



Contents lists available at ScienceDirect

Schizophrenia Research

journal homepage: www.elsevier.com/locate/schres

Brief assessment of schizotypal traits: A multinational study

Eduardo Fonseca-Pedrero^{a,ae,*}, Javier Ortuño-Sierra^a, Beatriz Lucas-Molina^b, Martin Debbané^{c,af}, Raymond C.K. Chan^{d,e}, David C. Cicero^f, Lisa C. Zhang^g, Colleen Brenner^g, Emma Barkus^h, Richard J. Linscottⁱ, Thomas Kwapil^j, Neus Barrantes-Vidal^k, Alex Cohen^l, Adrian Raine^m, Michael T. Comptonⁿ, Erin B. Tone^o, Julie Suhr^p, Julio Bobes^{q,ae}, Axit Fumero^r, Stella Giakoumaki^s, Ioannis Tsaousis^s, Antonio Preti^t, Michael Chmielewski^u, Julien Laloyaux^{v,w,ag}, Anwar Mechri^x, Mohamed Aymen Lahmar^x, Viviana Wuthrich^y, Frank Larøi^{v,w,ag}, Johanna C. Badcock^z, Assen Jablensky^{aa}, David Barron^{ab}, Viren Swami^{ab,ac}, Ulrich S. Tran^{ad}, Martin Voracek^{ad}

^a Department of Educational Sciences, University of La Rioja, Logroño, Spain

^b Department of Developmental and Educational Psychology, University of Valencia, Valencia, Spain

^c Faculty of Psychology and Educational Sciences, University of Geneva, Geneva, Switzerland

^d Neuropsychology and Applied Cognitive Neuroscience Laboratory, CAS Key Laboratory of Mental Health, Institute of Psychology, Chinese Academy of Sciences, Beijing, China

^e Department of Psychology, University of Chinese Academy of Sciences, Beijing, China

^f Department of Psychology, University of Hawaii at Manoa, Honolulu, HI, USA

^g Department of Psychology, University of British Columbia, Vancouver, BC, Canada

^h School of Psychology, University of Wollongong, Wollongong, Australia

ⁱ Department of Psychology, University of Otago, Dunedin, New Zealand

^j Department of Psychology, University of North Carolina at Greensboro, Greensboro, NC, USA

^k Department of Clinical and Health Psychology, Universitat Autònoma de Barcelona, Barcelona, Spain

^l Department of Psychology, Louisiana State University, Louisiana, LA, USA

^m Departments of Criminology, Psychiatry, and Psychology, University of Pennsylvania, Philadelphia, PA, USA

ⁿ Department of Psychiatry, Lenox Hill Hospital, New York, NY, USA

^o Department of Psychology, Georgia State University, Atlanta, GA, USA

^p Department of Psychology, Ohio University, Athens, OH, USA

^q Department of Psychiatry, University of Oviedo, Oviedo, Spain

^r Department of Psychology, University of La Laguna, Santa Cruz de Tenerife, Spain

^s Department of Psychology, University of Crete, Rethymno, Greece

^t Genneruxi Medical Center, Cagliari, Italy

^u Department of Psychology, Southern Methodist University, Dallas, TX, USA

^v Department of Biological and Medical Psychology, University of Bergen, Bergen, Norway

^w Psychology and Neuroscience of Cognition Research Unit, University of Liège, Liège, Belgium

^x Psychiatry Department, University Hospital of Monastir, Monastir, Tunisia

^y Centre for Emotional Health, Department of Psychology, Macquarie University, Sydney, Australia

^z Centre for Clinical Research in Neuropsychiatry, Division of Psychiatry, Faculty of Health and Medical Sciences, University of Western Australia, Perth, Australia

^{aa} Centre for Clinical Research in Neuropsychiatry, School of Psychiatry and Clinical Neurosciences, University of Western Australia, Perth, Australia

^{ab} Centre for Psychological Medicine, Perdana University, Serdang, Malaysia

^{ac} Department of Psychology, Anglia Ruskin University, Cambridge, UK

^{ad} Department of Basic Psychological Research and Research Methods, School of Psychology, University of Vienna, Vienna, Austria

^{ae} Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Oviedo, Spain

^{af} Department of Clinical, Educational and Health Psychology, University College London, London, UK

^{ag} NORMENT – Norwegian Center of Excellence for Mental Disorders Research, University of Oslo, Oslo, Norway

ARTICLE INFO

Article history:

Received 8 May 2017

Received in revised form 28 July 2017

Accepted 29 October 2017

Available online xxxxx

ABSTRACT

The Schizotypal Personality Questionnaire-Brief (SPQ-B) was developed with the aim of examining variations in healthy trait schizotypy, as well as latent vulnerability to psychotic-spectrum disorders. No previous study has studied the cross-cultural validity of the SPQ-B in a large cross-national sample. The main goal of the present study was to analyze the reliability and the internal structure of SPQ-B scores in a multinational sample of 28,426 participants recruited from 14 countries. The mean age was 22.63 years ($SD = 7.08$; range 16–68 years), 37.7% ($n = 10,711$) were men. The omega coefficients were high, ranging from 0.86 to 0.92 for the

* Corresponding author at: University of La Rioja, C/Luis de Ulloa, 2, Edificio VIVES, C.P. 26004, Logroño, La Rioja, Spain.
E-mail address: eduardo.fonseca@unirioja.es (E. Fonseca-Pedrero).

Keywords:

Schizotypy
Schizotypal personality
Psychosis
Cross-cultural
SPQ-B
Psychosis risk

total sample. Confirmatory factor analysis revealed that SPQ-B items were grouped either in a theoretical structure of three first-order factors (Cognitive-Perceptual, Interpersonal, and Disorganized) or in a bifactor model (three first-order factors plus a general factor of schizotypal personality). In addition, the results supported configural but not strong measurement invariance of SPQ-B scores across samples. These findings provide new information about the factor structure of schizotypal personality, and support the validity and utility of the SPQ-B, a brief and easy tool for assessing self-reported schizotypal traits, in cross-national research. Theoretical and clinical implications for diagnostic systems, psychosis models, and cross-national mental health strategies are derived from these results.

© 2017 Elsevier B.V. All rights reserved.

1. Introduction

In the past two decades, the early and reliable identification of individuals potentially at-risk for psychotic-spectrum disorders, based on psychometric indices, has become a focus of extensive and expanding research and debate (Addington et al., 2015; Fonseca-Pedrero et al., 2016b; Fusar-Poli et al., 2014; Kline and Schiffman, 2014; Mason, 2015). The identification of specific subgroups of individuals at high risk for psychotic-spectrum disorders may help us to elucidate both risks factors and protective factors, as well as etiological mechanisms and developmental pathways that mitigate, delay, or even prevent the onset of clinically significant psychotic disorders (Barrantes-Vidal et al., 2015).

Schizotypal traits are considered to be a phenotypic-indicator of schizotypy (Meehl, 1962), a latent personality organization reflecting a putative liability for schizophrenia-spectrum disorders (Barrantes-Vidal et al., 2015; Fonseca Pedrero and Debbané, 2017; Lenzenweger, 2010). Schizotypal traits encompass anomalies and deficits across cognitive (e.g., paranoid ideation, ideas of reference), social/emotional (e.g., anhedonia, no close friends), and behavioral (e.g., odd behavior and language) systems (Cohen et al., 2015; Fonseca-Pedrero et al., 2017). Previous findings support the notion of assumed phenomenological, temporal, and etiological continuity between the subclinical and clinical psychosis phenotype and lend validity to the concept of schizotypal traits (Cohen et al., 2015; Ettinger et al., 2014; Linscott and van Os, 2013).

Several measurement instruments allow clinicians and researchers to document the presence, frequency, and severity of schizotypal traits (Fonseca-Pedrero et al., 2016b; Mason, 2015). These tools have been developed with the aim of examining variation in healthy trait schizotypy, as well as latent vulnerability to psychotic-spectrum disorders, in both clinical and non-clinical populations (e.g., general population, clinical, and genetic high risk samples). The Schizotypal Personality Questionnaire (SPQ) (Raine, 1991), in its brief version (SPQ-B) (Raine and Benishay, 1995), or its brief revised version (SPQ-BR) (Cohen et al., 2010), measure a broad range of psychotic-like traits—originally nine identified subordinate traits based on the operational definition of Schizotypal Personality Disorder (SPD) (American Psychiatric Association, 1987), and is among the more widely-used measured of this type.

The SPQ-B has been used with patients and relatives of patients with schizophrenia-spectrum disorders (Compton et al., 2007; Moreno-Izco et al., 2015), adolescents (Fonseca-Pedrero et al., 2009), twins (Ericson et al., 2011), outpatients (Axelrod et al., 2001), and college students (Compton et al., 2009a; Fonseca-Pedrero et al., 2011; Mata et al., 2005; Raine and Benishay, 1995). The psychometric properties of the SPQ-B have been examined previously. For instance, the reliability of scores and several sources of evidence of validity have been demonstrated (e.g., Fonseca-Pedrero et al., 2016b; Mason, 2015). Moreover, translations of the measure have been validated in several countries (e.g., France, China, Spain, Turkey, Switzerland) (e.g., Aycicegi et al., 2005; Ma et al., 2015; Ortuño-Sierra et al., 2013).

