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An Examination of the Higher-Order Dimensionality and Psychometric Properties of a Romanian
Translation of the Schizotypal Personality Questionnaire (SPQ)

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Abstract

The Schizotypal Personality Questionnaire (SPQ) is a self-report measure of schizotypal personality traits, but the higher-order dimensionality of its scores continues to be debated. As a contribution to this debate, we examined the psychometric properties of a Romanian translation of the SPQ. A total of 711 university students (488 women, 223 men) from Romania completed a novel translation of the SPQ alongside measures of quality of life, self-esteem, and life satisfaction. Confirmatory factor analysis suggested that a 4-factor model of SPQ scores had better fit to the data than alternative models. The 4-factor model also demonstrated partial measurement invariance across sex, although sex differences on domain scores were negligible ($\eta_p^2 = 0.01-0.02$). Romanian SPQ scores evidenced adequate construct and concurrent validity *vis-à-vis* quality of life, satisfaction with life, and self-esteem. Our results provide support for a 4-factor conceptualisation of SPQ scores in a hitherto neglected linguistic group.

Keywords: Schizotypy; Romania; Confirmatory Factor Analysis; Schizotypal Personality Questionnaire; Quality of Life

1. Introduction

First coined by Rado (1953) and later extended into a highly influential pathogenetic model by Meehl (1962), schizotypy is today conceptualised as a heterogeneous personality factor that represents the phenotypic manifestation for schizophrenia-spectrum psychopathology and other psychotic disorders (Ettinger et al. 2018; Kwapil and Barrantes-Vidal 2015; Lenzenweger 2011). In this view, schizotypal features are considered to represent early, prodromal stages of schizophrenia-spectrum personality disorders and full psychosis (Debanné et al. 2015; Fonseca-Pedrero and Debanné 2017; Grant et al. 2018). For this reason, schizotypal instruments are important tools for both screening people who may be at risk for developing psychosis (Cicero et al. 2014; Moore et al. 2018) and assessing antecedents and concomitants of the schizophrenia spectrum in diverse populations (Kwapil and Barrantes-Vidal 2015; Raine 2006).

A variety of measures have been developed to assess the construct of schizotypy (for reviews, see Kwapil and Chun 2015; Mason 2015). These measures broadly contrast between personality and clinical approaches to the measurement of schizotypy. Originally stemming from the Eysenckian approach of broad personality dimensions, the personality approach attempts to identify a personality construct (Mason 2015) and measures tap phenomena that are theoretically relevant (e.g., lack of self-control; Oxford-Liverpool Inventory of Feelings and Experiences, Mason et al. 1995). The clinical approach, on the other hand attempts to assess symptom-like criteria and measures conceptualise either single-symptom constructs (e.g., magical ideation; Magical Ideation Scale; Eckblad and Chapman 1983) or broader multidimensional description (e.g., positive, negative, and disorganised dimensions; Multidimensional Schizotypy Scale; Kwapil et al. 2018).

The Schizotypal Personality Questionnaire (SPQ; Raine 1991) is an extensively used self-report tool for the assessment of schizotypal traits in both clinical and non-clinical

populations (Fonseca-Pedrero et al. 2014). The widespread use of the SPQ allows for large-scale cross-national sample comparisons (e.g., Fonseca-Pedrero et al. 2018) and is therefore a suitable measurement tool when stimulating research on schizotypy. The SPQ was originally designed by Raine (1991) to assess the multidimensional characteristics of schizotypal personality disorder in the third, revised edition of the *Diagnostic and Statistical Manual* (American Psychiatric Association 1987). The lower-order, 9-factor dimensionality of SPQ scores reliably maps the nine symptoms of schizotypal personality disorder (SPD), but its higher-order dimensionality has been the subject of some debate. Early research using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) provided support for a 3-dimensional higher-order model of SPQ scores (e.g., Reynolds et al. 2000; Rossi and Daneluzzo 2002), consisting of Cognitive-Perceptual, Disorganised, and Interpersonal domains.

However, the findings of more recent CFAs have suggested that this 3-dimensional model achieves less-than-adequate fit (e.g., Cicero 2015; Compton et al. 2009; Fonseca-Pedrero and Debane 2017; Fonseca-Pedrero et al. 2014, 2018). As a result, various alternative higher-order models have been proposed in the literature. These include alternative 3-dimensional models (e.g., Preti et al. 2015; Wuthrich and Bates 2006) and 4-dimensional models (e.g., Compton et al. 2009; Stefanis et al. 2004) consisting of Cognitive-Perceptual, Paranoid, Negative, and Disorganised domains. In the past decade, the latter has emerged as the most prominent model of SPQ higher-order dimensionality (see Cicero 2005; Compton et al. 2009; Gross 2014). In North American samples, for example, Stefanis and colleague's (2004) 4-dimensional model had superior fit over all alternative higher-order models that were tested for CFA fit (Compton et al. 2009), irrespective of specific model pathways that were tested.

