^b In this model items 9 and 17 correspond to the Positive factor and items 7 and 14 to the Interpersonal factor.

^c In this original study the Social anxiety scale loaded below 0.30 in the Paranoid factor. Hence, in the present work it was included in the Negative factor. Likewise items 7 and 14 share the Paranoid and Negative factors.

Table 2
Descriptive statistics (mean and S.D.) for the Schizotypal Personality Questionnaire-Brief (SPQ-B) items and standardized coefficients for the Raine et al. (1994) Disorganized Model.

SPQ-B item	M	S.D.	Positive λ	Interpersonal λ	Disorganized λ	R ²
1	2.54	1.25		0.69		0.30
2	1.76	1.18	0.73			0.38
3	2.32	1.19			0.63	0.28
4	1.88	1.16	0.59			0.26
5	1.95	1.24	0.73			0.35
6	1.96	1.19			0.86	0.52
7	1.87	1.17	0.42	0.38		0.34
8	2.02	1.12			0.63	0.32
9	2.13	1.26	0.48	0.25		0.26
10	2.01	1.22	0.57			0.22
11	2.60	1.25		0.79		0.40
12	1.45	1.01	0.51			0.25
13	2.11	1.19			0.64	0.29
14	2.41	1.28	0.25	0.61		0.35
15	2.50	1.21		0.77		0.40
16	2.04	1.22	0.71			0.33
17	1.99	1.15	0.38	0.40		0.34
18	1.75	1.03		0.60		0.33
19	1.70	1.09			0.72	0.44
20	2.01	1.11			0.67	0.36
21	2.36	1.18		0.73		0.39
22	2.85	1.36		0.74		0.30

Note: M: Mean; S.D.: Standard Deviation; λ: standardized coefficients; R²: proportion of explained variance.

All standardized coefficients were statistically significant ($p < 0.01$).

dimensions, the standardized loadings ranged from 0.25 to 0.86 and the proportion of explained variance from 0.22 to 0.52 (see Table 2). In this model, the correlation between the latent variables ranged from 0.45 (Positive-Interpersonal) to 0.76 (Interpersonal-Disorganized). The four-factor model showed strong parallels with the Disorganized model with respect to the standardized loadings and the proportion of explained variance, which ranged from 0.13 to 0.86 and from 0.25 to 0.52, respectively. For this model, the correlation between the latent variables ranged from 0.40 (Positive-Interpersonal) to 0.83 (Paranoid-Positive). In accordance with (a) the parsimony criterion (fewer dimensions) and (b) the high correlation between the Paranoid and Positive factors in the four-factor model, Raine et al.'s (1994) three-factor model was selected as the most adequate. In addition, this model was used to test measurement invariance across sex and age.

3.3. Invariance across sex and age

Measurement invariance for the model hypothesized by Raine et al. (1994) for males and females was studied. The results are presented in Table 5. The goodness-of-fit indices obtained for both groups were satisfactory, indicating an adequate fit to the data. Likewise, the configural model in which no equality constraints were imposed showed an excellent fit to the data. Next, metric invariance

for the two groups was tested. The CFI values for the configural model were similar to those for the metric invariant model, which indicated that the hypothesis of metric invariance was tenable. Subsequently, strong measurement invariance was tested, where the item intercepts and factor loadings were constrained to be equal across groups. Hence, the results support configural, metric and strong invariance of the SPQ-B across sex.

Subsequently, measurement invariance of the SPQ-B across age was analyzed. The goodness-of-fit indices for the three age groups are shown in Table 5. The configural model, in which no equality constraints were imposed, provided adequate fit to the data. As can be observed, when the equivalence of the factorial loadings and intercept values were incorporated, the difference in the ΔCFI between the configural and constrained models did not exceed 0.01. Therefore, we concluded that the factorial structure of the SPQ-B was operating equivalently across the three age groups.

