Schizotypal Personality Questionnaire: New sources of validity evidence in college students

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ABSTRACT

Schizotypal traits represent the behavioral expression of vulnerability to psychosis in general population. Among the most widely used measurement instruments, we could find the Schizotypal Personality Questionnaire (SPQ) (Raine, 1991). However, some aspects of its psychometric quality have yet to be analyzed. The main goal of the present study was to gather new sources of validity evidence of the SPQ scores in non-clinical young adults. The final sample was made up of 1123 college students ($M=20.3$ years; S.D.$=2.6$). The study of the internal structure using exploratory factor analysis revealed that SPQ items were grouped in a theoretical structure of seven second-order factors. Confirmatory factor analyses showed that the four-factor model (Paranoid) displayed better goodness-of-fit indices than the other hypothetical dimensional models tested. More complex measurement models, such as those tested using second-order confirmatory factor analyses and Exploratory Structural Equation Modeling, also showed adequate goodness-of-fit indices. The reliability of the SPQ scores ranged from 0.80 to 0.91. A total of 11 items showed differential functioning by gender. Advances in psychosis phenotype measurement open up new horizons to understand the structure and content of schizotypy.

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1. Introduction

Psychotic symptoms, such as hallucination experiences or paranoid ideation, can be found in the general population, below the clinical threshold, and without necessarily being associated with a mental disorder (Linscott and van Os, 2013; van Os et al., 2009). This set of experiences expressed at a subclinical level is known as schizotypal traits or psychotic-like experiences. Schizotypy is a complex construct intimately related to psychosis at genetic, biochemical, phenotypic, and behavioral levels (Kwapil and Barrantes-Vidal, 2013; Kwapil et al., 2008; Lenzenweger, 2010; Meehl, 1962; Raine, 2006), and captures the expression of schizophrenic symptoms and impairment from subclinical levels to full-blown psychosis. Independent follow-up studies show that healthy participants who report schizotypal traits, compared to those who do not report such experiences, are at greater risk of transition to schizophrenia-spectrum disorders (Chapman et al., 1994; Dominguez et al., 2011;

Gooding, Tallent et al., 2005; Kwapil et al., 2013; Werbeloff et al., 2012). However, it is also true that recent studies indicate the low specificity of these experiences and that their evolution is limited not only to the formal diagnosis of psychosis but also to other mental disorders (e.g., depression) (Fisher et al., 2013). Schizotypy is also a relevant predictive factor when examining individuals who are at-high genetic risk (Shah et al., 2012) and at-high clinical risk to psychosis (Morrison et al., 2006). Furthermore, healthy individuals who report high scores on schizotypy measures also present subtle emotional, behavioral, neurocognitive, psychophysiological, and/or social deficits (Barrantes-Vidal et al., 2013a; Barrantes-Vidal et al., 2013b; Cella et al., 2013; Fonseca-Pedrero et al., 2013; Gooding et al., 2006; Gooding and Pflum, 2011; Gooding, Shea et al., 2005; Horan et al., 2008; Martin et al., 2012), similar to those found in patients with schizophrenia or schizotypal personality disorder. In this sense, schizotypal traits would represent the behavioral expression of latent vulnerability to psychosis, and could be considered as a risk marker for psychosis and related disorders (van Os et al., 2009).

Several measurement instruments for schizotypy assessment have been developed (Fonseca-Pedrero et al., 2008). The Chapman Scales (Chapman et al., 1976, 1978; Eckblad et al., 1982), the Oxford–Liverpool Inventory of Feelings and Experiences (Mason and Claridge,

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2006), and the Schizotypal Personality Questionnaire (SPQ) (Raine, 1991), or its brief version (SPQ-B) (Raine and Benishay, 1995), are some examples for the adult population. The Chapman Scales have been widely studied, and their psychometric properties are consistent across studies and samples (Barrantes-Vidal et al., 2013a; Kwapil et al., 2008). Regarding SPQ, its psychometric properties, reliability, and sources of validity evidence have been analyzed (Compton et al., 2009; Chen et al., 1997; Fonseca-Pedrero et al., 2008; Fossati et al., 2003; Wuthrich and Bates, 2006). Nevertheless, several limitations in the reliability of the scores or inconsistencies regarding the underlying factor structure have been found. In terms of reliability of scores, some studies have criticized the low levels of reliability found for the SPQ subscales (Cohen et al., 2010). In this sense, other authors have proposed a five-option Likert-type response format to improve reliability of the scores (Cohen et al., 2010; Fonseca-Pedrero et al., 2011; Wuthrich and Bates, 2006).

