Psicothema

Psychometric Properties of the Schizotypal Personality Questionnaire (SPQ) in a Mexican Population: Invariance Across Gender and Age

Rosario J. Marrero[1], Ascensión Fumero[1], José Ángel González-Villalobos[2], Juan Andrés Hernández-Cabrera[1], and Eduardo Fonseca-Pedrero[3]

[1] Universidad de La Laguna, [2] Universidad Autónoma de San Luis Potosí, and [3] Universidad de La Rioja

Abstract

Background: The present study tested the factorial structure of the Schizotypal Personality Questionnaire (SPQ) in Mexican adults. Although this instrument has been validated in different cultural contexts, there are no studies to date that analyze its psychometric properties in a Mexican sample. **Method:** 307 adults completed the SPQ, seven participants were removed for being at high risk of psychosis. The final sample was made up of 300 participants (M = 34.58, SD = 13.77), of whom 62.8% were female. Raine's three-factor model and Stefanis et al.'s four-factor model were tested. **Results:** The results indicated that both factor structures had a good fit to the data. However, the best evidence was for the three-factor solution. Configural, metric, and scalar invariance according to gender and age for the three-factor model was displayed. Further analyses showed women scored slightly higher in excessive social anxiety but this result was not statistically significant. Younger participants had higher scores on ideas of reference, excessive social anxiety, no close friends, and odd speech than the older group. **Conclusions:** These findings provide support for the use of the SPQ in the Mexican population.

Keywords: Schizotypy, SPQ, validation, Confirmatory factor analysis, measurement invariance.

Resumen

Propiedades Psicométricas del Cuestionario de Personalidad Esquizotípica (SPQ) en Población Mexicana: Invarianza en Función del Género y la Edad. **Antecedentes:** el presente estudio probó la estructura factorial del Cuestionario de personalidad esquizotípica (SPQ) en una muestra de adultos mexicanos. Aunque este instrumento ha sido validado en diferentes contextos culturales, no se han encontrado estudios que analicen las propiedades psicométricas en una muestra mexicana. **Método:** el SPQ fue cumplimentado por 307 adultos, aunque siete participantes fueron eliminados por estar en alto riesgo de psicosis. La muestra final incluyó 300 participantes (M = 34.58, SD = 13.77), de los cuales el 62,8% eran mujeres. Se probó la estructura factorial con tres factores, según la propuesta de Raine, y con cuatro factores según sugiere Stefanis et al. **Resultados:** los resultados indicaron que ambas estructuras factoriales se ajustaban bien a los datos. Sin embargo, se encontró un mejor ajuste para la solución de tres factores. Este modelo demostró invariancia configuracional, métrica y escalar en función del sexo y la edad. Además, se encontró que las mujeres obtuvieron puntuaciones ligeramente más altas en ansiedad social, aunque no fue significativo. Los adultos jóvenes mostraron mayor puntuación en ideas de referencia, ansiedad social, sin amigos cercanos y discurso extraño comparados con el grupo de adultos mayores. **Conclusiones:** estos hallazgos apoyan la utilidad del SPQ en población mexicana.

Palabras clave: esquizotipia, SPQ, validación, análisis factorial confirmatorio, invarianza de medida.

Schizotypal traits are considered as one of the possible phenotypic-indicators of schizotypy, which reflects a latent personality organization related to psychotic-spectrum disorders (Barrantes-Vidal et al., 2015; Lenzenweger, 2018; Meehl, 1962). Schizotypy has shown to be associated with negative psychosocial functioning (Skodol, 2018), such as higher levels of affective disturbance (Osma et al., 2014), greater stress responsivity (Smith & Lenzenweger, 2013), childhood trauma (Radua et al., 2018),

higher suicide risk (Jahn et al., 2016), decreased familial and peer social support (Verbeke et al., 2017), and lower well-being (Fumero et al., 2018). Longitudinal and family studies show considerable support for the study of schizotypal traits as biological mechanisms of psychosis (Walter et al., 2016). Additionally, biological factors that are at the base of schizotypy have also been found in other clinical disorders and in healthy children of the clinical population (Flückiger et al., 2016). Schizotypal traits are continuously distributed throughout the general population, but they do not necessarily reach the threshold for a psychotic diagnosis or generate distress (Fonseca-Pedrero & Debbané, 2017).

The study of the underlying structure of schizotypal traits reveals that it is a multidimensional construct that can be captured through self-administered scales and can be quantified by assessing levels of these schizotypal traits (Fonseca-Pedrero et al.,

2017; Fonseca-Pedrero et al., 2018a). The Schizotypal Personality Questionnaire (SPQ; Raine, 1991) is one well-established self-report measure to assess schizotypal traits according to the DSM III-R. The SPQ measures nine schizotypal traits. These subscales can be grouped into three higher-order domains, which include a positive dimension (cognitive-perceptual factor) characterized by perceptual distortions, such as unusual perceptual experiences; a negative dimension (interpersonal factor) characterized by interpersonal deficits, such as introvertive anhedonia; and a disorganized dimension (disorganized factor) characterized by manifestations of distorted thinking, such as odd speech and disrupted thoughts (Fonseca-Pedrero et al., 2014a; Fonseca-Pedrero et al., 2018a; Raine, 1991).

Confirmatory factor analysis was used for testing competing models with higher-order two, three, and four factors both for the long version and for the short version (SPQ-b) of the SPQ (Fonseca-Pedrero et al., 2011; Fonseca-Pedrero et al., 2014a; Rabella et al., 2018). The results indicated that although a four-factor model fit the data well, and this factor structure displayed configural and metric invariance across diverse groups (Cicero, 2015), the three-factor model appears to fit the data better than other models in different countries and cultures (Fonseca-Pedrero et al., 2017; Fonseca-Pedrero et al., 2018b; Raine et al., 1994). However, there are not enough data to provide a definitive answer to this question, because the populations (age, gender, or ethnicity), sampling strategies, and psychometric procedures used are heterogeneous.