Examination of the SPQ-B factor structure has yielded factorial solutions of two (Aycicegi et al., 2005), three (Compton et al., 2009a;

Fonseca-Pedrero et al., 2011, 2009; Ma et al., 2015; Mata et al., 2005; Ortuño-Sierra et al., 2013; Tran et al., 2015), and four factors (Cohen et al., 2010; Fonseca-Pedrero et al., 2010). The three-factor model characterized by Cognitive-Perceptual (e.g., hallucinations, ideas of reference, magical thinking or paranoid ideation), Interpersonal (e.g., blunted affect, social anxiety or lack of close friends), and Disorganized (e.g., odd behavior and speech) dimensions has been widely replicated across studies. However, although the underlying structure of schizotypal personality, as assessed via the SPQ-B, has been analyzed, previous research has produced some contradictory results. These mixed findings are partially explained by variations in sampling method (random, convenience), sample characteristics (clinical, non-clinical, and country), and the data-analytic approach employed (exploratory vs. confirmatory factor analysis).

To the best of our knowledge, no previous studies have validated the psychometric quality of SPQ-B scores across multiple countries. For instance, we have little information about the factorial structure of SPQ-B scores and its possible variation across countries, particularly non-Western countries. Moreover, as previous studies have demonstrated with the SPQ, alternative models (e.g., Barron et al., 2017; Preti et al., 2015) may better explain the latent structure of SPQ-B scores. Thus, it is important to gather new information about the validity of this tool through cross-cultural research and collaborative multinational studies. Furthermore, and despite the globalization of psychosis research, no previous study has analyzed the psychometric quality of psychosis risk screeners in multinational samples.

The purpose of the present study was to analyze the psychometric properties of SPQ-B scores in a large sample recruited from 14 countries. Derived from this main goal are the following specific objectives: a) to estimate the reliability of SPQ-B scores across countries; b) to study the internal structure of SPQ-B scores across countries; and c) to analyze the measurement invariance of SPQ-B scores across countries. We hypothesized that the three-factor model of the SPQ-B would have adequate goodness-of-fit indices across samples. Moreover, we hypothesized that new measurement models, such as a bifactor model, would fit adequately. In addition, we further hypothesized that SPQ-B scores would show configural measurement invariance across samples.

2. Method

2.1. Participants

Participants were gathered from 24 sites across 14 countries (Australia, Austria, Belgium, Canada, China, Germany, Greece, Italy, Mauritius, New Zealand, Spain, Tunisia, United States of America, and United Kingdom). Partial data from the present study has been published elsewhere (Fonseca-Pedrero et al., 2017). The overall sample consisted of 28,426 participants. The mean age was 22.63 years ($SD = 7.08$; range 16–68 years). A total of 14.5% ($n = 4113$) of participants did not provide age. Participants were 10,711 males (37.7%) and 17,208 females (60.5%); 507 (1.8%) did not specify gender. Thus, 27,919 (98.2%) participants reported gender and 22,888 (80.52%) reported age. In this study, we considered information at country level and not at research level. Information about the age, gender, and other

participant characteristics are reported in Table 1. Information about sampling procedures and demographic characteristics of the samples across sites are presented in the Supplementary Materials.

2.2. Instrument

2.2.1. The Schizotypal Personality Questionnaire-Brief (SPQ-B)

The SPQ-B provides a common index of schizotypal traits across all countries. The SPQ-B is a 22-item (True/False) self-report scale based on the SPQ (Raine, 1991) for the assessment of SPD traits as defined by DSM-III-R diagnostic criteria (American Psychiatric Association, 1987). The SPQ-B includes items that fall within three domains: Cognitive-Perceptual (ideas of reference, paranoid ideation, magical thinking, and unusual perceptual experiences), Interpersonal (social anxiety, no close friends, blunted affect, and paranoid ideation), and Disorganized (odd speech and behavior). In the present study, the items of the brief version were extracted from the original SPQ validated for each country. Item selection was based on the original brief SPQ: English (Raine, 1991), Spanish (Fonseca-Pedrero et al., 2014b), Italian (Fossati et al., 2003), Chinese (Chen et al., 1997), Arabic (Lahmar et al., 2014), French (Dumas et al., 2000), Creole (Reynolds et al., 2000), Greek (Tsaousis et al., 2015), and German version (Klein et al., 1997).

2.3. Procedure

Conventions for obtaining informed consent required by each investigator's research institution, as well as IRB or ethical committees were followed. All participants provided written informed consent prior to participation. The study was conducted in accordance with the guidelines of the Declaration of Helsinki (World Medical Association, 2013). In the present study the SPQ-B scores being reported are derived from the administration of the full 74 item SPQ (see Fonseca-Pedrero et al., 2017). Similarly, the SPQ was sometimes administered in the context of larger studies (see Supplemental Material for further information).

2.4. Data analyses

Descriptive statistics for the items of the SPQ-B were calculated as the first step. In order to test the reliability of SPQ-B scores, and due to the limitations of Cronbach's α (Dunn et al., 2014), coefficient ω was estimated (Zinbarg et al., 2005). Next, in order to analyze the internal structure of SPQ-B scores, and based on previous studies, several confirmatory factor analyses (CFAs) were conducted at the item level. Considering the categorical nature of the data, we used the robust mean-adjusted weighted least square method (WLSMV) for parameter

estimation (Muthén and Muthén, 1998–2012). The following goodness-of-fit indices were used: Chi-square (χ^2), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Weighted Root Mean Square Residual (WRMR). CFI and TLI values >0.95 are preferred and those close to 0.90 are considered acceptable; RMSEA values should be under 0.08 for a reasonable fit, and under 0.05 for a good fit, whereas WRMR values <0.08 are considered evidence of a good model (Brown, 2006; Hu and Bentler, 1999).

Taking into account previous studies, different measurement models were tested: a) a unidimensional model; b) a bidimensional solution with a Cognitive-Perceptual, and a Negative factor (Siever and Gunderson, 1983); c) the Raine et al. (1994) model that includes Cognitive-Perceptual, Interpersonal, and Disorganized dimensions with Items 7, 9, 14, and 17 overlapping (i.e., cross-loading) in both the Cognitive-Perceptual and Interpersonal dimensions; d) the Raine and Benishay (1995) three-factor solution with no item cross-loadings allowed, and; e) a bifactor model that includes a general factor of schizotypal personality and three first order factors (Cognitive-Perceptual, Interpersonal, and Disorganized). Correlations among error terms were not permitted. Finally, and with the aim of studying measurement invariance across countries, we conducted successive multi-group CFAs models (MGCFAs models) for categorical outcomes (Muthén and Asparouhov, 2002).

The relatively few missing values in the data were replaced by regression-based estimates, to which an error component was added, based on the SPSS Missing Value Analysis module. SPSS 22.0 (IBM Corp Released, 2013), Mplus 7.4 (Muthén and Muthén, 1998–2012), FACTOR 10.5 (Ferrando and Lorenzo-Seva, 2017), and R (R Development Core Team, 2011) were used for the data analyses.

3. Results

3.1. Descriptive statistics and internal consistency of the SPQ-B scores

Means and standard deviations for the SPQ-B items for all countries are shown in Table 2. Internal consistency values for SPQ-B scores in the total sample and by country are shown in Table 3. Omega coefficients were adequate for data from all participating countries. Values for the total sample were 0.86, 0.91, 0.89, and 0.92 for the Cognitive-Perceptual, Interpersonal, and Disorganized subscales, and the Total score, respectively. Across countries, values ranged from 0.77 (Cognitive-Perceptual for China) to 0.94 (total score for the United States, Interpersonal and Disorganization for Germany).

3.2. Internal structure of schizotypal traits

Goodness-of-fit indices for the analyzed models are presented in Table 4. As can be seen, the models that showed the best fit in all the countries were the bifactor and Raine et al. (1994) models (models c and e). The bifactor model displayed better goodness-of-fit indices, but, as explained below, the factor loadings in this solution revealed some inconsistencies. It is worth noting that, in several countries, some of the goodness-of-fit indices such as CFI and TLI were close to the standard cut-off values, but still inadequate. In particular, values of CFI lower than 0.90 were observed in both models, especially in the model of Raine et al. Nonetheless, RMSEA values in both factorial solutions were good for all of the countries analyzed. As noted by Yu (2002), the RMSEA index may be preferred for analysis with the WLSMV estimator and ordered categorical variables. Thus, by this standard, the goodness-of-fit indices for the analyzed models could be considered adequate.

Tables 5 and 6 show the factor loadings for each of the 22 items for the Raine et al. (1994) and the bifactor models, respectively. In addition, the means and range of the factor loadings for the SPQ-B items in the two models are presented. In the case of the Raine et al. (1994) model, correlations among the latent variables were calculated, with

Table 1
Demographic characteristics of the sample.

	Country		Gender		Age		
	n	%	Male	Female	M	SD	Range
US	10,477	36.9	3162	7212	22.0	6.7	16–55
Spain	1123	4.0	224	899	20.2	2.0	18–29
New Zealand	1698	6.0	515	1183	20.1	3.0	17–51
Italy	649	2.3	305	344	24.3	3.5	19–38
Australia	1931	6.8	634	1294	28.5	11.2	17–55
Belgium	893	3.1	245	648	24.9	9.1	17–55
UK	1199	4.2	404	795	22.8	6.5	16–68
Tunisia	458	1.6	137	321	20.4	1.4	18–29
China	4907	17.3	2973	1533	19.7	1.0	17–24
Canada	1849	6.5	562	1287	20.8	2.9	18–53
Greece	1041	3.7	390	651	32.4	9.9	17–55
Mauritius	1201	4.2	688	513	23.4	1.2	21–27
Austria	611	1.4	294	317	33.2	12.6	19–66
Germany	389	2.1	178	211	32.7	13.2	19–66
Total	28,426	100	10,711	17,208	22.63	7.08	16–68

Table 2
Descriptive statistics for the SPQ-B across countries and total sample.