3.4. Tests for latent mean differences

Latent mean differences across groups were estimated fixing the latent mean values to zero first in males and then in the 12- to 15-year-old groups. For comparisons among groups in the latent means, statistical significance was based on the z statistic. The comparison of the sex and age groups in latent means revealed statistically significant differences. The comparison of the sex groups in latent means indicated that, on average, females scored 0.125 units below males in the Positive dimension, and that this difference was statistically significant (-0.125 ; $p < 0.01$). Likewise, males scored higher in the Disorganized dimension in comparison to females (-0.155 ; $p < 0.01$). Comparison of the age groups in the latent mean indicated that, on average, the 16 to 18-year-olds scored 0.136 units below the 12 to 15-year-olds in the Positive dimension (-0.136 ; $p < 0.01$) and 0.09 units above them in the Interpersonal (Negative) dimension (0.090; $p < 0.05$). For its part, the 19 to 25-year-old group scored 0.326 units below the 12 to 15-year-olds in the Positive dimension (-0.326 ; $p < 0.01$) and 0.098 units below them in the Disorganized dimension (-0.098 ; $p < 0.05$).

4. Discussion and conclusions

The main goal of the present research was to analyze the dimensional structure and measurement invariance of the Schizotypal Personality Questionnaire-Brief (SPQ-B) (Raine and Benishay, 1995) across sex and age in a representative sample of nonclinical adolescents and young adults. This would help us to understand the structure and content of schizotypal personality, via the SPQ-B, in an age group at special risk for schizophrenia-spectrum disorders, to establish links with the phenotypal structure found in other studies and to avoid the possible confounding effects present in clinical samples (e.g., medication). The results showed that the Likert version of the SPQ-B presented adequate psychometric properties for the assessment of schizotypal features in nonclinical populations. Also,

Table 3
Descriptive statistics (mean and standard deviation) for the Schizotypal Personality Questionnaire-Brief (SPQ-B) subscales and total score.

SPQ-B	Sex		Age			Total
	Male	Female	12–15 years	16–18 years	19–25 years	
	(n = 754)	(n = 1035)	(n = 549)	(n = 782)	(n = 459)	
	M (S.D.)	M (S.D.)	M (S.D.)	M (S.D.)	M (S.D.)	M (S.D.)
Cognitive	15.6 (5.9)	14.9 (5.6)	16.1 (6.3)	15.3 (5.6)	14.1 (5.2)	15.2 (5.8)
Interpersonal	18.9 (6.2)	18.8 (6.3)	18.6 (6.3)	19.1 (6.1)	19.0 (6.5)	18.9 (6.3)
Disorganized	12.7 (4.8)	11.7 (4.6)	12.3 (4.8)	12.3 (4.7)	11.5 (4.6)	12.1 (4.7)
Total Score	47.3 (14.5)	45.4 (13.9)	46.9 (15)	46.7 (13.7)	44.6 (13.8)	46.2 (14.2)

Table 4
Goodness-of-fit indices for the theoretical models proposed.

Model	S-B χ^2	df	CFI	RMSEA	RMSEA 90% IC	SRMR	AIC
One-factor	2696.1	209	0.924	0.082	0.079–0.084	0.066	3673.9
Siever and Gunderson, 1983	1981.9	208	0.944	0.069	0.066–0.072	0.062	2729.1
Two-factor							
Raine et al., 1994; ^a	1405.7	202	0.962	0.058	0.055–0.061	0.051	1959.1
Three-factor (disorganized)							
Raine and Benishay, 1995; ^b	1738.6	206	0.951	0.064	0.062–0.067	0.060	2393.1
Three-factor							
Bergman et al., 1996	2103.2	206	0.940	0.072	0.069–0.075	0.061	2863.5
Three-factor (paranoia)							
Battaglia et al., 1997	1955.7	206	0.945	0.069	0.062–0.072	0.062	2682.4
Three-factor (eccentric)							
Stefanis et al., 2004; ^c	1355.1	199	0.963	0.057	0.054–0.060	0.050	1896.4
Four-factor (paranoid)							

Note: S-B χ^2 = Satorra-Bentler scaled statistic; df = Degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; IC = Confidence Interval; SRMR = Standardized Root Mean Square Residual; AIC = Akaike information Criterion.

^a Items 7, 9, 14 and 17 belong to both the Interpersonal and Positive factors.

^b Items 9 and 17 correspond to the Positive factor; items 7 and 14 to the Disorganized factor.

^c Items 7 and 14 belong to both the Interpersonal and Paranoid factors.

the dimensional structure of the SPQ-B is of a multidimensional character and holds invariant across sex and age.