Gender, age, country of origin, and ethnic or migrant status correlate with schizotypal traits at clinical and subclinical levels (Jongsma et al., 2018; Linscott & van Os, 2013; McGrath et al., 2015). Generally, females score higher on the cognitive-perceptual dimension than males, and males score higher on the negative and disorganized dimensions than females (Barron et al., 2015; Karcher et al., 2014). Age is negatively associated with subclinical expressions of the psychosis phenotype (e.g., schizotypal traits, psychotic-like experiences) (Linscott & van Os, 2013; McGrath et al., 2015). Furthermore, findings support the invariance across age and gender of the three-factor model structure (Fonseca-Pedrero et al., 2018a; Fonseca-Pedrero et al., 2011; Raine, 2006; Reynolds et al., 2000). The SPQ includes different and inconsistent factor structures (Gerritsen et al., 2018).

Likewise, it has been suggested that there may be cultural acceptance of psychotic phenomena (e.g. hallucinations and magical thinking) as normative experiences (Laroi et al., 2014). However, it has been found that psychotic experiences generate distress regardless of culture. For instance, Wüsten et al. (2018), in a multinational study, found that there was a universal positive correlation between higher frequency of psychotic experiences and more distress, but the distress levels controlled for frequency were significantly higher in high-income countries. In another study, an African sample reported comparable levels of psychotic experiences related to distress as a European sample (Vermeiden et al., 2019). Racial/ethnic differences and cultural context influence the meaning that individuals ascribe to stressful experiences and how acceptable adaptive responses to stress are defined, also how the psychological symptoms of distress are expressed and how mental disorders are understood.

The majority of studies of personality disorder traits do not include ethnicity, and studies reporting personality disorder among Spanish speakers have been inconsistent. Fonseca-Pedrero et al. (2018b) examined the differences in SPQ according to nationality,

but no Latin-American countries (e.g., Mexico) were included. To the best of our knowledge, no previous studies have examined the schizotypal traits in Mexican samples. Therefore, there is a lack of systematic studies about the prevalence and manifestation of schizotypal traits across different Spanish-speaking cultural and ethnic groups.

In order to address these possible sources of inconsistency in prior research findings, our aim was to evaluate the factorial structure and measurement invariance across gender and age of the SPQ scores in a Mexican community sample.

Method

Participants

Participants were a convenience community sample of 307 adults resident in Mexico. An attempt was made to ensure that different ages, professions, and genders were represented. Psychology students distributed an online link with the questionnaires among people from their social surroundings. Participants who self-reported having family history of psychosis and also scored in the top 10% of the SPQ, so for whom there was a high probability of having a disorder or being at a subthreshold level (Raine, 1991), were removed from the sample ($N = 7$). The final sample included 300 participants, 37.2% male and 62.8% female, ranging in age from 18 to 84 ($M = 34.58$, $SD = 13.77$). Of the participants, 55% were employed, 5% were unemployed, 5% were retired, and 35% were students.

Instruments

The Spanish version of the *Schizotypal Personality Questionnaire* (SPQ, Fonseca-Pedrero et al., 2014a) was used in its original form, after revision by a native speaker of Mexican Spanish. The SPQ is composed of 74 items with a yes or no answer format that have been used for assess schizotypal traits in both clinical and non-clinical populations. The SPQ was designed to collect the nine traits that define the Schizotypal Personality Disorder (SPD) according to DSM-III-R (APA, 1987; Raine, 1991). The scores in nine traits are obtained by adding the corresponding items: ideas of reference (9 items), magical thinking (7 items), unusual perceptual experiences (9 items), suspiciousness (8 items), excessive social anxiety (8 items), no close friends (9 items), constricted affect (8 items), odd behavior (7 items) and odd speech (9 items), and a total schizotypal score. Confirmatory factor analyses showed a structure of second order three factors: cognitive-perceptual, interpersonal, and disorganized features (Fonseca-Pedrero et al., 2018a). Adequate reliability has been met in the SPQ subscales for the Spanish sample, ranging from .80 to .91 (Fonseca-Pedrero et al., 2014a).

The Positive and Negative Affect Schedule (PANAS, Watson et al., 1988) assesses positive and negative affect referring to the present, using 10 descriptors each. PANAS uses a 5-point scale (from 1: strongly disagree to 5: strongly agree). Both scales showed adequate internal consistency in the Mexican population, with measures between .85 and .90 for positive affect and .81 to .85 for negative affect (Robles & Páez, 2003).

Procedure

Participants were informed about the aim of the research and the anonymity and confidentiality of the information gathered. It

was also clarified that the completion of the instruments constituted express consent to use the data for research purposes. Participants completed the battery of questionnaires online within a maximum period of one week. Ethical approval for the conduct of the research study was granted by the Animal Welfare and Research Ethics Committee of Universidad de La Laguna.

Data analysis

First, descriptive statistics (mean and standard deviation), inter-scales correlations and internal consistencies of the SPQ subscales were calculated.

Second, confirmatory factor analysis (CFA) were conducted using the *R* library lavaan (R Core Team, 2016; Rosseel, 2012) with ULLRToolbox by Hernández and Betancort (2016). CFA allows checking the factor structure of an instrument in later phases of psychometric development, especially when its structure has been previously validated through exploratory factor analysis. With CFA, alternative models are tested and then goodness of fit for these models is compared. At first, the measurement model was analyzed for each of the nine SPQ subscales. Next, the higher-order factor structure of three (Raine, 1991; Fonseca-Pedrero et al., 2014a) and four factors (Stefanis et al., 2004) were examined using the predicted scores in each of the nine SPQ factors. The standard goodness-of-fit indices used for testing the acceptability of the model were: χ^2, goodness-of-fit index (GFI), comparative fit index (CFI), Tucker-Lewis index (TLI), normative fit index (NFI), non-normed fit index (NNFI), standardized root mean square residual (SRMR), the root mean-square error of approximation (RMSEA) and the Akaike Information Criterion (AIC; Akaike, 1987). The recommended values for adequate fit were around .90 for the CFI, TLI, GFI, NFI, and NNFI indexes (Kline, 2011). The well-fitting models obtained SRMR values under .05 and RMSEA values of .08 indicated a reasonable fit of the model, whereas values ranging to .10 reflect a mediocre fit (Gierl & Rogers, 1996; Hu & Bentler, 1999). Models with the lowest AIC should be preferred (Schermelleh-Engel et al., 2003). A confidence interval of 90% was established.