Items	USA (n = 10,477)		Spain (n = 1123)		New Zealand (n = 1698)		Italy (n = 649)		Australia (n = 1931)		Belgium (n = 893)		UK (n = 1199)		Tunisia (n = 458)		China (n = 4907)		Canada (n = 1849)		Greece (n = 1041)		Mauritius (n = 1201)		Austria (n = 390)		Germany (n = 610)		Total sample (N = 28,426)		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1	0.32	0.47	0.46	0.50	0.23	0.42	0.38	0.49	0.42	0.49	0.47	0.50	0.42	0.49	0.53	0.50	0.31	0.46	0.30	0.46	0.43	0.50	0.41	0.49	0.29	0.45	0.26	0.44	0.34	0.48	
2	0.4	0.49	0.30	0.46	0.38	0.49	0.26	0.44	0.51	0.50	0.34	0.47	0.48	0.50	0.36	0.48	0.45	0.50	0.29	0.45	0.23	0.42	0.26	0.44	0.27	0.44	0.27	0.45	0.38	0.49	
3	0.31	0.46	0.30	0.46	0.28	0.45	0.31	0.46	0.26	0.44	0.33	0.47	0.34	0.47	0.54	0.50	0.31	0.46	0.27	0.45	0.28	0.45	0.47	0.50	0.15	0.36	0.15	0.36	0.31	0.46	
4	0.24	0.43	0.34	0.48	0.25	0.44	0.27	0.45	0.33	0.47	0.28	0.45	0.31	0.46	0.37	0.48	0.69	0.46	0.24	0.43	0.35	0.48	0.19	0.39	0.13	0.34	0.11	0.31	0.34	0.47	
5	0.36	0.48	0.46	0.50	0.25	0.43	0.32	0.47	0.39	0.49	0.30	0.46	0.33	0.47	0.68	0.47	0.85	0.36	0.30	0.46	0.35	0.48	0.37	0.48	0.25	0.43	0.23	0.42	0.44	0.50	
6	0.16	0.37	0.42	0.49	0.14	0.34	0.09	0.29	0.17	0.38	0.10	0.30	0.26	0.44	0.12	0.33	0.13	0.34	0.12	0.33	0.07	0.26	0.18	0.38	0.12	0.32	0.12	0.33	0.16	0.37	
7	0.24	0.43	0.17	0.37	0.17	0.38	0.29	0.45	0.15	0.35	0.25	0.44	0.24	0.43	0.57	0.50	0.09	0.29	0.23	0.42	0.38	0.49	0.61	0.49	0.13	0.34	0.07	0.26	0.22	0.42	
8	0.19	0.39	0.13	0.34	0.13	0.34	0.18	0.38	0.14	0.35	0.28	0.45	0.23	0.42	0.48	0.50	0.37	0.48	0.17	0.37	0.15	0.36	0.28	0.45	0.19	0.4	0.16	0.37	0.22	0.41	
9	0.30	0.46	0.18	0.38	0.31	0.46	0.12	0.33	0.28	0.45	0.22	0.41	0.38	0.49	0.27	0.44	0.16	0.36	0.27	0.44	0.17	0.37	0.34	0.48	0.15	0.35	0.12	0.33	0.25	0.44	
10	0.35	0.48	0.22	0.42	0.34	0.48	0.12	0.33	0.34	0.47	0.13	0.34	0.36	0.48	0.24	0.43	0.21	0.41	0.32	0.47	0.13	0.33	0.36	0.48	0.38	0.49	0.31	0.46	0.30	0.46	
11	0.38	0.49	0.34	0.48	0.33	0.47	0.15	0.35	0.45	0.50	0.30	0.46	0.36	0.48	0.50	0.50	0.29	0.45	0.30	0.46	0.22	0.42	0.58	0.49	0.18	0.38	0.15	0.36	0.35	0.48	
12	0.15	0.35	0.10	0.30	0.14	0.35	0.09	0.28	0.17	0.37	0.17	0.37	0.25	0.43	0.16	0.37	0.19	0.39	0.08	0.27	0.15	0.35	0.18	0.39	0.15	0.36	0.20	0.40	0.15	0.36	
13	0.37	0.48	0.41	0.49	0.42	0.49	0.25	0.44	0.35	0.48	0.46	0.50	0.46	0.50	0.45	0.50	0.43	0.50	0.32	0.47	0.27	0.44	0.36	0.48	0.28	0.45	0.30	0.46	0.38	0.47	
14	0.45	0.50	0.47	0.50	0.38	0.49	0.59	0.49	0.29	0.45	0.42	0.49	0.50	0.50	0.68	0.47	0.25	0.43	0.42	0.49	0.56	0.50	0.73	0.45	0.38	0.49	0.38	0.49	0.42	0.49	
15	0.35	0.48	0.41	0.49	0.28	0.45	0.16	0.36	0.25	0.44	0.34	0.48	0.38	0.49	0.38	0.49	0.53	0.50	0.35	0.48	0.47	0.50	0.26	0.44	0.34	0.47	0.32	0.47	0.37	0.48	
16	0.30	0.46	0.36	0.48	0.30	0.46	0.24	0.43	0.34	0.47	0.31	0.46	0.40	0.49	0.28	0.45	0.21	0.41	0.25	0.44	0.26	0.44	0.43	0.50	0.18	0.39	0.16	0.37	0.29	0.45	
17	0.30	0.46	0.24	0.43	0.24	0.43	0.19	0.40	0.21	0.41	0.44	0.50	0.36	0.48	0.72	0.45	0.22	0.41	0.23	0.42	0.46	0.50	0.55	0.50	0.19	0.39	0.11	0.32	0.29	0.45	
18	0.23	0.42	0.12	0.33	0.17	0.38	0.06	0.24	0.15	0.36	0.16	0.36	0.26	0.44	0.22	0.42	0.12	0.33	0.22	0.41	0.14	0.34	0.37	0.48	0.26	0.44	0.22	0.42	0.20	0.39	
19	0.27	0.44	0.13	0.33	0.19	0.39	0.11	0.31	0.17	0.37	0.36	0.48	0.29	0.46	0.31	0.46	0.07	0.26	0.20	0.40	0.11	0.32	0.23	0.42	0.15	0.36	0.14	0.35	0.20	0.40	
20	0.24	0.43	0.17	0.38	0.14	0.35	0.14	0.35	0.17	0.38	0.29	0.45	0.29	0.45	0.39	0.49	0.31	0.46	0.20	0.40	0.21	0.41	0.33	0.47	0.17	0.38	0.17	0.37	0.24	0.43	
21	0.34	0.47	0.35	0.48	0.31	0.46	0.18	0.39	0.25	0.43	0.28	0.45	0.33	0.47	0.38	0.49	0.16	0.36	0.28	0.45	0.22	0.42	0.38	0.49	0.15	0.36	0.12	0.33	0.28	0.45	
22	0.48	0.5	0.54	0.50	0.43	0.50	0.47	0.50	0.37	0.48	0.59	0.49	0.51	0.50	0.66	0.47	0.04	0.20	0.48	0.50	0.48	0.50	0.52	0.50	0.46	0.50	0.42	0.49	0.40	0.49	
Subscales																															
POS	2.41	2.07	2.21	1.79	2.21	1.88	1.62	1.71	2.57	1.92	2.18	1.84	2.86	2.09	3.09	1.81	2.97	1.55	1.99	1.87	2.10	1.80	2.69	1.90	1.71	1.84	1.52	1.62	2.44	1.93	
INT	2.79	2.42	2.86	2.09	2.29	2.24	2.28	1.79	2.32	1.99	2.82	2.20	2.99	2.36	3.92	2.11	1.79	1.63	2.58	2.28	2.90	2.23	3.86	2.08	2.18	2.13	1.95	1.94	2.58	2.35	
DIS	1.55	1.70	1.57	1.41	1.30	1.46	1.08	1.38	1.26	1.51	1.82	1.53	1.88	1.80	2.30	1.62	1.62	1.41	1.28	1.53	1.10	1.34	1.84	1.68	1.06	1.47	1.03	1.44	1.51	1.59	
Total score	6.74	4.99	6.64	3.91	5.80	4.27	4.98	3.83	6.15	4.04	6.82	4.29	7.73	4.89	9.31	4.16	6.37	3.46	5.85	4.43	6.09	4.17	8.39	4.65	4.95	4.28	4.50	3.79	6.54	4.50	

Note. SD = standard deviation; POS = positive; INT = interpersonal; DIS = disorganized.

Table 3
Omega coefficients for the SPQ-B scores across countries and total sample.