The study of the underlying factor structure of the SPQ subscales reveals that schizotypy is a multidimensional construct. Specifically, using the SPQ (or SPQ-B), Raine et al.'s (1994) three-factor model (Disorganized) has been widely replicated, and is relatively invariant across studies and other variables (e.g., age, sex) (Badcock and Dragovic, 2006; Chen et al., 1997; Fonseca-Pedrero et al., 2009, 2011; Fossati, et al., 2003; Ortuño-Sierra et al., 2013; Reynolds et al., 2000; Wuthrich and Bates, 2006). This model includes the Cognitive–Perceptual, Interpersonal, and Disorganization dimensions. However, Stefanis et al.'s (2004) four-factor model (Paranoid), which includes the Cognitive–Perceptual, Interpersonal (Negative), Disorganization, and Paranoid dimensions, has also been replicated in both the SPQ and SPQ-B. The goodness-of-fit indices found for the Stefanis et al. model are similar to, or even better than, those reported for Raine's model (Bora and Arabaci, 2009; Compton et al., 2009; Fonseca-Pedrero et al., 2011; Wuthrich and Bates, 2006). This fact, together with the lack of factorial consistency among studies, has led some authors to examine the factor structure of SPQ scores at the item level (Cohen et al., 2010; Chmielewski and Watson, 2008), or to refine the SPQ through the development of a revised brief version (Callaway et al., 2014; Cohen et al., 2010). These results have stimulated a debate on whether schizotypy is a three or four-dimensional construct, and whether the SPQ subscales have the necessary empirical support to be used, with scientific guarantees, in both research and clinical practice. Also, it is noteworthy that new factorial studies to test whether the SPQ subscales are one-dimensional or to test new measurement models through different approaches (e.g., Exploratory Structural Equation Modeling) should be conducted with the aim to capture the complexity of schizotypy phenotype. In order to advance in the underlying factor structure of the SPQ scores, further analyses incorporating new statistical procedures are needed.

As it can be seen, the dimensional structure of the SPQ at the item level has not received sufficient analysis, and the available factorial results until date are still inconsistent with regard to the number and content of the dimensions at the subscale level. Likewise, testing new measurement models which take into account that the items are grouped in subscales (first-order factor), and those ones loading in higher order dimensions of schizotypy (second-order factors), is needed. Furthermore, other psychometric properties of the SPQ, such as differential item functioning (DIF) by sex, have to be explored in depth yet. From this point of view, the aim of the present study was to gather new sources of validity evidence of the SPQ scores in a sample of non-clinical young adults. The internal structure of the SPQ has been examined, through exploratory factor analysis at the item level, and confirmatory factor analysis at both the subscale and item level. Moreover, the reliability of the SPQ scores and DIF by sex were calculated.

2. Method

2.1. Participants

The final sample consisted of a total of 1123 university students, 224 were males (19.9%), from different courses at three Spanish institutions: University of Oviedo (Education and Psychology), University of La Rioja (Education), and University of La Laguna (Psychology). Participants mean age was 20.15 years, ranging from 17 to 29 (S.D.=1.98). Participants were asked if they had any psychological disorder. If yes, they were removed from the sample. Just 2.2% of the sample reported having a first-degree relative who had been diagnosed with a psychotic disorder or schizophrenia, while 11.1% reported having a first-degree relative with antecedents of some other psychological disorder. In order to make the relevant statistical analyses, a cross-validation study with the total sample divided into two subsamples was carried out. The first subsample consisted of 594 students (119 men; M=20.24; S.D.=2), and the second of 529 students (105 men; M=20.05 years; S.D.=1.9). There were no statistically significant differences, neither by sex (χ^2=0.006; p=0.106) nor by age (F=2.610; p=0.938), between the two subsamples.