The measurement invariance by gender and age was tested through multi-group CFA estimation using the model that showed the best fit. First, configural invariance was tested where the factorial structure is constrained to be the same for both groups (male and female; youth and adults). In a next step, we tested metric invariance where the magnitude of all factor loadings was constrained to be the same for both gender and age groups. Later, the scalar invariance or intercept invariance was calculated constraining the intercepts of items to be the same across groups (by gender and by age) indicating if two groups used the response scale in a similar way. Scalar invariance must be satisfied before interpreting mean differences between the groups.

In addition, MANOVAs including nine SPQ subscales as dependent variables and gender and age as independent variables were applied. Finally, following the recommendations by Muñiz and Fonseca-Pedrero (2019), the differential item functioning (DIF) between gender, the standardization of scales, and evidence about validity were applied.

Results

Descriptive statistics and Pearson correlations

Table 1 depicts means (*SD*), correlations, and internal consistency for the SPQ subscales. Participants had the highest mean scores on ideas of reference, excessive social anxiety, and odd speech subscales. The means for the SPQ subscales were similar to previous studies with a Spanish-speaking population, but Mexican participants scored slightly lower in ideas of reference and excessive social anxiety compared to the Spanish participants (Fonseca-Pedrero et al., 2014a). Correlations between all subscales were high ($r = .40$, $p < .001$), with only magical thinking having lower correlations with some subscales (excessive social anxiety, no close friends, and constricted affect).

The reliability coefficients of the SPQ subscales were acceptable; only the no close friends and constricted affect subscales had indices below .70.

Comparison of structural models

The SPQ three-factor structure of Raine et al. (1994) and the SPQ four-factor structure of Stefanis et al. (2004) were tested through CFA. Previously, the measurement model was analyzed for each of the nine SPQ subscales separately. The standardized loadings indicated that the latent constructs were well represented by their indicators. In all cases, the measurement models yielded a good fit to the data (Table 2).

Table 1
Descriptive Statistics, Pearson Correlations, and Internal Consistencies of SPQ Subscales

Subscales	1	2	3	4	5	6	7	8	9
1. Ideas of reference		.55	.60	.63	.48	.41	.44	.52	.53
2. Magical thinking			.69	.41	.24	.35	.27	.50	.40
3. Unusual perceptual experiences				.54	.38	.46	.39	.63	.51
4. Suspiciousness					.46	.55	.57	.52	.51
5. Excessive social anxiety						.57	.58	.34	.54
6. No close friends							.69	.52	.51
7. Constricted affect								.47	.53
8. Odd behavior									.54
9. Odd speech									
M (*SD*)	2.49 (2.29)	1.34 (1.72)	1.82 (2.03)	1.99 (1.93)	2.56 (2.38)	2.47 (2.09)	1.88 (1.72)	1.55 (1.72)	2.52 (2.35)
α	.76	.74	.74	73	.80	.69	.64	.72	.77

p < .001

Table 2
Goodness of Fit Indexes for the Measurement Models of each SPQ Subscale

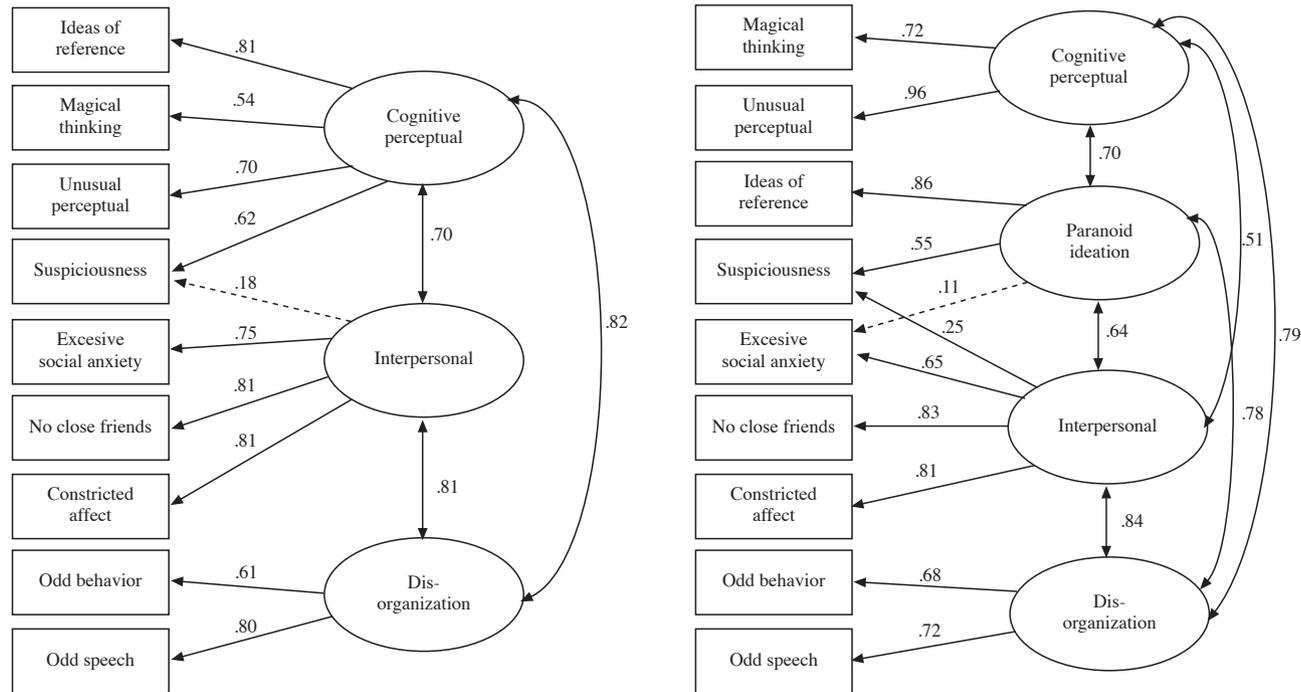| Measurement model	χ^2	df	NFI	NNFI	CFI	TLI	MFI	RMSEA	(90%CI)	AIC	BIC	SRMR
Ideas of reference	48.04**	26	.914	.942	.958	.942	.962	.055	(.03 - .079)	2438.37	2447.25	.046
Magical thinking	16.30	12	.959	.98	.988	.98	.992	.036	(0 - .075)	1486.46	1493.87	.030
Unusual perceptual experiences	42.82*	26	.888	.933	.952	.933	.971	.048	(.019 - .073)	2062.29	2071.17	.042
Suspiciousness	42.68***	17	.912	.908	.944	.908	.955	.073	(.046 - .101)	1829.93	1838.75	.049
Excessive social anxiety	25.76	19	.959	.983	.989	.983	.988	.036	(0 - .067)	2269.34	2277.22	.033
No close friends	38.80*	25	.886	.935	.955	.935	.976	.044	(.01 - .07)	2599.88	2609.23	.043
Constricted affect	23.63	18	.899	.958	.973	.958	.99	.033	(0 - .067)	1961.67	1969.96	.040
Odd behavior	18.95	11	.955	.962	.98	.962	.986	.051	(0 - .088)	1404.06	1411.95	.036
Odd speech	38.56*	25	.922	.957	.97	.957	.976	.044	(.009 - .07)	2492.73	2502.01	.040