SPQ-B	US	Spain	NZ	Italy	Australia	Belgium	UK	Tunisia	China	Canada	Greece	Mauritius	Austria	Germany	Total
Positive	0.88	0.84	0.87	0.87	0.84	0.85	0.86	0.79	0.77	0.87	0.88	0.83	0.88	0.91	0.86
Interpersonal	0.93	0.90	0.93	0.89	0.88	0.91	0.92	0.85	0.88	0.92	0.92	0.86	0.92	0.94	0.91
Disorganization	0.91	0.85	0.92	0.91	0.91	0.84	0.93	0.85	0.88	0.90	0.90	0.86	0.92	0.94	0.89
Total score	0.94	0.89	0.93	0.93	0.91	0.91	0.93	0.88	0.89	0.93	0.92	0.91	0.92	0.93	0.92

Note. NZ = New Zealand.

averages of 0.561 (Cognitive-Perceptual-Disorganized), 0.286 (Positive-Interpersonal), and 0.593 for the total sample. As can be seen, some factor loadings on the latent factors of the bifactor model were negative and nominally not significant, thus suggesting that this model could be further improved. Factor loadings for the Raine et al. (1994) model were all adequate and statistically significant.

3.3. Measurement invariance of the SPQ-B scores across countries

Measurement invariance across all participating countries was studied for the two models that displayed best fit, namely the Raine et al. (1994) model ($\chi^2 = 19,973.89$; $df = 2828$; CFI = 0.912; TLI = 0.90; RMSEA = 0.055, with 95% CI: 0.054–0.055; WRMR = 8.62) and the bifactor model ($\chi^2 = 14,564.89$; $df = 2618$; CFI = 0.938; TLI = 0.924; RMSEA = 0.047 with 95% CI: 0.047–0.048; WRMR = 7.01). The configural invariance model, in which no equality constraints were imposed, showed an adequate fit to the data for both models. Next, a strong invariance model was tested with the item thresholds and factor loadings constrained to equality across groups. The Δ CFI between the constrained and the unconstrained models was over 0.01, indicating that strong invariance was not supported in the case of the bifactor model ($\chi^2 = 23,498.71$; $df = 3086$; CFI = 0.895; TLI = 0.890; RMSEA = 0.057 with 95% CI: 0.056–0.058; WRMR = 9.80). For the Raine et al. (1994) model, no convergence was found and the program did not allow us to calculate strong invariance parameters. The Δ CFI between the constrained and the unconstrained models was over 0.01, indicating that strong invariance was not supported. Hence, the results support configural invariance, whereas strong measurement invariance of the SPQ-B across the 14 countries studied was not tenable.

4. Discussion

The psychometric assessment of schizotypal traits offers distinctive benefits, such as being relatively inexpensive, non-invasive, and useful for screening large samples of the general population, as well as for identifying participants at increased risk for psychosis (e.g., Fonseca-Pedrero et al., 2016b; Lenzenweger, 2010; Mason, 2015). For these purposes, and in tandem with global mental health research strategies, there is a clear need for psychometrically sound tools for both psychosis risk and schizotypal screening, which are validated across countries, to use in international research studies and diverse cultural settings. To date, no study has attempted to validate the SPQ-B in a cross-national sample. Furthermore, it remains unclear whether the factorial structure underlying SPQ-B scores is invariant across multiple countries. Thus, the main goal of the present study was to analyze the reliability, internal structure and measurement invariance by country of SPQ-B scores in a multinational sample of participants recruited from 14 countries.

Our analyses highlighted several important findings. First, SPQ-B scores showed adequate levels of internal consistency across countries. The reliability of SPQ-B scores, estimated with coefficient omega, was generally above 0.8. This research provides further support for the reliability of the SPQ-B scores, extending previous findings to non-clinical samples from different countries and variable study contexts. Thus, the SPQ-B could be used as a screening instrument to identify individuals who may be at increased risk for psychosis-spectrum disorders as

well as to examine variations in healthy trait schizotypy in cross-cultural studies.

Second, examination of the factorial structure underlying the SPQ-B scores indicated that schizotypal traits have a multidimensional, rather than unidimensional, structure. SPQ-B items were grouped, in the present analysis, in a theoretical structure of three first-order factors (i.e., Cognitive-Perceptual, Interpersonal, and Disorganization dimensions) as well as in a bifactor model (three first-order factors plus general factor of schizotypal personality). In fact, this is the first study to show that it is possible to derive a total score for the SPQ-B and to obtain distinct subscores for the three classic schizotypal dimensions. Schizotypal personality is a multifaceted construct phenotypically similar to that found in patients with psychosis (e.g., Liddle, 1987). Just as the manifestation of schizophrenia is heterogeneous – encompassing a broad range of emotional, cognitive, perceptual, social and behavioral functions – schizotypy involves a diverse set of traits. Numerous studies, using the SPQ-B, have obtained evidence of such a three-factor structure for schizotypal personality (Compton et al., 2009a; Fonseca-Pedrero et al., 2011, 2009; Ma et al., 2015; Mata et al., 2005; Ortuño-Sierra et al., 2013; Tran et al., 2015), consistent with the Raine et al. (1994) model. Furthermore, the present results corroborate those found when comparing SPQ scores across samples (e.g., Bora and Arabaci, 2009; Compton et al., 2009b; Fonseca-Pedrero et al., 2016a; Fonseca-Pedrero et al., 2017; Fossati et al., 2003; Raine et al., 1994; Reynolds et al., 2000). Furthermore, this factorial structure is similar to that found in the new measure of schizotypy named the Multidimensional Schizotypy Scale (MSS) (Kwapil et al., in press).

Third, multigroup CFA showed that the SPQ-B three-factor model had configural, but not strong measurement invariance, across countries. Similar results have been found in prior research using the SPQ and its brief versions, as well as other schizotypy tools (e.g., the short form of the Oxford-Liverpool Inventory of Feelings and Experiences and Chapman's scales of psychosis proneness) (Cicero, 2016; Fonseca-Pedrero et al., 2015, 2014a; Kwapil et al., 2012; Ortuño-Sierra et al., 2013). For instance, Ortuño-Sierra et al. (2013), when comparing the factorial equivalence of the SPQ-B between Spanish and Swiss adolescents, found that SPQ-B scores had configural and partial strong invariance across the two samples. In addition, the present results demonstrated that several items showed differential functioning by country. To date, differential item functioning (DIF) for psychosis risk or schizotypy measures has yet to be thoroughly addressed. In cross-cultural research, it is vital to test whether varied groups show differing probabilities of success on (or likelihood of endorsing) an item after matching on the underlying construct (e.g., schizotypy) that the item is intended to measure (Byrne et al., 2009; Zumbo, 2007). DIF is of particular importance in international, comparative, and cross-cultural research particularly in efforts to ensure fairness and equity in testing (Zumbo, 2007). The present findings suggest that some schizotypal traits reflecting emotion, behavior, and cognition may differ across countries, at least those that were included in the present study. In fact, schizotypal traits assessed in different cultures have the potential to provide us with information about cultural variations in social and affective functioning (Cohen et al., 2015). Similar results have been found when psychotic symptoms or psychotic-like experiences are analyzed in samples recruited around the world (Larøi et al., 2014; Nuevo et al., 2012; Woods et al., 2014). The finding of configural measurement

Table 4
Goodness-of-fit indices of the models tested in the confirmatory factor analysis.