First, the Likert-type response format of the SPQ-B showed high levels of internal consistency in the participants' scores. According to related psychometric literature, a graduated response format improves the psychometric characteristics of the measurement instruments (e.g. reliability or validity) (Muñiz et al., 2005). The use of the Likert-type format has more advantages than disadvantages in the case of personality questionnaires. In this regard, previous studies that have employed the Likert version of the SPQ or SPQ-B have found that this response format improves the metric properties of the scores (Wuthrich and Bates, 2005; Fonseca-Pedrero et al., 2010a, 2010b). This response format is particularly relevant in the study of schizotypal features, one of the main aims of which is the early psychometric detection of individuals at heightened risk for the later development of schizophrenia-spectrum disorders.

Second, schizotypal personality consists of cognitive, affective and behavioral symptoms that can be grouped into a multidimensional structure (Kwapil and Barrantes-Vidal, in press; Raine, 2006). In this study, the models that best fit the data were the Disorganized model by Raine et al. (1994) and the Paranoid model by Stefanis et al. (2004). However, based on the high degree of overlap of the dimensions in the four-factor model (clearly indicating the low discriminant validity of the dimensions) as well as the parsimony criterion and the high replicability

and stability of the Disorganized model in the literature, Raine et al.'s (1994) model was chosen as the most pertinent. Previous studies, using SPQ-B, have found that schizotypal personality is essentially made up of three factors (Axelrod et al., 2001; Mata et al., 2005; Compton et al., 2009; Fonseca-Pedrero et al., 2009), though other studies have also found two (Aycicegi et al., 2005) or four factors (Cohen et al., 2010; Fonseca-Pedrero et al., 2010a, 2010b, 2010c). For instance, Fonseca-Pedrero et al. (2009), using the SPQ-B in a sample of nonclinical adolescents, obtained similar results to those found in this study, the models by Raine et al. (1994) and Stefanis et al. (2004) showing a reasonably good fit to the data. Bearing in mind the difficulties inherent to the strict comparison among studies due to sample heterogeneity and the statistical analyses performed, these factorial studies probably indicate lack of convergence on a factor structure underlying the SPQ-B and may represent a fundamental problem for the instrument (Cohen et al., 2010). Due to these inconsistencies found with the SPQ-B, Cohen et al. (2010) have proposed a new version of the SPQ-B (denominated SPQ-BR) composed of 32 items. The levels of internal consistency for the subscales ranged from 0.70 to 0.86. Moreover, based on different exploratory and confirmatory factor analyses they propose a structure with seven first-order dimensions grouped into three (Cognitive Perceptual, Disorganized and Interpersonal) or four (Cognitive Perceptual, Disorganized, Social Anxiety and No CloseFriends/Constricted affect) second-order dimensions. In general terms, the data seem to

Table 5
Configural, Weak and Strong measurement invariance for Schizotypal Personality Questionnaire-Brief: goodness-of-fit statistics.

Model	S-B χ^2	df	CFI	RMSEA	RMSEA 90% CI	SRMR	AIC	Δ CFI
<i>Sex</i>								
Male (n = 754)	550.3	202	.974	.048	.043–.053	.047	815.3	
Female (n = 1035)	1055.1	202	.953	.064	.060–.067	.060	1509.8	
<i>Multiple group</i>								
Configural invariance	1612.6	404	.962	.058	.055–.061	.060	2325.1	
Weak invariance	1680.0	427	.960	.057	.054–.060	.061	2353.5	-.01
Strong invariance	1781.4	446	.958	.058	.055–.061	.061	2500	-.01
<i>Age</i>								
12–15 years old (n = 549)	437.4	202	.976	.046	.040–.052	.047	689.5	
16–18 years old (n = 782)	826.1	202	.951	.063	.058–.067	.059	1149.4	
19–25 years old (n = 458)	602.2	202	.958	.066	.060–.072	.069	885.0	
<i>Multiple group</i>								
Configural invariance	1854.5	606	.961	.059	.056–.062	.069	2723.9	
Weak invariance	1946.7	652	.959	.058	.055–.061	.071	2727.5	-.01
Strong invariance	2086.3	690	.956	.058	.055–.061	.071	2913.3	-.01

Note: S-B χ^2 = Satorra-Bentler scaled statistic; df = Degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval; SRMR = Standardized Root Mean Square Residual; AIC = Akaike Information Criterion.

indicate that the dimensional structure of schizotypal personality, measured through the SPQ-B, appears to have an underlying dimensional structure of three or four factors.