* p < .05, ** p < .01, ***, p < .001

Figure 1 shows the subscale loadings in both three-factor and four-factor models. In the three-factor model, the suspiciousness subscale did not significantly load on the Interpersonal factor, while the remaining subscales loaded highly on their respective latent factor. In the four-factor model, suspiciousness had a lower load on the Interpersonal factor than the Paranoid ideation factor, and the excessive social anxiety subscale did not significantly load on the Paranoid ideation factor.

The three-factor model showed a slightly better fit to the data (χ^2(19, $N = 300$) = 40.69, $p < .01$; CFI = .98; TLI = .96; NFI = .96; NNFI = .96; SRMR = .03; RMSEA = .07) than the four-factor model (χ^2(19, $N = 300$) = 58.59, $p < .001$; CFI = .96; TLI = .92; NFI = .94; NNFI = .92; SRMR = .05; RMSEA = .10) . Lower AIC values indicated that the three-factor model provided a better fit than the four-factor model. Since the three-factor model seems to fit the data better, the measurement invariance of the SPQ according to gender and age was tested with this model.

Measurement invariance of SPQ scores across gender and age

The measurement invariance across gender and age was tested. The results are shown in Table 3. The configural model, which does not constrain any parameters, showed similar loads of SPQ subscales on the latent factor in both males and females. The metric invariance, where factor loads are constrained to be equal, also showed an adequate fit to data, indicating that the factors are the same for males and females. The scalar invariance model, in which the loads and intercepts are constrained, also had a good fit to the data, so that both groups scored similarly on the factors. Comparison between both configural and metric models, through Satorra-Bentler's (2001) chi-squares differences, indicated that the two models were indistinguishable ($\chi^2_{diff} = 5.14$, $p = .643$). The β difference criterion concluded that there were no DIF present in the SPQ items according to gender.

Figure 1. Three-Factor and Four-Factor Models

Table 3
Measurement Invariance across Gender and Age

Models	χ^2	df	NFI	NNFI	CFI	TLI	MFI	RMSEA	(90%CI)
GENDER									
Configural invariance	68.18**	38	.930	.942	.969	.942	.918	.080	(.051 - .117)
Metric invariance	72.79**	45	.926	.954	.971	.954	.918	.075	(.041 - .106)
Scalar invariance	79.10**	51	.919	.961	.972	.961	.919	.070	(.037 - .099)
AGE									
Configural invariance	85.72***	38	.936	.929	.962	.929	.919	.094	(.068 - .121)
Metric invariance	98.90***	45	.926	.932	.958	.932	.909	.092	(.067 - .116)
Scalar invariance	117.55***	51	.912	.926	.948	.926	.889	.096	(.073 - .119)

$* p < .05, ** p < .01, ***, p < .001$

Table 4
Standardization of SPQ Scores in Mexican Adults

Percentile level	Ideas of reference	Magical thinking	Unusual perceptual	Suspiciousness	Excessive social anxiety	No close friends	Constricted affect	Odd behavior	Odd speech	Cognitive perceptual	Interpersonal	Dis-Organization	SPQ Total
10	0	0	0	0	0	0	0	0	0	0	0.6	0	3
20	0	0	0	0	0	1	0	0	0	2	2	1	6
30	1	0	0	1	1	1	1	0	1	3	3	1	9
40	1	0	1	1	1	1	1	1	1	4	4	2	12
50	2	1	1	2	2	2	2	1	2	6	5	3	16
60	3	1	2	2	3	3	2	1	3	8	6	4	20
70	3	2	3	3	4	3	2.6	2	3	10	8	6	26
80	5	3	3	4	5	4	3	3	4	13	10	7	31
90	6	4	5	5	6	6	4.2	4	6	17	13	9	38
100	9	7	9	8	8	8	7	7	9	32	20	15	68
Mean	2.49	1.34	1.82	2	2.56	2.47	1.88	1.55	2.52	7.69	5.90	4.07	18.70
SD	2.29	1.72	2.03	1.93	2.38	2.09	1.72	1.72	2.35	6.59	4.67	3.59	13.41

Two age groups were constituted: youth (18-30 years old) and adults (31-84 years old). When the configural model was tested, most of the goodness indices showed an adequate fit of the model to the data, although the RMSEA values were slightly above .08. The metric invariance also showed the same pattern of an acceptable fit, except in the RMSEA index. However, the scalar model had more difficulty adjusting properly to the data. The goodness-of-fit indices MFI and RMSEA indicated a mediocre fit. Comparison between both configural and metric models, through Satorra-Bentler's chi-squares differences, indicated that the two models were relatively indistinguishable ($\chi^2_{diff} = 13.10, p = .069$).