	χ^2	df	CFI	TLI	RMSEA (90% CI)	WRMR
Model a: unidimensional						
US	13,644.01	209	0.820	0.801	0.085 (0.084–0.081)	6.825
Spain	5375.73	209	0.700	0.668	0.090 (0.088–0.092)	4.469
New Zealand	2717.42	209	0.775	0.751	0.084 (0.081–0.087)	3.178
Italy	743.17	209	0.826	0.808	0.063 (0.058–0.068)	1.709
Australia	2730.01	209	0.740	0.713	0.079 (0.076–0.082)	3.220
Belgium	1505.39	209	0.748	0.722	0.083 (0.079–0.087)	2.423
UK	2654.50	209	0.761	0.736	0.099 (0.095–0.101)	3.188
Tunisia	598.52	209	0.783	0.754	0.064 (0.061–0.066)	1.523
China	4309.68	209	0.772	0.751	0.064 (0.062–0.067)	3.904
Canada	3036.70	209	0.785	0.762	0.086 (0.083–0.088)	3.371
Greece	1578.64	209	0.793	0.774	0.080 (0.079–0.082)	2.475
Mauritius	741.28	209	0.921	0.912	0.046 (0.042–0.050)	1.564
Austria	721.908	209	0.803	0.782	0.079 (0.073–0.086)	1.727
Germany	971.177	209	0.749	0.723	0.077 (0.072–0.082)	1.998
Total sample	42,494.65	209	0.768	0.743	0.084 (0.084–0.085)	12.104
Model b: bidimensional						
US	14,069.65	208	0.855	0.839	0.080 (0.079–0.081)	6.960
Spain	1479.03	208	0.742	0.713	0.074 (0.070–0.077)	2.423
New Zealand	2285.08	208	0.814	0.793	0.077 (0.074–0.080)	2.921
Italy	667.05	208	0.850	0.834	0.058 (0.053–0.063)	1.611
Australia	2430.40	208	0.774	0.748	0.072 (0.068–0.074)	3.042
Belgium	1357.85	208	0.783	0.749	0.078 (0.074–0.081)	2.305
UK	2,293.71	208	0.796	0.774	0.091 (0.088–0.095)	2.968
Tunisia	525.48	208	0.817	0.796	0.058 (0.052–0.064)	1.415
China	3870.22	208	0.796	0.773	0.060 (0.058–0.062)	3.703
Canada	2456.85	208	0.829	0.810	0.076 (0.074–0.079)	3.035
Greece	1205.26	208	0.853	0.838	0.073 (0.068–0.075)	2.164
Mauritius	608.31	208	0.940	0.934	0.040 (0.036–0.044)	1.412
Austria	580.94	208	0.856	0.841	0.069 (0.061–0.074)	1.531
Germany	801.94	208	0.805	0.783	0.068 (0.063–0.073)	1.814
Total sample	37,064.26	208	0.797	0.775	0.079 (0.078–0.080)	11.325
Model c: three factor model						
US	8297.27	202	0.915	0.903	0.062 (0.061–0.063)	5.184
Spain	990.75	202	0.840	0.820	0.059 (0.055–0.063)	1.943
New Zealand	1336.89	202	0.900	0.880	0.058 (0.055–0.060)	2.186
Italy	414.88	202	0.931	0.921	0.040 (0.035–0.046)	1.211
Australia	1180.56	202	0.899	0.885	0.050 (0.047–0.053)	2.054
Belgium	897.01	202	0.865	0.846	0.062 (0.058–0.066)	1.820
UK	1444.63	202	0.897	0.861	0.072 (0.068–0.075)	2.285
Tunisia	396.64	202	0.871	0.871	0.046 (0.039–0.053)	1.195
China	2847.80	202	0.852	0.831	0.052 (0.050–0.053)	3.170
Canada	1482.74	202	0.903	0.889	0.059 (0.056–0.061)	2.291
Greece	872.69	202	0.899	0.884	0.056 (0.053–0.060)	1.790
Mauritius	521.96	202	0.952	0.945	0.036 (0.033–0.040)	1.292
Austria	374.84	202	0.933	0.924	0.047 (0.039–0.054)	1.154
Germany	482.39	202	0.908	0.895	0.048 (0.042–0.053)	1.342
Total sample	22,683.56	202	0.876	0.859	0.063 (0.062–0.063)	8.727
Model d: three factor model (no overlap)						
US	10,267.63	206	0.895	0.882	0.068 (0.067–0.069)	5.860
Spain	1245.25	206	0.789	0.763	0.067 (0.063–0.071)	2.208
New Zealand	1675.86	206	0.868	0.852	0.065 (0.062–0.068)	2.476
Italy	510.998	206	0.901	0.889	0.048 (0.043–0.053)	1.383
Australia	1474.20	206	0.869	0.853	0.056 (0.054–0.059)	2.333
Belgium	1020.36	206	0.842	0.823	0.067 (0.062–0.071)	1.971
UK	1,656.99	206	0.858	0.841	0.077 (0.073–0.080)	2.484
Tunisia	418.60	206	0.877	0.862	0.047 (0.041–0.054)	1.246
China	3552.65	206	0.813	0.791	0.058 (0.056–0.059)	3.541
Canada	1809.23	206	0.878	0.863	0.065 (0.062–0.068)	2.572
Greece	1124.98	206	0.861	0.845	0.065 (0.062–0.069)	2.063
Mauritius	614.40	206	0.939	0.932	0.041 (0.037–0.044)	1.414
Austria	484.997	206	0.893	0.880	0.059 (0.052–0.066)	1.362
Germany	701.291	206	0.837	0.817	0.063 (0.058–0.068)	1.671
Total sample	28,597.38	206	0.844	0.825	0.070 (0.069–0.070)	9.878
Model e: bifactor						
US	5847.31	187	0.941	0.927	0.054 (0.053–0.055)	4.123
Spain	687.21	187	0.898	0.875	0.049 (0.045–0.053)	1.544
New Zealand	902.85	187	0.936	0.921	0.047 (0.044–0.051)	1.695
Italy	338.92	187	0.950	0.939	0.035 (0.029–0.041)	1.051
Australia	1036.82	187	0.912	0.892	0.049 (0.046–0.051)	1.830
Belgium	695.55	187	0.901	0.878	0.055 (0.051–0.060)	1.532
UK	957.491	187	0.925	0.907	0.059 (0.055–0.062)	1.749
Tunisia	339.87	187	0.912	0.891	0.042 (0.035–0.049)	1.072

Table 4 (continued)

	χ^2	df	CFI	TLI	RMSEA (90% CI)	WRMR
China	2124.12	187	0.892	0.866	0.046 (0.044–0.048)	2.640
Canada	1006.38	187	0.938	0.923	0.049 (0.046–0.052)	1.780
Greece	709.26	187	0.921	0.903	0.052 (0.048–0.056)	1.547
Mauritius	415.24	187	0.966	0.958	0.032 (0.028–0.036)	1.127
Austria	299.357	187	0.957	0.947	0.039 (0.031–0.047)	0.956
Germany	373.595	187	0.939	0.924	0.040 (0.034–0.046)	1.102
Total sample	17,695.42	187	0.904	0.881	0.057 (0.057–0.058)	7.357

Note. χ^2 = Chi square; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval; WRMR = Weighted Root Mean Square Residual.

equivalence across cultures provides essential evidence of construct validity for the schizotypal dimensions, as well as evidence of the cross-cultural validity of SPQ-B scores; however, examination of DIF by sex, age, and language will be an important next step in future studies.

The results of the present study should be considered in light of the following limitations. First, there is an inherent problem in the use of

self-reports as indirect indicators of schizotypal traits. Second, the nature of the sample, composed of a majority of college students, precludes the generalization of the results to other populations of interest. Third, the fact that not all the samples employed the infrequency response to detect those participants who displayed random or pseudo-random patterns of responses may undermine the validity and

Table 5

Factor loadings for the bifactor model.