2.2. Instruments

The Schizotypal Personality Questionnaire (SPQ) (Raine, 1991) is a self-report instrument made up of 74 items with a dichotomic response format (Yes/No), developed to measure schizotypal personality according to DMS-III-R criteria (American Psychiatric Association, 1987). The items are distributed in 9 subscales: Odd beliefs or Magical thinking, Unusual perceptual experiences, Ideas of reference, Paranoid ideation/suspiciousness, Excessive social anxiety, No close friends, Constricted affect, Odd or eccentric behavior, and Odd speech. The psychometric properties of the SPQ scores have been analyzed (Compton et al., 2009; Fonseca-Pedrero et al., 2008; Fossati et al., 2003; Wuthrich and Bates, 2006). In the present work we used the adapted and validated version for the Spanish context (Fumero et al., 2009). This adaptation was made according to the International Test Commission Guidelines for translating and adapting tests (Muñiz et al., 2013).

2.3. Procedure

Participants fulfilled SPQ in a group session (10–50 students), during a normal hour class. Participants were informed about the research and, after signing the consent form, were asked to complete anonymous questionnaires. They did so voluntarily. They received no type of incentive for their participation in the study. Administration of the measurement instrument was always under the supervision of a researcher. This study is part of a broader research initiative on early detection and intervention in the context of psychological disorders in early adulthood and the analysis of psychopathological and personality variables. The study was approved by the Research and Ethics Committees at Oviedo, La Rioja, and La Laguna Universities.

2.4. Data analysis

First of all, descriptive statistics of the SPQ subscales for the total sample were calculated. Second, a cross-validation study, dividing the total sample into two subsamples, was carried out. In the first subsample we conducted exploratory factor analysis (EFA) on the SPQ scores. We first examined the one-dimensionality of the nine subscales independently. We used the tetrachoric correlation matrix. The procedure employed for determining the number of factors was optimal implementation of Parallel Analysis (Timmerman and Lorenzo-Seva, 2011). Then, we carried out a second-order EFA (principal axis factoring and Oblimin rotation) at the item level. Only the factors with eigenvalues above 1 (Kaiser's criterion) were included in the second-order EFA. The aim of the second-order EFA was to reduce the dimensionality of the data and to improve their interpretation.

Thirdly, with the second subsample, we tested different hypothetical dimensional models by means of confirmatory factor analysis (CFA) and Exploratory Structural Equation Modeling (ESEM). The models tested at the level of the SPQ subscales are shown in Table 1. Given the continuous nature of the variables, the method used was Restricted Maximum Likelihood estimator. At the item level we tested two models: (a) a second-order dimensional model, in which the items are grouped in subscales, and the subscales in the second-order dimensions of schizotypy, for both Raine et al.'s (1994) and Stefanis et al.'s (2004) models; and (b) a dimensional model within ESEM approach, in which the items are grouped in the nine theoretical factors (subscales). In both cases we took into account the dichotomic nature of the variables, so that we used the Weighted Least Squares Method estimator. The ESEM approach makes it possible to solve some of the problems associated with CFAs of multidimensional constructs, such as those cases in which there are no satisfactory goodness-of-fit indices, lack of DIF, or modifications are made to the hypothesized models (e.g., correlating the error terms) (Asparohov and Muthén, 2009; Marsh et al., 2010). In ESEM, all the factor loadings

Table 1
Dimensional models of schizotypy tested.