The SPQ was standardized using the score distribution of the sample. Scale scores corresponding to the percentile range (10th-100th) were used to generate a scoring grid for the nine SPQ subscales, the three SPQ factors, and the total SPQ score (Table 4).

The MANOVA found no significant gender differences in the SPQ subscales. Only marginally significant differences were found in excessive social anxiety, $F(1,268) = 15.63, p < .10, \eta^2 = .010$, $1-\beta = .379$, where females scored higher. Age-related marginal and significant differences were found in four subscales: excessive social anxiety, $F(1,269) = 75.55, p < .001, \eta^2 = .049, 1-\beta = .960$; no close friends, $F(1,268) = 3.91, p < .05, \eta^2 = .014, 1-\beta = .504$; ideas of reference, $F(1,268) = 2.86, p < .10, \eta^2 = .011, 1-\beta = .392$; and odd speech, $F(1,268) = 3.21, p < .10, \eta^2 = .012, 1-\beta = .431$. Younger participants tended to have higher scores on all subscales than the older group.

Convergent and discriminant validity

Convergent and discriminant validity were analyzed through Pearson's correlation between all the SPQ scales and negative and positive affect, respectively. All SPQ scales were positively correlated with negative affect. The highest correlations were between the excessive social anxiety subscale and negative affect ($r = .42, p < .001$), followed by odd speech, ideas of reference, and suspiciousness ($r = .39, r = .30, r = .30 , p < .001$, respectively), and the lowest correlations were found for no close friends, unusual perceptual experiences, constricted affect, odd behavior ($r = .28, r = .28, r = .27, r = .25, p < .001$, respectively), and magical thinking ($r = .15, p < .05$). The three second-order factors also showed significant correlations with negative affect ($r = .32$ for cognitive perceptual, $r = .32$ for interpersonal and $r = .38$ for disorganization, $p < .001$) and the total SPQ score correlated with .41 ($p < .001$).

SPQ scales had low and negative association with positive affect: constricted affect ($r = -.26, p < .001$), excessive social anxiety ($r = -.23, p < .001$), no close friends ($r = -.21, p < .001$), and odd speech ($r = -.14, p < .05$), although no significant associations were found between positive affect and the remaining SPQ scales (ideas of reference, suspiciousness, unusual perceptual experiences, odd behavior and magical thinking). The total SPQ score had a low correlation with positive affect ($r = -.13, p < .05$). The second-order factors, interpersonal ($r = -.22, p < .001$) and disorganization ($r =$

-.13, $p < .05$) showed negative correlations with positive affect, but cognitive perceptual did not show significant relationships.

Discussion

The main goal of the present study wat to test SPQ factorial structure in a Mexican population. In particular, the psychometric properties of the SPQ scores, such as reliability of the scores and factorial structure, were analyzed. In addition, measurement invariance across gender and age of the SPQ scores in a Mexican community sample was also tested. The results indicated that the internal consistency coefficients of the SPQ were adequate; that the three-factor model (Raine, 1991) had a better fit to the data than the four-factor model (Stefanis et al., 2004); that this three-factor model showed invariance across gender and age in this Mexican community sample.

First, the measurement model for each of the nine SPQ subscales showed that the latent constructs were well represented by their indicators. The results suggested that the 74 items of the SPQ had an adequate fit in each of the nine subscales to which they belonged consistent with previous studies (Cicero, 2015; Fonseca-Pedrero et al., 2014a).

Second, both three- and four-factor models had an adequate fit to data. Previous research has shown evidence in favor of both the three-factor model (Raine et al., 1994; Reynolds et al., 2000; Yu et al., 2016) and the four-factor model (Cicero, 2015; Fonseca-Pedrero et al., 2014b; Rabella et al., 2018) in several different languages and different cultural contexts through CFA. In our study, the results suggested a small change in the second-order structure in both the three- and four-factor models. Specifically, in the three-factor model, the suspiciousness subscale adequately represented the cognitive-perceptual dimension but was not significant for the interpersonal dimension. On the other hand, in the four-factor model, the excessive social anxiety subscale did not adequately represent the paranoid ideation dimension.

The results of our study showed the superiority of three-factor model over the four-factor model consistent with the findings obtained by Tiliopoulos & Crawford (2007) with British adults. The four-factor model also had a proper fit to data in line with other studies with German and Greek community participants (Barron et al., 2018; Tsaousis et al., 2015). However, the adjustment of the four-factor model was slightly poorer, so according to the parsimony criterion, it was decided to assume the three-factor model. Most of the studies have analyzed the SPQ factorial structure with populations of young people or university students (Cicero, 2015; Fonseca-Pedrero et al., 2014a; Yu et al., 2016). Our study included community participants in a concrete cultural context for which, as far as we know, no SPQ validation study has been done. In a recent study with 27,001 young participants from 12 countries of Europe, America, Asia, and Australia, the three-factor structure was applied, showing differences in schizotypal traits according to country (Fonseca-Pedrero et al., 2018b). Our study suggests a change in Raine's three-factor model for the Mexican population in which the suspicious subscale be eliminated from the interpersonal dimension. Considering that the SPQ can be useful to identify people vulnerable to psychotic spectrum disorder

(Fonseca-Pedrero et al., 2011; Raine, 1994), a separate, different dimension model could be more relevant than the original cross-load model.