	US	Spain	NZ	Italy	Australia	Belgium	UK	Tunisia	China	Canada	Greece	Mauritius	Austria	Germany	Total sample	Across samples	
																Mean	Range
General factor																	
1	0.68	0.47	0.73	0.39	0.37	0.57	0.64	0.42	0.53	0.61	0.54	0.66	0.66	0.54	0.58	0.55	0.37–0.73
2	0.32	0.18	0.18	0.33	0.23	0.19	0.27	0.21	0.20	0.24	0.22	0.51	0.51	0.30	0.27	0.25	0.18–0.50
3	0.57	0.37	0.41	0.67	0.53	0.56	0.50	0.44	0.54	0.47	0.49	0.63	0.63	0.49	0.54	0.51	0.37–0.67
4	0.38	0.22	0.33	0.49	0.37	0.27	0.30	0.18	0.07	0.30	0.15	0.33	0.33	0.49	0.20	0.28	0.07–0.49
5	0.34	0.23	0.30	0.47	0.39	0.32	0.33	0.31	0.12	0.31	0.29	0.31	0.31	0.45	0.22	0.31	0.12–0.47
6	0.60	0.31	0.50	0.63	0.50	0.77	0.57	0.51	0.73	0.51	0.45	0.72	0.72	0.52	0.57	0.56	0.31–0.77
7	0.71	0.70	0.74	0.59	0.68	0.63	0.66	0.33	0.51	0.73	0.74	0.57	0.57	0.89	0.65	0.63	0.33–0.74
8	0.78	0.57	0.70	0.73	0.62	0.55	0.75	0.57	0.62	0.72	0.58	0.70	0.70	0.64	0.67	0.66	0.55–0.73
9	0.56	0.54	0.56	0.71	0.57	0.57	0.46	0.56	0.67	0.55	0.54	0.59	0.59	0.84	0.59	0.57	0.43–0.71
10	0.46	0.35	0.33	0.57	0.33	0.43	0.46	0.37	0.37	0.41	0.45	0.47	0.47	0.29	0.44	0.42	0.33–0.57
11	0.51	0.33	0.42	0.44	0.23	0.36	0.47	0.39	0.38	0.42	0.60	0.42	0.42	0.59	0.44	0.42	0.23–0.59
12	0.31	0.17	0.17	0.33	0.23	0.16	0.14	0.30	0.17	0.27	0.21	0.32	0.32	0.36	0.25	0.22	0.05–0.33
13	0.57	0.31	0.40	0.63	0.50	0.39	0.47	0.61	0.24	0.51	0.51	0.54	0.54	0.43	0.48	0.47	0.31–0.63
14	0.67	0.66	0.69	0.43	0.54	0.64	0.66	0.35	0.43	0.66	0.68	0.53	0.53	0.58	0.59	0.58	0.35–0.69
15	0.53	0.43	0.53	0.43	0.25	0.48	0.41	0.47	0.21	0.43	0.50	0.42	0.42	0.48	0.40	0.42	0.21–0.50
16	0.52	0.34	0.39	0.45	0.42	0.47	0.52	0.35	0.38	0.50	0.45	0.50	0.50	0.58	0.50	0.44	0.38–0.50
17	0.64	0.64	0.56	0.72	0.57	0.47	0.60	0.28	0.45	0.59	0.63	0.51	0.51	0.63	0.62	0.56	0.45–0.72
18	0.69	0.61	0.65	0.34	0.53	0.55	0.67	0.59	0.70	0.67	0.66	0.34	0.34	0.63	0.63	0.59	0.34–0.73
19	0.66	0.46	0.61	0.59	0.59	0.56	0.61	0.69	0.74	0.63	0.52	0.65	0.65	0.58	0.65	0.61	0.46–0.74
20	0.78	0.65	0.75	0.75	0.70	0.78	0.76	0.73	0.73	0.76	0.74	0.67	0.67	0.72	0.75	0.73	0.65–0.78
21	0.54	0.38	0.43	0.50	0.38	0.37	0.45	0.46	0.47	0.47	0.60	0.53	0.53	0.69	0.47	0.47	0.37–0.60
22	0.55	0.57	0.57	0.18	0.35	0.45	0.58	0.15	0.59	0.57	0.60	0.46	0.46	0.61	0.47	0.47	0.15–0.62
Latent factors																	
Positive																	
2	0.64	0.65	0.69	0.71	0.42	0.57	0.70	0.73	0.60	0.61	0.76	0.39	0.81	0.92	0.58	0.66	0.39–0.92
4	0.45	0.40	0.41	0.27	0.44	0.42	0.41	0.42	0.47	0.46	0.32	0.39	0.51	0.51	0.55	0.42	0.27–0.51
5	0.63	0.61	0.59	0.48	0.63	0.66	0.61	0.50	0.60	0.65	0.67	0.41	0.60	0.68	0.70	0.59	0.41–0.68
9	0.04	0.26	0.30	0.12	0.24	0.25	0.29	0.29	0.09	0.38	0.35	0.28	0.18	0.11	0.19	0.23	0.04–0.38
10	0.32	0.32	0.28	0.17	0.43	0.24	0.27	0.23	0.22	0.39	0.31	0.24	0.10	0.18	0.23	0.26	0.10–0.39
12	0.51	0.59	0.64	0.65	0.35	0.70	0.58	0.45	0.30	0.47	0.61	0.35	0.84	0.69	0.49	0.55	0.30–0.84
16	0.42	0.43	0.40	0.30	0.41	0.31	0.35	0.41	0.37	0.41	0.37	0.11	0.27	0.40	0.31	0.35	0.11–0.43
17	0.21	0.18	0.22	0.09	0.13	0.57	0.24	0.26	0.08	0.24	0.18	0.19	0.20	0.08	0.11	0.21	0.08–0.57
Interpersonal																	
1	0.18	0.34	0.22	0.42	0.25	0.33	0.07	0.31	0.28	0.18	0.22	–0.03	0.38	0.31	0.22	0.25	0.01–0.33
7	0.13	–0.12	0.16	0.09	0.31	0.16	0.22	0.18	–0.07	0.04	–0.10	0.03	–0.10	–0.11	0.19	0.06	0.03–0.24
11	0.68	0.75	0.76	0.83	0.47	0.79	0.78	0.65	0.60	0.77	0.69	0.56	0.70	0.56	0.67	0.68	0.47–0.83
14	0.22	0.07	0.17	0.32	0.45	0.20	0.14	0.36	0.19	0.17	–0.05	0.19	0.14	0.16	0.30	0.19	–0.05–0.45
15	0.56	0.50	0.52	0.58	0.62	0.50	0.56	0.53	0.49	0.61	0.45	0.33	0.52	0.56	0.46	0.52	0.33–0.62
18	0.27	0.28	0.37	0.30	0.53	0.28	0.29	0.27	0.39	0.30	0.36	0.25	0.39	0.37	0.35	0.33	0.25–0.53
21	0.72	0.85	0.76	0.68	0.59	0.86	0.84	0.66	0.62	0.78	0.72	0.71	0.58	0.54	0.75	0.71	0.59–0.86
22	0.39	0.17	0.36	0.45	0.63	0.35	0.29	0.50	0.53	0.38	0.19	0.31	0.23	0.34	0.44	0.37	0.17–0.63
Disorganized																	
3	0.44	0.40	0.64	0.35	0.52	0.31	0.53	0.08	0.26	0.56	0.57	–0.09	0.54	0.51	0.42	0.40	0.08–0.64
6	0.70	0.74	0.70	0.54	0.77	0.62	0.74	0.44	0.44	0.70	0.78	0.05	0.74	0.75	0.65	0.62	0.05–0.78
8	0.04	0.09	0.04	–0.25	0.18	–0.15	0.08	0.06	–0.27	0.09	0.20	0.05	0.36	0.21	–0.02	0.05	0.04–0.27
13	0.36	0.28	0.38	0.10	0.33	–0.20	0.46	–0.25	0.17	0.39	0.33	0.12	0.45	0.44	0.29	0.24	0.09–0.52
19	0.54	0.79	0.59	0.58	0.65	0.42	0.54	0.49	0.40	0.57	0.55	0.07	0.70	0.57	0.49	0.53	0.07–0.79
20	–0.11	–0.02	–0.07	–0.20	–0.08	–0.32	–0.07	–0.38	–0.54	–0.07	–0.10	0.95	0.13	0.17	–0.16	0.05	0.01–0.95

Table 6
Factor loadings for the Raine et al. (1994) model.

Items	US	Spain	NZ	Italy	Australia	Belgium	UK	Tunisia	China	Canada	Greece	Mauritius	Austria	Germany	Total sample	Across samples	
																Mean	Range
Positive																	
2	0.60	0.53	0.54	0.54	0.43	0.47	0.58	0.57	0.49	0.53	0.60	0.63	0.72	0.74	0.55	0.57	0.43–0.74
4	0.60	0.45	0.57	0.61	0.59	0.50	0.52	0.40	0.31	0.53	0.32	0.43	0.73	0.69	0.46	0.52	0.31–0.73
5	0.62	0.56	0.63	0.64	0.68	0.64	0.61	0.58	0.41	0.61	0.64	0.42	0.76	0.78	0.54	0.61	0.41–0.78
7	0.31	0.46	0.29	0.42	0.34	0.31	0.26	0.21	0.37	0.38	0.36	0.52	0.49	0.35	0.23	0.36	0.20–0.52
9	0.54	0.56	0.50	0.58	0.53	0.55	0.48	0.52	0.40	0.59	0.59	0.55	0.51	0.31	0.46	0.51	0.39–0.59
10	0.63	0.53	0.52	0.66	0.54	0.57	0.62	0.51	0.54	0.61	0.64	0.56	0.35	0.32	0.59	0.54	0.51–0.64
12	0.54	0.49	0.50	0.55	0.41	0.50	0.41	0.55	0.38	0.49	0.53	0.41	0.81	0.61	0.49	0.51	0.38–0.81
14	0.22	0.25	0.27	0.18	0.14	0.27	0.28	0.08	0.12	0.29	0.31	0.30	0.06	0.17	0.13	0.21	0.06–0.31
16	0.75	0.59	0.64	0.56	0.62	0.65	0.73	0.59	0.63	0.72	0.70	0.56	0.73	0.70	0.71	0.66	0.56–0.75
17	0.46	0.52	0.45	0.58	0.38	0.47	0.46	0.38	0.34	0.52	0.45	0.50	0.42	0.30	0.36	0.44	0.38–0.58
Interpersonal																	
1	0.74	0.61	0.78	0.60	0.48	0.70	0.66	0.56	0.65	0.67	0.61	0.70	0.67	0.67	0.66	0.65	0.48–0.78
7	0.53	0.35	0.61	0.29	0.59	0.49	0.57	0.28	0.29	0.47	0.48	0.11	0.50	0.60	0.57	0.44	0.11–0.61
9	0.52	0.21	0.29	0.28	0.23	0.23	0.17	0.26	0.47	0.19	0.21	0.15	0.50	0.57	0.31	0.31	0.15–0.57
11	0.79	0.73	0.76	0.88	0.47	0.81	0.87	0.70	0.60	0.79	0.87	0.60	0.84	0.77	0.73	0.75	0.47–0.87
14	0.59	0.52	0.58	0.45	0.67	0.54	0.52	0.46	0.45	0.52	0.48	0.32	0.58	0.52	0.63	0.52	0.32–0.57
15	0.73	0.65	0.73	0.73	0.59	0.72	0.64	0.72	0.40	0.69	0.65	0.53	0.65	0.68	0.59	0.65	0.40–0.73
17	0.35	0.33	0.31	0.28	0.65	0.20	0.32	0.08	0.28	0.25	0.38	0.10	0.36	0.50	0.41	0.31	0.08–0.65
18	0.79	0.71	0.78	0.49	0.80	0.66	0.77	0.70	0.87	0.78	0.77	0.43	0.75	0.73	0.77	0.72	0.43–0.87
21	0.82	0.80	0.77	0.87	0.68	0.84	0.88	0.77	0.71	0.84	0.88	0.73	0.90	0.82	0.79	0.81	0.68–0.90
22	0.69	0.63	0.71	0.41	0.68	0.61	0.68	0.40	0.79	0.71	0.67	0.58	0.69	0.63	0.65	0.64	0.40–0.79
Disorganized																	
3	0.67	0.54	0.61	0.71	0.71	0.60	0.67	0.44	0.55	0.63	0.64	0.62	0.70	0.68	0.64	0.63	0.44–0.71
6	0.77	0.59	0.74	0.71	0.81	0.75	0.80	0.52	0.76	0.72	0.68	0.73	0.83	0.79	0.71	0.73	0.59–0.83
8	0.80	0.63	0.74	0.71	0.66	0.56	0.78	0.57	0.64	0.76	0.66	0.72	0.78	0.79	0.68	0.70	0.57–0.79
13	0.65	0.44	0.52	0.64	0.61	0.39	0.60	0.60	0.26	0.62	0.61	0.56	0.60	0.53	0.55	0.55	0.39–0.62
19	0.79	0.77	0.80	0.68	0.85	0.60	0.79	0.67	0.78	0.79	0.69	0.67	0.87	0.80	0.76	0.76	0.60–0.87
20	0.77	0.67	0.77	0.74	0.65	0.76	0.75	0.70	0.70	0.76	0.76	0.71	0.79	0.85	0.73	0.74	0.65–0.85
Factor correlations																	
F2-F1	0.64	0.04	0.52	0.77	0.56	0.67	0.60	0.60	0.59	0.60	0.55	0.79	0.50	0.42	0.62	0.58	0.04–0.79
F3-F1	0.38	0.05	0.25	0.32	0.22	0.23	0.30	0.27	0.20	0.30	0.26	0.59	0.40	0.21	0.29	0.29	0.05–0.59
F3-F2	0.70	0.04	0.61	0.57	0.47	0.62	0.59	0.68	0.73	0.62	0.66	0.80	0.61	0.67	0.65	0.59	0.04–0.80

generalizability of the results found in the present cross-national study. Finally, in the present study, the items of the SPQ-B were extracted from the original full version of the SPQ.