Third, the results support the measurement invariance of the SPQ-B across sex and age. Previous studies have found that the Disorganized model, measured through the subscales of the SPQ, has proved to be equivalent across sex, age, culture and religious affiliation (Reynolds et al., 2000; Fossati et al., 2003; Badcock and Dragovic, 2006; Wuthrich and Bates, 2006; Bora and Arabaci, 2009). Similar results are found on analyzing measurement invariance across sex and/or age with the Wisconsin Schizotypy Scales (Kwapil et al., 2008; Fonseca-Pedrero et al., 2010c). The comparability between different groups only makes sense if it can be guaranteed that participants interpret and understand the construct in a similar manner. Hence, from a psychometric point of view, the study of measurement invariance is a prerequisite for performing any group comparisons (Meredith, 1993; Byrne, 2008). When the data support the dimensional structure underlying the SPQ-B as invariant across sex and age, we are asserting that participants interpret and respond to the items in the measurement instrument in a similar manner, that the factorial structure found is similar and that it is presented in the same metric across groups. If any difference in the latent mean score is found, we can be sure that such difference is a result of a true difference in the latent variable, and not a measurement artifact. It is worth mentioning that once the data support strong measurement invariance, comparison among the latent means can be performed, but not among the raw scores (i.e., extracted from the sum of the items comprising the scales), as occurs in many of the published studies in this field.

Regarding sex and age, the results show that there are statistically significant differences in the latent means of schizotypal features as a function of sex and age. Males obtained higher scores than females in the Positive and Disorganized dimensions. Previous studies have found that males obtain higher scores than females in the Disorganized dimension (or in any of its facets) (Raine, 1992; Fossati et al., 2003; Mata et al., 2005; Wuthrich and Bates, 2006; Bora and Arabaci, 2009). However, the results we obtained regarding the Positive dimension contradict those from the previous literature, which found that females score higher than males in the Positive dimension (Raine, 1992; Fossati et al., 2003; Mason and Claridge, 2006; Fonseca-Pedrero et al., 2008a, 2008b; Kwapil et al., 2008), even though other studies have failed to find this relationship (Fonseca-Pedrero et al., 2009; Miettunen and Jääskeläinen, 2010). Given that the analysis of latent means in structural equation modeling only permits the taking into account of one variable at a time (e.g., sex or age), we conducted a MANOVA taking the SPQ-B dimensions as the dependent variables and sex and age as fixed factors. We have found that the sex differences in the Positive dimension disappeared ($F=2.94$; $p=.084$), whereas the rest of the differences found in the latent means remained. By age, younger participants obtained higher scores than older participants in the Positive and Disorganized dimensions, and older participants obtained higher scores than younger participants in the Negative dimension (Interpersonal). Previous research found that younger individuals obtain higher total scores on schizotypal self-reports and/or in the Positive dimension than older participants (Venables and Bailes, 1994; Chen et al., 1997; Fossati et al., 2003; Mata et al., 2005; Badcock and Dragovic, 2006; Bora and Arabaci, 2009), whereas scores in the Negative dimension seem to increase with age (Mason and Claridge, 2006). These results highlight the impact of these two sociodemographic variables on the phenotypic expression of schizotypal traits as can be found in patients with schizophrenia.

There is no doubt that our findings have clear implications with a view to integrating studies on schizotypal traits into the current models of developmental psychology, as well as contributing to an understanding of the course and nature of this personality type; however the results of the present study should be interpreted in the

light of the following limitations: a) the detection of individuals at risk for schizophrenia spectrum-disorders is based solely on the use of self-report measures, and this both restricts participants' capacity to report about their own experiences and behaviors and facilitates the possibility of distorting the answers given in the questionnaires; b) adolescence and young adulthood is a period marked by substantial self-identity, family-related, social and biological changes (e.g., hormonal changes), which could be playing a relevant role in the phenotypic expression of these personality traits; and c) it must be pointed out that no information was obtained regarding possible family psychiatric morbidity in the sample.

Future research should continue to advance in the study of measurement invariance of schizotypal personality traits across cultures, with a view to guaranteeing the comparability and cross-cultural equivalence of this construct, as well incorporating new psychometric methodologies such as computerized-adaptive testing. Likewise, the use of self-reports such as the SPQ-B as a screening method in community studies, given their easy and rapid administration, or their use in combination with endophenotypes for the early detection of schizophrenia-spectrum disorders, represents highly promising lines of research.

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