Third, the three-factor structure was shown to be invariant for gender and age in a Mexican population. Previous analyses of measurement invariance are a fundamental requirement before comparisons can be made between subgroups of individuals. Few studies have analyzed the measurement invariance through gender and age in a Spanish-speaking population (Fonseca-Pedrero et al., 2014a) and no study has been carried out with a non-Spanish Hispanic population. In addition, the SPQ in a Mexican population showed convergent and discriminant validity with positive and negative affect.

Fourth, since the factorial structure is similar according to gender and age, it is possible to establish comparisons between groups of individuals. The results of comparing the mean scores in the nine SPQ subscales for males and females did not suggest gender differences, contrary to that obtained in other studies (Raine et al., 1994; Wuthrich & Bates, 2006). However, age differences were found in excessive social anxiety, no close friends, ideas of reference, and odd speech subscales. Younger individuals obtained higher scores, consistent with previous research (Fonseca-Pedrero et al., 2011).

Some limitations of this study should be recognized. First, the sample size was limited, although in other studies the instrument has been validated with a similar number of participants (Tiliopoulos & Crawford, 2007; Wuthrich & Bates, 2006); future research could examine the factorial structure with a representative population. Second, the SPQ was the only scale used, and this scale includes different factor structures and different association patterns with theoretical constructs (Raine et al., 1994). Third, an SPQ assessment in community-based studies may serve as a tool for early identification of schizophrenia susceptibility, but it must be corroborated by diagnostic interviews. Fourth, studies across two interval time could be necessary in order to analyze the stability of the SPQ in Mexican population (Kemp et al., 2019).

Future research should analyze SPQ structure in different Spanish-speaking groups from different cultural contexts to identify whether the factorial structure is determined according to the language or the culture. Similarly, it might be of interest to analyze whether there are differences in means in the different subscales according to culture. Some studies have found differences in specific symptoms in different cultural groups (Cicero, 2015; Fonseca-Pedrero et al., 2018b; Schiffman, 2004).

In sum, the goodness of fit for the three-factor model was better than for the four-factor model. This study has important implications, since it is the first to validate the SPQ instrument with a Mexican adult population. The fact that a community population has participated could be explaining this three-factor structure. Three-factor solutions were found for adults and four-factor solutions were obtained for an undergraduate sample (Zhang & Brenner, 2017). In this sense, the higher-order factor structure of three factors allows clarifying the inconsistencies that have appeared in other studies with non-clinical adolescents and young people.

References

Akaike H. (1987). Factor Analysis and AIC. In E. Parzen, K. Tanabe, & G. Kitagawa (Eds.), *Selected Papers of Hirotugu Akaike*. Springer Series in Statistics. https://doi.org/10.1007/978-1-4612-1694-0_29

American Psychological Association (1987). *DSM-III-R: Diagnostic and Statistical Manual of Mental Disorders*. 3rd ed., revised. American Psychiatric Association.

Barrantes-Vidal, N., Grant, P., & Kwapil, T. (2015). The role of schizotypy in the study of the etiology of schizophrenia spectrum disorders. *Schizophrenia Bulletin*, *41*(suppl_2), 408-416. https://doi.org/10.1093/schbul/sbu191

Barron, D., Swami, V., Towell, T., Hutchinson, G., & Morgan, K. (2015). Examination of the factor structure of the Schizotypal Personality Questionnaire among British and Trinidadian adults. *BioMed Research International*, *ID 258275*. http://dx.doi.org/10.1155/2015/258275

Barron, D., Voracek, M., Tran, U., San Ong, H., Morgan, K., Towell, T., & Swami, V. (2018). A reassessment of the higher-order factor structure of the German Schizotypal Personality Questionnaire (SPQ-G) in German-speaking adults. *Psychiatry Research*, *269*, 328-336. https://doi.org/10.1016/j.psychres.2018.08.070

Cicero, D. (2015). Measurement invariance of the Schizotypal Personality Questionnaire in Asian, Pacific Islander, White, and multiethnic populations. *Psychological Assessment*, *28*(4), 351-361. http://dx.doi.org/10.1037/pas0000180

Flückiger, R., Ruhrmann, S., Debbané, M., Michel, C., Hubl, D., Schimmelmann, B., Klosterkötter, J., & Schultze-Lutter, F. (2016). Psychosis-predictive value of self-reported schizotypy in a clinical high-risk sample. *Journal of Abnormal Psychology*, *125*(7), 923-932. http://doi.apa.org/getdoi.cfm?doi=10.1037/abn0000192

Fonseca-Pedrero, E., & Debbané, M. (2017). Schizotypal traits and psychotic-like experiences during adolescence: An update. *Psicothema*, *29*(1), 5-17. https://www.redalyc.org/pdf/727/72749498001.pdf

Fonseca-Pedrero, E., Chan, R., Debbané, M., Cicero, D., Zhang, L., Brenner, C., & Cohen, A. (2018a). Comparisons of schizotypal traits across 12 countries: Results from the International Consortium for Schizotypy Research. *Schizophrenia Research*, *199*, 128-134. https://doi.org/10.1016/j.schres.2018.03.021

Fonseca-Pedrero, E., Compton, M., Tone, E., Ortuño-Sierra, J., Paino, M., Fumero, A., & Lemos-Giráldez, S. (2014b). Cross-cultural invariance of the factor structure of the Schizotypal Personality Questionnaire across Spanish and American college students. *Psychiatry Research*, *220*(3), 1071-1076. https://doi.org/10.1016/j.psychres.2014.06.050