Model	Factor	OBMT	IOR	UPE	PI	ESA	NCF	CA	OEB	OS
One-dimensional	General	x	x	x	x	x	x	x	x	x
Kendler et al. (1991)	Positive	x	x	x	x	x				x
	Negative					x	x	x	x	
Siever and Gunderson (1983)	Positive	x	x	x	x				x	x
	Negative					x	x	x		
Raine et al. (1994)	Positive	x	x	x	x					
	Interpersonal				x	x	x	x		
	Disorganized								x	x
Wuthrich and Bates (2006)	Positive	x	x	x	x	x				
	Interpersonal				x	x	x	x		
	Disorganized								x	x
Stefanis et al. (2004)	Cognitive	x		x						
	Negative					x	x	x	x	
	Disorganized								x	x
	Paranoid		x		x	x				

Note: OBMT=Odd beliefs or Magical thinking; IOR=Ideas of reference; UPE=Unusual perceptual experiences; PI=Paranoid ideation/Suspiciousness; ESA=Excessive social anxiety; NCF=No close friends; CA=Constricted affect; OEB=Odd or eccentric behavior; OS=Odd speech.

are estimated, whilst in CFA certain restrictions are placed on the parameters. ESEM, an overarching integration of the best aspects of CFA and EFA, provides confirmatory tests of a priori factor structures, and relations between latent factors. ESEM has broad applicability to clinical studies that are not appropriately addressed either by EFA or by CFA. The goodness-of-fit indices employed were: the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA) and its confidence interval (continuous variables), and the Standardized Root Mean Square Residual (SRMR) (continuous variables) and WRMR (Weighted Root Mean Square Residual) (categorical variables). To achieve a good fit of the data to the model, the values of CFI and TLI should be over 0.95 and the RMSEA and SRMR/WRMR values should be under 0.08 for a reasonable fit and under 0.05 for a good fit (Brown, 2006; Hu and Bentler, 1999).

Then in the fourth step, we estimated the ordinal alpha of the scores for the total sample (Elosúa and Zumbo, 2008; Zumbo et al., 2007). Score reliability must be calculated taking into account the dichotomic nature of the variables. In the fifth place, we examined the differential item functioning (DIF) across sex. An item presents DIF when the probability of a positive score in individuals with the same level in the latent trait varies according to the group to which they belong (e.g., sex). DIF analysis involves a procedure to determine whether the differences between scores are due to real differences in the trait assessed or, on the other hand, are attributable to a statistical artifact of the measurement process. The Mantel–Haenszel procedure is among those most widely used to evaluate DIF, given its simplicity of calculation and interpretation. In the present work we employed the Generalized Mantel–Haenszel test (GMH) (Mantel and Haenszel, 1959), specifically the Generalized Ordinal MH statistic(2) – QGMH(2). The statistical significance level was set at 0.01. GHMDIF (Fidalgo, 2011) program was used for DIF analysis. It is noteworthy to mention that GHMDIF does not allow calculating the effect size for DIF. For the data analyses we used SPSS 15.0 (Statistical Package for the Social Sciences, 2006), FACTOR 9.2 (Lorenzo-Seva and Ferrando, 2006), and Mplus 5.2 (Muthén and Muthén, 1998-2007).

3. Results

3.1. Descriptive statistics of the SPQ subscales

Table 2 shows the descriptive statistics referring to the number of items, mean, standard deviation, asymmetry, kurtosis, range, and internal consistency for the SPQ subscales (calculated considering the variables as both continuous and categorical). As it can be seen, the internal consistency levels in the case of the estimation of internal consistency with continuous variables ranged between 0.61 and 0.78; on the other hand, in the case of ordinal alpha they ranged from 0.80 to 0.91.

3.2. Evidence based on the internal structure of the SPQ scores

3.2.1. Dimensionality of the SPQ subscales

First of all, we tested whether the SPQ subscales were essentially one-dimensional, examining the percentage of variance explained by the first factor of each subscale individually. The results indicated that, in all cases, the variance explained by the first factor was higher than 36%, ranging from 36.18% (Constricted affect) to 69.17% (Odd behavior). In the case of the procedure for determining the number of dimensions, the advised number of dimensions was one for each of the SPQ subscales.