5. Conclusions

We have provided the first comprehensive validation study of the SPQ-B using a large, multinational sample from 14 countries. These results offer new information about the brief assessment of schizotypal traits using the same psychometric tool and analytic procedures to compare results obtained in different countries and linguistic groups. In addition, our results demonstrated that schizotypal personality is composed, at a minimum, of three dimensions (i.e., Cognitive-Perceptual, Interpersonal, and Disorganized), and is perhaps encompassed by a general schizotypal factor. The results derived from this cross-national study have theoretical and clinical implications for diagnostic systems, psychosis models, and cross-national mental health strategies.

Conflict of interest

All the authors have declared that there are no conflicts of interest in relation to this study.

Contributors

E.F.-P. designed the study, coordinated the data collection, contributed to the data analyses, and was lead author of the manuscript. J. O.-S. contributed to the data analyses and manuscript preparation. All the authors contributed to the study design and manuscript preparation. All authors have approved the final manuscript.

Role of funding source

E.F.P. was supported by the Spanish Ministry of Science and Innovation (MICINN) (PSI2014-56114-P), by the Instituto Carlos III, Center for Biomedical Research in the Mental Health Network (CIBERSAM), and by 2015 edition of the BBVA Foundation Grants for

Researchers and Cultural Creators. M.D. was supported by the Swiss National Science Foundation (100019_159440). R.C. was supported by the Beijing Training Project for Leading Talents in S&T (Z151100000315020), the Beijing Municipal Science & Technology Commission Grant (Z161100000216138), and the National Basic Research Program of China (Precision Psychiatry Program: 2016YFC0906402). JCB was partly funded by the Co-operative Research Centre-Mental Health, Carlton, Australia. S.G. and I.T. were supported by the "ARISTEIA II" Action of the Operational Programme Education and Lifelong Learning and was co-funded by the European Social Fund (ESF) and National Resources [grant number KA 2990].

Acknowledgment

The authors do not have to declare any funding or administrative support for this manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.schres.2017.10.043>.

References

- Addington, J., Stowkowy, J., Weiser, M., 2015. Screening tools for clinical high risk for psychosis. *Early Interv. Psychiatry* 9, 345–356.
- American Psychiatric Association, 1987. *Diagnostic and statistical manual of mental disorders. DSM-III-R, 3rd ed. revised* APA, Washington, DC.
- Axelrod, S.R., Grilo, M.C., Sanislow, C., McGlashan, T.H., 2001. Schizotypal personality questionnaire-brief: factor structure and convergent validity in inpatient adolescent. *J. Personal. Disord.* 15, 168–179.
- Aycicegi, A., Dinn, W.M., Harris, C.L., 2005. Validation of Turkish and English versions of the schizotypal personality questionnaire-B. *Eur. J. Psychol. Assess.* 21, 34–43.
- Barrantes-Vidal, N., Grant, P., Kwapil, T., 2015. The role of schizotypy in the study of the etiology of schizophrenia spectrum disorders. *Schizophr. Bull.* 41, S408–416.
- Barron, D., Morgan, K.D., Towell, T., Jaafar, J.L., Swami, V., 2017. Psychometric Properties of the Malay Schizotypal Personality Questionnaire: Measurement Invariance and Latent Mean Comparisons of Malay and Chinese Adults. *Asia-Pacific Psychiatry* (in press).