Fonseca-Pedrero, E., Debbané, M., Ortuño-Sierra, J., Chan, R., Cicero, D., Zhang, L. C., & Barrantes-Vidal, N. (2018b). The structure of schizotypal personality traits: A cross-national study. *Psychological Medicine*, *48*(3), 451-462. https://doi.org/10.1017/S0033291717001829P

Fonseca-Pedrero, E., Fumero, A., Paino, M., de Miguel, A., Ortuño-Sierra, J., Lemos-Giráldez, S., & Muñiz, J. (2014a). Schizotypal Personality Questionnaire: New sources of validity evidence in college students. *Psychiatry Research*, *219*(1), 214-220. https://doi.org/10.1016/j.psychres.2014.04.054

Fonseca-Pedrero, E., Ortuño-Sierra, J., De Álbeniz, A., Muñiz, J., & Cohen, A. (2017). A latent profile analysis of schizotypal dimensions: Associations with psychopathology and personality. *Psychiatry Research*, *253*, 110-115. https://doi.org/10.1016/j.psychres.2017.02.038

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 Research*, *190*(2-3), 309-315. https://doi.org/10.1016/j.psychres.2011.05.021

Fumero, A., Marrero, R. J., & Fonseca-Pedrero, E. (2018). Well-being in schizotypy: The effect of subclinical psychotic experiences. *Psicothema*, *30*(2), 177-182. https://doi.org/10.7334/psicothema2017.100

Gerritsen, C., Chmielewski, M., Zakzanis, K., & Bagby, R. (2018). Examining the dimensions of schizotypy from the top down: A hierarchical comparison of item-level factor solutions. *Personality Disorders: Theory, Research, and Treatment*, *9*(5), 467-477. https://doi.org/10.1037/per0000283

Gierl, M., & Rogers, W. (1996). A confirmatory factor analysis of the test anxiety inventory using Canadian high school students. *Educational and Psychological Measurement*, *56*(2), 315-324. https://doi.org/10.1177/0013164496056002012

Hernández, J., & Betancort, M. (2016). *ULLRToolbox*. https://sites.google.com/site/ ullrtoolbox/

Hu, L., & Bentler, P. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling*, *6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Jahn, D., DeVylder, J., & Hilimire, M. (2016). Explanatory risk factors in the relations between schizotypy and indicators of suicide risk. *Psychiatry Research*, *238*, 68-73. https://doi.org/10.1016/j.psychres.2016.02.021

Jongsma, H., Gayer-Anderson, C., Lasalvia, A., Quattrone, D., Mulè, A., Szöke, A., & Berardi, D. (2018). Treated incidence of psychotic disorders in the multinational EU-GEI study. *JAMA Psychiatry*, *75*(1), 36-46. https://doi.org/10.1001/jamapsychiatry.2017.3554

Karcher, N., Slutske, W., Kerns, J., Piasecki, T., & Martin, N. (2014). Sex differences in magical ideation: a community-based twin study. *Personality Disorders: Theory, Research, and Treatment*, *5*(2), 212-219. https://doi.org/10.1037/per0000040

Kemp, K. C., Gross, G. M., & Kwapil, T. R. (2019). Psychometric properties of the Multidimensional Schizotypy Scale and Multidimensional Schizotypy Scale–Brief: Item and scale test–retest reliability and concordance of original and brief forms. *Journal of Personality Assessment*, *102*(4), 508-515. https://doi.org/10.1080/00223891.2019.159142

Kline, R. (2011). Convergence of structural equation modeling and multilevel modeling. In M. Williams (Ed.), *Handbook of methodological innovation*. Sage.

Laroi, F., Luhrmann, T., Bell, V., Christian Jr, W., Deshpande, S., Fernyhough, C., & Woods, A. (2014). Culture and hallucinations: Overview and future directions. *Schizophrenia Bulletin*, *40*(Suppl_4), S213-S220. https://doi.org/10.1093/schbul/sbu012

Lenzenweger, M. (2018). Schizotypy, schizotypic psychopathology and schizophrenia. *World Psychiatry*, *17*(1), 25-26. https://doi.org/10.1002/wps.20479

Linscott, R., & 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. *Psychological Medicine*, *43*(6), 1133-1149. https://doi.org/10.1017/S0033291712001626

McGrath, J., Saha, S., Al-Hamzawi, A., Alonso, J., Bromet, E., Bruffaerts, R., & Florescu, S. (2015). Psychotic experiences in the general population: A cross-national analysis based on 31 261 respondents from 18 countries. *JAMA Psychiatry*, *72*(7), 697-705. https://doi.org/10.1001/jamapsychiatry.2015.0575

Muñiz, J., & Fonseca-Pedrero, E. (2019). Diez pasos para la construcción de un test [Ten steps for test development]. *Psicothema, 31*(1), 7-16. https://doi.org/10.7334/psicothema2018.291

Osma, J., García-Palacios, A., Botella, C., & Barrada, J. R. (2014). Personality disorders among patients with panic disorder and individuals with high anxiety sensitivity. *Psicothema*, *26*(2), 159-165. https://doi.org/10.7334/psicothema2018.41

R Core Team (2016). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing

Rabella, M., Grasa, E., Trujols, J., Gich, I., Torrubia, R., Corripio, I., Pérez, V., & Riba, J. (2018). Validation of a Spanish version of the schizotypal personality questionnaire (SPQ): Psychometric characteristics and underlying factor structure derived from a healthy university student sample. *Actas Españolas de Psiquiatría*, *46*(5), 159-173. http://europepmc.org/abstract/MED/30338773

Radua, J., Ramella-Cravaro, V., Ioannidis, J. P., Reichenberg, A., Phiphopthatsanee, N., Amir, T., & McGuire, P. (2018). What causes psychosis? An umbrella review of risk and protective factors. *World Psychiatry*, *17*(1), 49-66. https://doi.org/10.1002/wps.20490

Raine, A. (2006). Schizotypal personality: Neurodevelopmental and psychosocial trajectories. *Annual Review of Clinical Psychology*, *2*, 291-326. https://doi.org/10.1146/annurev.clinpsy.2.022305.095318