3.2.2. Exploratory factor analysis of the SPQ items

In the first subsample we conducted EFA at item level. An EFA with subsequent Oblimin rotation on the 74 items of the SPQ was carried out. The Kaiser–Meyer–Olkin (KMO) value was 0.80, and Bartlett's sphericity index was 10961.6 ($p \leq 0.001$). A total of twenty-three eigenvalues attained values higher than 1, explaining 59.32% of the total variance. In order to reduce the dimensionality of the data and to improve their interpretation, we conducted a second-order EFA. The KMO measure of sampling adequacy was 0.73, and Bartlett's sphericity index was 2689.6 ($p < 0.001$). A total of seven eigenvalues attained values higher than 1, explaining 55.91% of the total variance. Table 3 shows the factor loadings, eigenvalues, and proportion of explained variance for the seven second-order factor structure. The first factor grouped aspect related to Ideas of reference, so that it was called *Ideas of Reference*. The second factor grouped aspects related to No close friends, Odd behavior and Flat affect, so that it was labeled *No close friend/Odd behavior*. The third factor brought together aspects related to Social anxiety, so that we named it *Social anxiety*. The fourth factor grouped Magical thinking and Unusual perceptual experiences, so that it was called *Reality distortion*. The fifth factor grouped aspects related to Odd speech, and was labeled *Odd speech*. The sixth factor grouped the heterogeneous facets related to Ideas of reference and No close friends, so that it was called *Ideas of reference/No close friends*. The seventh factor grouped aspects related to Paranoid thinking and Suspiciousness, so that we named it *Paranoid*.

3.2.3. Confirmatory factor analysis

Next, in the second subsample, we tested different dimensional models at SPQ subscales level by means of CFA. Table 4 shows the goodness-of-fit indices for the dimensional models of the SPQ tested. As it can be seen, the hypothetical model with the best goodness-of-fit indices was Stefanis et al.'s (2004) model. Raine et al.'s (1994) model presented goodness-of-fit indices close to the recommended cut-off points. Table 5 shows the standardized loadings estimated and the percentage of explained variance for Stefanis et al.'s (2004) four-factor model. For this measurement model, the correlations between factors ranged from 0.23 (Paranoid–Interpersonal) to 0.64 (Disorganization–Cognitive–Perceptual).

We next tested two more measurement models considering both the subscales and the items of the SPQ. These measurement models capture more in depth the heterogeneity of the schizotypy phenotype. First, a dimensional model similar to that proposed by Raine et al. (1994), but taking into account the 74 items, was tested. This model was made up of three second-order dimensions (three schizotypy factors), nine first-order factors (the nine subscales) and the 74 items (indicators). The grouping of the first-order factors in the second-order factors was identical to that proposed in Raine et al.'s (1994) model. The goodness-of-fit indices were: χ^2=6669.5; d.f.= 2615; CFI=0.87; TLI=0.86; RMSEA=0.054; WRMR= 1.42. Second, a dimensional model similar to that proposed by Stefanis et al. (2004), made up of four second-order dimensions (four schizotypy factors), nine first-order

Table 2
Descriptive statistics for the Schizotypal Personality Questionnaire (SPQ) subscales.

SPQ subscales	Number of items	Mean	S.D.	Asymmetry	Kurtosis	Range	α	Ordinal α[a]
Ideas of reference	9	3.37	2.26	0.46	−0.62	0–9	0.71	0.83
Excessive social anxiety	8	3.86	2.29	0.06	−1.11	0–8	0.77	0.87
Odd beliefs or Magical thinking	7	1.12	1.41	1.50	2.10	0–7	0.64	0.84
Unusual perceptual experiences	9	1.81	1.68	0.98	0.61	0–8	0.61	0.82
Odd or eccentric behavior	7	1.48	1.79	1.25	0.62	0–7	0.78	0.91
No close friends	9	2.13	1.81	0.80	0.15	0–9	0.63	0.82
Odd speech	9	2.56	1.96	0.84	0.32	0–9	0.66	0.83
Constricted affect	8	1.58	1.35	0.87	0.73	0–7	0.63	0.80
Paranoid ideation/suspiciousness	8	2.31	1.85	0.84	0.27	0–8	0.67	0.82

[a] Ordinal alpha calculated taking into account the dichotomic nature of the data.

Table 3
Second-order factor analysis of the Schizotypal Personality Questionnaire.