- Bora, E., Arabaci, L.E., 2009. Confirmatory factor analysis of schizotypal personality traits in university students. *Turk. J. Psychiatry* 20, 339–345.
- Brown, T.A., 2006. *Confirmatory Factor Analysis for Applied Research*. Guilford Press, New York.
- Byrne, B.M., Oakland, T., Leong, F.T., van de Vijver, F.J., Hambleton, R., Cheung, F.M., Bartram, D., 2009. A critical analysis of cross-cultural research and testing practices: implications for improved education and training in psychology. *Train. Educ. Prof. Psychol.* 3, 29–105.
- Chen, W.J., Hsiao, C.K., Lin, C.C.H., 1997. Schizotypy in community samples: the three-factor structure and correlation with sustained attention. *J. Abnorm. Psychol.* 106, 649–654.
- Cicero, D.C., 2016. Measurement invariance of the schizotypal personality questionnaire in Asian, Pacific Islander, White, and multiethnic populations. *Psychol. Assess.* 28, 351–361.
- Cohen, A.S., Matthews, R.A., Najolia, G.M., Brown, L.A., 2010. Toward a more psychometrically sound brief measure of schizotypal traits: introducing the SPQ-brief revised. *J. Personal. Disord.* 24, 516–537.
- Cohen, A., Mohr, C., Ettinger, U., Chan, R.C.K., Park, S., 2015. Schizotypy as an organizing framework for social and affective sciences. *Schizophr. Bull.* 41, S427–435.
- Compton, M.T., Chien, V.H., Bollini, A., 2007. Psychometric properties of the brief version of the schizotypal personality questionnaire in relatives with schizophrenia-spectrum disorders and non-psychotic control. *Schizophr. Res.* 91, 122–131.
- Compton, M.T., Goulding, S.M., Bakeman, R., McClure-Tone, E.B., 2009a. An examination of the factorial structure of the schizotypal personality questionnaire-brief (SPQ-B) among undergraduate students. *Schizophr. Res.* 115, 286–289.
- Compton, M.T., Goulding, S.M., Bakeman, R., McClure-Tone, E.B., 2009b. Confirmation of a four-factor structure of the schizotypal personality questionnaire among undergraduate students. *Schizophr. Res.* 111, 46–52.
- Corp Released, I.B.M., 2013. *IBM SPSS Statistics for Windows, Version 22.0*. IBM Corp, Armonk, NY.
- Dumas, P., Bouafia, S., Gutknecht, C., Saoud, M., Dalery, J., d'Amato, T., 2000. Validation of the French version of the Raine schizotypal personality disorder questionnaire—categorical and dimensional approach to schizotypal personality traits in a normal student population. *L'Encéphale* 26, 23–29.
- Dunn, T.J., Baguley, T., Brunsden, V., 2014. From alpha to omega: a practical solution to the pervasive problem of internal consistency estimation. *Br. J. Psychol.* 105, 399–412.
- Ericson, M., Tuvblad, C., Raine, A., Young-Wolff, K., Baker, L.A., 2011. Heritability and longitudinal stability of schizotypal traits during adolescence. *Behav. Genet.* 41, 499–511.
- Ettinger, U., Meyhöfer, I., Steffens, M., Wagner, M., Koutsouleris, N., 2014. Genetics, cognition, and neurobiology of schizotypal personality: a review of the overlap with schizophrenia. *Front. Psychiatry* 5, 18.
- Ferrando, P.J., Lorenzo-Seva, U., 2017. Program FACTOR at 10: origins, development and future directions. *Psicothema* 29, 236–240.
- Fonseca Pedrero, E., Debbané, M., 2017. Schizotypal traits and psychotic-like experiences during adolescence: an update. *Psicothema* 29, 5–17.
- Fonseca-Pedrero, E., Lemos-Giráldez, S., Paino, M., Villazón-García, U., Muñiz, J., 2009. Validation of the schizotypal personality questionnaire brief form in adolescents. *Schizophr. Res.* 111, 53–60.
- Fonseca-Pedrero, E., Lemos-Giráldez, S., Paino-Piñeiro, M., Villazón-García, U., Muñiz, J., 2010. Schizotypal traits, obsessive-compulsive symptoms, and social functioning in adolescents. *Compr. Psychiatry* 51, 71–77.
- Fonseca-Pedrero, E., Paino, M., Lemos-Giráldez, S., Sierra-Baigrie, S., Muñiz, J., 2011. Measurement invariance of the schizotypal personality questionnaire-brief across gender and age. *Psychiatry Res.* 190, 309–315.
- Fonseca-Pedrero, E., Compton, M., Tone, E.B., Ortuño-Sierra, J., Paino, M., Fumero, A., Lemos-Giráldez, S., 2014a. Cross-cultural invariance of the factor structure of the schizotypal personality questionnaire across Spanish and American college students. *Psychiatry Res.* 30, 1071–1076.
- Fonseca-Pedrero, E., Fumero, A., Paino, M., de Miguel, A., Ortuño-Sierra, J., Lemos Giraldez, S., Muñiz, J., 2014b. Schizotypal personality questionnaire: new sources of validity evidence in college students. *Psychiatry Res.* 219, 214–220.
- Fonseca-Pedrero, E., Ortuño-Sierra, J., Sierro, G., Daniel, C., Cella, M., Preti, A., Mohr, C., Mason, O., 2015. The measurement invariance of schizotypy in Europe. *Eur. Psychiatry* 30, 837–844.
- Fonseca-Pedrero, E., Debbané, M., Schneider, M., Badoud, D., Eliez, S., 2016a. Schizotypal traits in adolescents with 22q11.2 deletion syndrome: validity, reliability and risk for psychosis. *Psychol. Med.* 46, 1005–1013.
- Fonseca-Pedrero, E., Gooding, D., Debbané, M., Muñiz, J., 2016b. Psychopathology: psychosis assessment and high-risk paradigms. In: Bartram, D., Cheung, F., Geisinger, K.F., Iliescu, D. (Eds.), *The ITC International Handbook of Testing and Assessment*. Oxford University Press, UK, pp. 147–170.
- Fonseca-Pedrero, E., Debbané, M., Ortuño-Sierra, J., Chan, R.C.K., Cicero, D.C., Zhang, L.C., Brenner, C., Barkus, E., Linscott, R.J., Kwapil, T., Barrantes-Vidal, N., Cohen, A., Raine, A., Compton, M.T., Tone, E.B., Suhr, J., Muñiz, J., Fumero, A., Giakoumaki, S., Tsaousis, I., Preti, A., Chmielewski, M., Laloua, J., Mechri, A., Lahmar, M.A., Wuthrich, V., Larøi, F., Badcock, J.C., Jablensky, A., 2017. The structure of schizotypal personality traits: a cross-national study. *Psychol. Med.*:17:1–12 <https://doi.org/10.1017/S0033291717001829>.
- Fossati, A., Raine, A., Carretta, I., Leonardi, B., Maffei, C., 2003. The three-factor model of schizotypal personality: invariance across age and gender. *Personal. Individ. Differ.* 35, 1007–1019.
- Fusar-Poli, P., Carpenter, W.T., Woods, S.W., McGlashan, T.H., 2014. Attenuated psychosis syndrome: ready for DSM-5.1? *Annu. Rev. Clin. Psychol.* 10, 155–192.
- Hu, L.-T., Bentler, P.M., 1999. Cut off criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model.* 6, 1–55.
- Klein, C., Andresen, B., Jahn, T., 1997. Erfassung der schizotypen Persönlichkeit nach DSM-III-R: Psychometrische Eigenschaften einer autorisierten deutschsprachigen Übersetzung des "Schizotypal Personality Questionnaire" (SPQ) von Raine. *Diagnostica* 43, 347–369.
- Kline, E., Schifman, J., 2014. Psychosis risk screening: a systematic review. *Schizophr. Res.* 158, 11–18.
- Kwapil, T.R., Ros-Morente, A., Silvia, P.J., Barrantes-Vidal, N., 2012. Factor invariance of psychometric schizotypy in Spanish and American samples. *J. Psychopathol. Behav. Assess.* 34, 145–152.
- Kwapil, T.R., Gross, G.M., Silvia, P.J., Raulin, M.L., Barrantes-Vidal, N., 2017 Jul 20. Development and psychometric properties of the multidimensional schizotypy scale: a new measure for assessing positive, negative, and disorganized schizotypy. *Schizophr. Res.* (pii: S0920-9964(17)30402-4; in press). <https://doi.org/10.1016/j.schres.2017.07.001>.
- Lahmar, M.L., Gassab, L., Beltaief, F., Mechri, A., 2014. Psychometric properties of the Arabic version of the schizotypal personality questionnaire in Tunisian university students. *Tunis. Med.* 92, 318–322.
- Larøi, F., Luhrmann, T.M., Bell, V., Christian, W.A.J., Deshpande, S., Fernyhough, C., Jenkins, J., Woods, A., 2014. Culture and hallucinations: overview and future directions. *Schizophr. Bull.* 40, S213–220.
- Lenzenweger, M.F., 2010. *Schizotypy and Schizophrenia: The View From Experimental Psychopathology*. Guilford Press, New York.
- Liddle, P., 1987. The symptoms of chronic schizophrenia: a re-examination of the positive-negative dichotomy. *Br. J. Psychiatry* 151, 145–151.
- Linscott, R.J., van Os, J., 2013. An updated and conservative systematic review and meta-analysis of epidemiological evidence on psychotic experiences in children and adults: on the pathway from proneness to persistence to dimensional expression across mental disorders. *Psychol. Med.* 43, 1133–1149.
- Ma, W.-F., Lane, H.-Y., Chiang, L.-C., Wu, P.-L., Yang, S.-J., Tsai, G.E., 2015. Assessing the construct validity of the chinese-version schizotypal personality questionnaire-brief on male and female undergraduate students. *J. Nurs. Res.* 23, 162–166.
- Mason, O., 2015. The assessment of schizotypy and its clinical relevance. *Schizophr. Bull.* 41, S374–85.
- Mata, I., mataix-Cols, D., Peralta, V., 2005. Schizotypal personality questionnaire-brief: factor structure and influence of sex and age in a nonclinical population. *Personal. Individ. Differ.* 38, 1183–1192.
- Meehl, P.E., 1962. Schizotaxia, schizotypy, schizophrenia. *Am. Psychol.* 17, 827–838.
- Moreno-Izco, L., Sánchez-Torres, A.M., Lorente-Omeñaca, R., Fañanás, L., Rosa, A., Salvatore, P., Peralta, V., Cuesta, M.J., 2015. Ten-year stability of self-reported schizotypal personality features in patients with psychosis and their healthy siblings. *Psychiatry Res.* 227, 283–289.
- Muthén, B.O., Asparouhov, T., 2002. Latent variable analysis with categorical outcomes: Multiple-group and growth modeling in Mplus. *Mplus Web Note No. 4*, at <http://www.statmodel.com/mplus/examples/webnote.html>.
- Muthén, L.K., Muthén, B.O., 1998–2012. *Mplus User's Guide*. Seventh edition. Muthén & Muthén, Los Angeles, CA.
- Nuevo, R., Chatterji, S., Verdes, E., Naidoo, N., Arango, C., Ayuso-Mateos, J.L., 2012. The continuum of psychotic symptoms in the general population: a cross-national study. *Schizophr. Bull.* 38, 475–485.
- Ortuño-Sierra, J., Badoud, D., Knecht, F., Paino, M., Eliez, S., Fonseca-Pedrero, E., Debbané, M., 2013. Testing measurement invariance of the schizotypal personality questionnaire-brief scores across Spanish and Swiss adolescents. *PLoS One* 8. <https://doi.org/10.1371/journal.pone.0082041>.
- Preti, A., Siddi, S., Vellante, M., Scanu, R., Muratore, T., Gabrielli, M., Tronci, D., Masala, C., Petretto, D.R., 2015. Bifactor structure of the schizotypal personality questionnaire (SPQ). *Psychiatry Res.* 230, 940–950.
- R Development Core Team, 2011. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing Retrieved from <http://www.R-project.org> (Vienna, Austria).
- Raine, A., 1991. The SPQ: a scale for the assessment of schizotypal personality based on DSM-III-R criteria. *Schizophr. Bull.* 17, 555–564.
- Raine, A., Benishay, D., 1995. The SPQ-B: a brief screening instrument for schizotypal personality disorder. *J. Personal. Disord.* 9, 346–355.
- Raine, A., Reynolds, C., Lencz, T., Scerbo, A., Triphon, N., Kim, D., 1994. Cognitive-perceptual, interpersonal, and disorganized features of schizotypal personality. *Schizophr. Bull.* 20, 191–201.
- Reynolds, C.A., Raine, A., Mellinger, K., Venables, P.H., Mednick, S.A., 2000. Three-factor model of schizotypal personality: invariance across culture, gender, religious affiliation, family adversity, and psychopathology. *Schizophr. Bull.* 26, 603–618.
- Siever, L.J., Gunderson, J.G., 1983. The search for a schizotypal personality: historical origins and current status. *Compr. Psychiatry* 24, 199–212.
- Tran, U.S., Stieger, S., Voracek, M., 2015. Mixed-footedness is a more relevant predictor of schizotypy than mixed-handedness. *Psychiatry Res.* 225, 446–451.
- Tsaousis, I., Zourarakis, C., Karamaouna, P., Karagiannopoulou, L., Giakoumaki, S.G., 2015. The validity of the schizotypal personality questionnaire in a Greek sample: tests of measurement invariance and latent mean differences. *Compr. Psychiatry* 62, 51–62.
- Woods, A., Jones, N., Bernini, M., Callard, F., Alderson-Day, B., Badcock, J.C., Bell, V., Cook, C.H., Csordas, T., Humpston, C., Krueger, J., Larøi, F., McCarthy-Jones, S., Moseley, P., Powell, H., Raballo, A., Smailes, D., Fernyhough, C., 2014. Interdisciplinary approaches to the phenomenology of auditory verbal hallucinations. *Schizophr. Bull.* 40 (40 Suppl. 4), S246–54.

World Medical Association, 2013. World medical association declaration of Helsinki: ethical principles for medical research involving human subjects. *J. Am. Med. Assoc.* 310, 2191–2194.

Yu, C.Y., 2002. Evaluating Cutoff Criteria of Model Fit Indices for Latent Variable Models with Binary and Continuous Outcomes. Doctoral Dissertation. University of California, Los Angeles.

Zinbarg, R.E., Revelle, W., Yovel, I., Li, W., 2005. Cronbach's α , Revelle's β , and McDonald's ω^2 : their relations with each other and two alternative conceptualizations of reliability. *Psychometrika* 70, 123–133.

Zumbo, B.D., 2007. Three generations of DIF analyses: considering where it has been, where it is now, and where it is going. *Lang. Assess. Q.* 4, 223–233.