Raine, A. (1991). The SPQ: A scale for the assessment of schizotypal personality based on DSM-III-R criteria. *Schizophrenia Bulletin*, *17*(4), 555-564. https://doi.org/10.1093/schbul/17.4.555

Raine, A., Reynolds, C., Lencz, T., Scerbo, A., Triphon, N., & Kim, D. (1994). Cognitive-perceptual, interpersonal, and disorganized features of schizotypal personality. *Schizophrenia Bulletin*, *20*(1), 191-201. https://doi.org/10.1093/schbul/20.1.191

Reynolds, C., Raine, A., Mellingen, K., Venables, P., & Mednick, S. (2000). Three-factor model of schizotypal personality: Invariance across culture, gender, religious affiliation, family adversity, and psychopathology. *Schizophrenia Bulletin*, *26*(3), 603-618. https://doi.org/10.1093/oxfordjournals.schbul.a033481

Robles, R., & Páez, F. (2003). Estudio sobre la traducción al español y las propiedades psicométricas de las escalas de afecto positivo y negativo (PANAS) [Study on about translation into Spanish and the psychometric properties of The Positive and Negative Affect Scales (PANAS)]. *Salud Mental, 26*(1), 69-75. https://www.medigraphic.com/pdfs/salmen/sam-2003/sam031h.pdf

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*, 1-36. https://users.ugent.be/~yrosseel/lavaan/lavaanIntroduction.pdf

Satorra, A., & Bentler, P. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika*, *66*(4), 507-514. https://doi.org/10.1007/BF02296192

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online*, *8*(2), 23-74. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.509.4258&rep=rep1&type=pdf

Schiffman, J. (2004). Schizotypal traits in a non-clinical sample from Hawai'i. *Pacific Health Dialog*, *11*(1), 84-86. http://europepmc.org/abstract/MED/18181446

Skodol, A. (2018). Impact of personality pathology on psychosocial functioning. *Current Opinion in Psychology*, *21*, 33-38. https://doi.org/10.1016/j.copsyc.2017.09.006

Smith, N., & Lenzenweger, M. (2013). Increased stress responsivity in schizotypy leads to diminished spatial working memory performance. *Personality Disorders: Theory, Research, and Treatment*, *4*(4), 324-331. https://doi.org/10.1037/per0000014

Stefanis, N., Smyrnis, N., Avramopoulos, D., Evdokimidis, I., Ntzoufras, I., & Stefanis, C. (2004). Factorial composition of self-rated schizotypal traits among young males undergoing military training. *Schizophrenia Bulletin*, *30*(2), 335-350. https://doi.org/10.1093/oxfordjournals.schbul.a007083_

Tiliopoulos, N., & Crawford, G. (2007). Three-factor model of schizotypal personality in a British Christian sample. *Mental Health, Religion and Culture*, *10*(6), 563-569. https://doi.org/10.1080/13674670601018029

Tsaousis, I., Zouraraki, C., Karamaouna, P., Karagiannopoulou, L., & Giakoumaki, S. (2015). The validity of the Schizotypal Personality Questionnaire in a Greek sample: Tests of measurement invariance and latent mean differences. *Comprehensive Psychiatry*, *62*, 51-62. https://doi.org/10.1016/j.comppsych.2015.06.003

Verbeke, L., De Clercq, B., Van der Heijden, P., Hutsebaut, J., & Van Aken, M. (2017). The relevance of schizotypal traits for understanding interpersonal functioning in adolescents with psychiatric problems. *Personality Disorders: Theory, Research, and Treatment*, *8*(1), 54-63. https://doi.org/10.1037/per0000163

Vermeiden, M., Janssens, M., Thewissen, V., Akinsola, E., Peeters, S., Reijnders, J., Jacobs, N., Van Os, J., & Lataster, J. (2019). Cultural differences in positive psychotic experiences assessed with the Community Assessment of Psychic Experiences-42 (CAPE-42): A comparison of student populations in the Netherlands, Nigeria and Norway. *BMC Psychiatry*, *19*(1), 244. https://doi.org/10.1186/s12888-019-2210-8

Walter, E., Fernández, F., Snelling, M., & Barkus, E. (2016). Genetic consideration of schizotypal traits: A review. *Frontiers in Psychology*, *7*(1769), 1-19. https://doi.org/10.3389/fpsyg.2016.01769

Watson, D., Clark, L. A., & Tellegen, A. (1998). Development and validation of brief measures of Positive and Negative Affect: The PANAS Scales. *Journal of Personality and Social Psychology, 54*, 1063-1070. https://doi.org/10.1037/0022-3514.54.6.1063

Wüsten, C., Schlier, B., Jaya, E., Fonseca-Pedrero, E., Peters, E., Verdoux, H., & Lincoln, T. (2018). Psychotic experiences and related distress: A cross-national comparison and network analysis based on 7,141 participants from 13 countries. *Schizophrenia Bulletin*, *44*(6), 1185-1194. https://doi.org/10.1093/schbul/sby087

Wuthrich, V., & Bates, T. (2006). Confirmatory factor analysis of the three-factor structure of the schizotypal personality questionnaire and Chapman schizotypy scales. *Journal of Personality Assessment*, *87*(3), 292-304. https://doi.org/10.1207/s15327752jpa8703_10

Yu, J., Bernardo, A., & Zaroff, C. (2016). Chinese version of the Schizotypal Personality Questionnaire: Factor structure replication and invariance across sex. *Asia-Pacific Psychiatry*, *8*(3), 226-237. https://doi.org/10.1111/appy.12215

Zhang, L., & Brenner, C. (2017). The factor structure of the Schizotypal Personality Questionnaire in undergraduate and community samples. *Journal of Personality Disorders*, *31*(1), 1-15. https://doi.org/10.1521/pedi_2016_30_233