First-order factors	Second-order factors						
	I	II	III	IV	V	VI	VII
Ideas of reference I	0.73					0.27	
Ideas of reference II	0.58						
Ideas of reference III	0.27						
No close friends I		−0.75	0.27		−0.25		
No close friends II		0.45					
Flat affect I		−0.44					
Odd behavior		0.38					
No close friends III		0.38					
Flat affect II							
Social anxiety I			0.67				
Social anxiety II			−0.67				
Magical thinking I				0.73			
Magical thinking II				0.54			
Unusual experiences I				0.45			
Unusual experiences II	0.32			0.41			
Magical thinking III	0.33			0.33			
Odd speech I					0.71		
Odd speech II		−0.38			0.41		
No close friends III					0.30		
Ideas of reference III						0.40	
No close friends IV						0.31	
Paranoid I							0.68
Paranoid II							0.32
Eigenvalue	3.73	2.52	1.81	1.41	1.22	1.14	1.04
% of explained variance	16.21	10.96	7.86	6.11	5.31	4.94	4.53

Note: Factor loadings under 0.25 have been removed.

factors (the nine subscales), and the 74 items (indicators), was tested. The goodness-of-fit indices were: $\chi^2 = 6227.5$; d.f. $= 2610$; CFI $= 0.88$; TLI $= 0.88$; RMSEA $= 0.051$; WRMR $= 1.37$. The goodness-of-fit indices for these measurement models were acceptable.

3.2.4. Exploratory Structural Equation Modeling

Also, in the second subsample we tested a new dimensional model, developed within the ESEM approach. In this model the 74 items were grouped in nine hypothetical first-order factors (subscales). For this model, the goodness-of-fit indices were: $\chi^2 = 2534.6$; d.f. $= 2071$; CFI $= 0.99$; TLI $= 0.98$; RMSEA $= 0.021$; WRMR $= 0.069$. In the case of this model, we observed a clear grouping of the items in the majority of their respective theoretical subscales of the SPQ. The factors found were in the following order: Ideas of reference, Magical thinking/Unusual perceptual experiences, Excessive social anxiety, Odd behavior, Odd beliefs, Odd Speech, No close friends, Constricted affect, Emotional mistrust and Paranoid ideation.

3.3. Analysis of differential item functioning (DIF) by sex

The study of DIF by sex was carried out for each individual subscale of the SPQ. DIF by sex was found in the following subscales: Excessive social anxiety (four items), Odd beliefs or Magical thinking (two items), Unusual perceptual experiences (two items), No close friends (one item), and Odd speech (two items).

4. Discussion and conclusions

The main goal of this study was to gather new sources of validity evidence of the Schizotypal Personality Questionnaire (SPQ) (Raine, 1991) in a sample of non-clinical young adults. To this end, we estimated the score reliability for the SPQ subscales, and we analyzed the differential item functioning (DIF) by sex. We also examined the internal structure of the SPQ, through exploratory factor analysis (EFA) at the item level, and confirmatory factor analysis (CFA) at both the subscale and item levels. The results reveal that the SPQ scores showed adequate psychometric properties regarding internal consistency and different sources of validity evidence. Likewise, the findings have helped increasing and improving our understanding of schizotypy with regard to its structure and content in samples of non-clinical young adults.

The SPQ scores, considering the dichotomic nature of the response format, were above 0.80. These levels of internal consistency were higher than those found when the categorical nature of the variables was not taken into account, and were in line with the internal consistency values reported in previous studies (Cohen et al., 2010; Compton et al., 2009; Chen et al., 1997; Chmielewski and Watson, 2008; Fossati et al., 2003). Likewise, with a view to improving the internal consistency levels, it would be useful to incorporate a Likert-type response format (Markon et al., 2011). Previous studies using the SPQ or SPQ-B, with Likert-type response format, also report high levels of consistency (Cohen et al., 2010; Fonseca-Pedrero et al., 2011). The DIF study indicated that a total of 11 items showed differential functioning by sex. This aspect has received litter research in both the schizotypy and extended psychosis phenotype field, and it would be advisable to incorporate it in future studies. DIF has been examined previously in the Chapman's Scales (Fonseca-Pedrero et al., 2014; Winterstein et al., 2011) and in the PDI-21 (Fonseca-Pedrero et al., 2012). The presence of DIF is one of the principal threats to the test's validity (American Educational Research Association et al., 1999), and should be analyzed in any type of measurement instrument.

Examination of the dimensional structure underlying the SPQ scores reveals that schizotypy is a multidimensional construct. First, the EFA at the level of the SPQ items revealed the presence of seven general second-order factors. The items corresponding to

Table 4
Goodness-of-fit indices resulting from the dimensional models tested.

Model	χ^2	d.f.	CFI	TLI	RMSEA (90% CI)	SRMR
One-dimensional	480.58	27	0.62	0.49	0.18 (0.16–0.19)	0.09
Kendler et al. (1991)	205.61	24	0.85	0.77	0.12 (0.11–0.14)	0.08
Siever and Gunderson (1983)	210.77	26	0.84	0.78	0.12 (0.10–0.13)	0.07
Raine et al. (1994)	133.06	23	0.91	0.85	0.09 (0.08–0.11)	0.05
Wuthrich and Bates (2006)[a]	126.99	22	0.91	0.85	0.09 (0.08–0.11)	0.05
Stefanis et al. (2004)	75.55	19	0.96	0.91	0.07 (0.06–0.09)	0.04
Stefanis et al. (2004)[b]	88.08	20	0.94	0.90	0.08 (0.6–0.10)	0.04

Note: χ^2=chi-square; d.f.=Degrees of Freedom; CFI=Confirmatory Factor Index; TLI=Tucker–Lewis Index; RMSEA=Root Mean Square Error of Approximation; CI=Confidence Interval; SRMR=Standardized Root Mean Square Residual.

[a] The initial model does not converge. In the new model the OBMT subscale is not grouped in the Interpersonal dimension.
[b] A modification was made to the initial Stefanis et al. (2004) model, whereby the ESA subscale is grouped in the Interpersonal dimension.

Table 5
Standardized factor loadings for the Stefanis et al. (2004) model.

SPQ Subscales	Dimensions				R^2
	Cognitive	Paranoid	Interpersonal	Disorganized	
Odd beliefs or Magical thinking	0.55				0.30
Unusual perceptual experiences	0.88				0.78
Ideas of reference		0.98			0.97
Excessive social anxiety		0.18	0.50		0.32
Paranoid ideation/ suspiciousness		0.43	0.36		0.38
No close friends			0.85		0.71
Constricted affect			0.78		0.60
Odd speech				0.65	0.42
Odd or eccentric behavior				0.58	0.34

Note: All the standardized factor loadings estimated were statistically significant ($p < 0.01$).

the theoretical subscales Ideas of reference, No close friend, Excessive social anxiety, Odd behavior, Odd speech and Paranoid ideation, together with the combination of the subscales Unusual perceptual experiences and Magical thinking, showed some consistency with the second-order dimensions found. The Constricted affect subscale was not replicated as a second-order factor. The sixth second-order factor grouped few items, and their psychological interpretation is doubtful, calling their status as second-order components into question somewhat. These aspects, besides raising doubts over the status of some of the second-order dimensions found, lend some support to claims for a heterogeneous structure of the SPQ at item level in this sample. Previous studies have also analyzed the dimensional structure of the SPQ at the item level. For example, Chmielewski and Watson (2008), analyzing the SPQ items, found a dimensional structure of five factors called: Social anhedonia, Unusual beliefs and experiences, Social anxiety, Suspiciousness, and Eccentricity/Oddity. Nevertheless, it is important to stress that the methodology employed in the present work and in that of Chmielewski and Watson (2008) is not entirely the same, so that comparisons should be made with caution.

Second, CFAs at the level of the SPQ subscales indicated that Stefanis et al.'s (2004) model showed the best goodness-of-fit indices compared to the other measurement models. These results are convergent with those reported by Stefanis et al. (2004), Bora and Arabaci (2009) and Compton et al. (2009), and similar to those found in Wuthrich and Bates (2006) and with the SPQ-B by Fonseca-Pedrero et al. (2011). Schizotypy, measured by means of the SPQ, is grouped in a structure of four general factors, namely:

Positive, Intepersonal (Negative), Disorganized, and Paranoid. These results indicate that the four-factor model helps, to some extent, to clarify the studies that supported the three-factor model proposed by Raine et al. (1994). However, it is also true that the correlations between the latent factors for this four-factor model were moderately to strongly associated, with the Positive and Disorganized factors correlating 0.64. These results revealed the high degree of overlap between the factors and the lack of discriminant validity. Likewise, and in accordance with Compton et al. (2009), the study of the dimensionality of the SPQ scores permits the construction of dimensional schizotypy scores based on empirical models with a view to their use in clinical practice and in research settings.

Thirdly, the second-order factorial dimensional models tested presented adequate goodness-of-fit indices, especially if we take into account their factorial complexity. It is worth mentioning the results from the ESEM approach, which are quite similar to the theoretical grouping of the nine subscales proposed by Raine (1991). The ESEM approach makes it possible to overcome certain limitations of the CFA measurement model, and it would be advantageous to use it in personality measures (Asparohov and Muthén, 2009; Marsh et al., 2010). There is no doubt about the dimensional complexity of some of the models tested, so that it would be interesting to replicate these findings in future studies with new representative samples of the population. It is also advisable to test new measurement models that take into account the hierarchical levels of analysis (items, subscales and schizotypy dimensions), in order to capture the heterogeneity of the schizotypy construct. In this regard, Cohen et al. (2010) proposed a dimensional model of three or four factor higher-order structure of schizotypy that took into account the nature of the items and of the subscales at the same time.

The number and content of the dimensions found in this study may depend, to some extent, on the statistical techniques employed (EFA, CFA, ESEM), and on the level of analysis of the variables (subscales and/or items); at the same time, it is true that with different factor analysis techniques similar factorial solutions are obtained (three or four factors), with small variations that do not essentially change the interpretation of the construct. This study provides new evidences on aspects unexplored in previous studies, and has partially cleared up some of the inconsistencies found in the dimensional study of schizotypy, using SPQ, in samples of non-clinical young adults.

The schizotypy construct is closely linked to psychosis and related disorders, and supported by an extensive body of theoretical and empirical knowledge (Horan et al., 2008; Kwapil and Barrantes-Vidal, 2013; Kwapil et al., 2008; Lenzenweger, 2010; Raine, 2006). Schizotypy can be considered a multidimensional phenotype that covers the clinical, preclinical and subclinical manifestations of the psychotic phenotype. At the same time, it

has been considered a risk factor for schizophrenia-spectrum disorders and useful for examining possible etiopathogenic factors. Schizotypal experiences and traits may become more important because they include not only the positive dimension (similar to psychotic-like experiences), but also the Negative/Interpersonal dimensions, which have also demonstrated their relevant role in the prediction of a clinical disorder (Dominguez et al., 2010; Kwapil, 1998), and their relation to other risk markers for psychosis (Horan et al., 2008; Kwapil et al., 2008; Tarbox et al., 2012). Indeed, many scientists have highlighted the role of negative and disorganized dimensions in the study of samples at clinical high risk (Demjaha et al., 2012). It would be very useful to take into account the importance of this construct and incorporate it in future studies of clinical high risk and attenuated psychosis syndrome.

The findings of the present study should be interpreted in the light of the following limitations. First of all, the sample characteristics (participants were university students on human and health sciences courses) preclude the generalization of the results to other populations of interest. The low number of males (less than 20%) used to investigate the underlying structure or DIF by sex of the SPQ may be a methodological problem. Secondly, the study is subject to the problems inherent to any research based on self-reports, and future studies in this context should consider the use of external informants or interviews. Nevertheless, the SPQ is an instrument that covers a wide variety of facets related to schizotypy, so that it can be considered a reasonably accurate tool for measuring this construct. Finally, the presence of psychopathology in our sample could be a constraint in the interpretation of the results.

These results throw new light on this research field that help improving the understanding of schizotypy. Advances in the field of measurement and psychosis phenotype open up new horizons for assessment and in understanding of the structure and content of schizotypy. Future studies should look deeper into the analysis of SPQ scores through Item Response Theory, or testing the measurement invariance across cultures.

Acknowledgments

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