In contrast, there remains some debate about the higher-order dimensionality of SPQ scores outside predominantly English-speaking, North American populations. Studies that have been conducted in non-English populations generally indicate that both Stefanis et al.'s (2004) 4-dimensional model and Raine et al.'s (1994) 3-dimensional model both achieve adequate fit, with the former usually – though not always (see Badoud et al. 2010) – showing superior CFA fit (e.g., Barron et al. 2014, 2018a, 2018b; Cicero 2015; Mechri et al. 2010). Indeed, in the largest cross-cultural study to date, Fonseca-Pedrero and colleagues (2018) examined the higher-order dimensionality of SPQ scores in 27,001 participants from 12 countries and found that both the original 3- and 4-dimensional models achieved adequate fit. Of the two models, however, the latter had relatively better fit indices, which allowed the authors to conclude that a 4-dimensional model of higher-order SPQ scores may be superior to alternative models cross-nationally (Fonseca-Pedrero et al. 2018).

Beyond the higher-order dimensionality of its scores in disparate cultural and linguistic groups, studies in different populations have supported the sex invariance of SPQ scores when operationalised in terms of both the 3-dimensional (e.g., Badcock and Dragović 2006) and 4-dimensional models (e.g., Barron et al. 2018b; Tsaousis et al. 2015). This, in turn, has allowed for assessments of sex differences on latent scores, with studies generally showing that men have significantly higher scores than women on the Negative and Disorganised domains (e.g., Fossati et al. 2003; Raine 1992). In contrast, sex differences on the positive dimension – or Cognitive-Perceptual and Paranoid dimensions – are mixed, with some studies reporting that women have significantly higher scores (e.g., Fossati et al. 2003) and others reporting no significant sex differences (e.g., Miller and Burns 1995). These equivocal findings may reflect the fact that reported sex differences tend to be negligible-to-small and that sex may intersect in complex ways with cultural or linguistic backgrounds to influence schizotypal outcomes (Barron et al. 2018a).

Finally, studies also support the broader psychometric properties of SPQ scores through significant associations with clinical, functional, and cognitive correlates of psychosis (e.g., Cohen et al. 2012; Rabella et al. 2018). SPQ scores are also reliably associated with self-reported quality of life (e.g., Brosey and Woodward 2015; Cohen and Davis 2009; Ritsner et al. 2005), with the Negative dimension accounting for most of the unique variance (Abbott and Byrne 2012; Cohen and Davis 2009). Other studies have reported that SPQ scores – particularly on the Negative dimension – are significantly associated with lower objective and subjective well-being (e.g., self-esteem, life satisfaction) (e.g., Abbott and Byrne 2012; Barrantes-Vidal et al. 2013). These associations both provide support for the construct validity of SPQ scores and suggest that diminished subjective well-being and quality of life are characteristic along the schizophrenia spectrum, even among individuals with subclinical manifestations of psychosis.

1.1 The Present Study

In the present study, we sought to contribute to the cross-national literature on the SPQ by examining the higher-order dimensionality and psychometric properties of a Romanian (*limba română* or ЛИМБА РОМЫНЭ in Moldovan Cyrillic) translation of the instrument. We suggest that doing so is important for several reasons. First, Romanian is spoken by about 24 million people as a first language, mainly in Romania and Moldova, as well as by several million more as a second language (European Commission 2012). The availability of a Romanian version of the SPQ would, therefore, provide a valuable tool for a relatively neglected linguistic group in which improved diagnostic and research instruments are urgently required (Sfetcu et al. 2011). To be sure, the SPQ does appear to have been used with a Romanian-speaking sample (Mihalca et al. 2011), although the translational procedures used by these authors (i.e., forward-translation alone) was likely deficient (for a

discussion, see Swami and Barron 2019). Moreover, only 6 of the 9 SPQ subscales were translated and the authors did not examine the higher-order dimensionality of SPQ scores.

To overcome these issues, we prepared a fresh translation of the SPQ in Romanian following best-practice translational guidelines to ensure semantic, item, and operational equivalence (Swami and Barron 2019). To examine measurement equivalence of SPQ scores, we tested the fit of proposed higher-order 3- and 4-dimensional models using CFA. These hypothesised models were selected based on the recent SPQ literature, which suggests that they are the most prominent in terms of explaining the higher-order dimensionality of SPQ scores across nations (Fonseca-Pedrero et al. 2018). Here, we hypothesised that the 4-dimensional model of Stefanis et al. (2004) would demonstrate the best fit among the models tested, which would be consistent with previous work (Fonseca-Pedrero et al. 2018). Further, we predicted that an alternative 4-dimensional model (Compton et al. 2009) would provide better fit than Raine et al.'s (1994) 3-dimensional solution, thus highlighting the benefit of the inclusion of the Paranoid factor in the higher order structure.

In addition to testing the higher-dimensionality of Romanian SPQ scores, we also tested for sex invariance at the configural (i.e., whether similar factors are measured), metric (i.e., whether the magnitude of factor loadings is the same), and scalar (i.e., whether the intercept of the regression relating each item to its factor is the same) levels (Chen 2007). Based on recent work in other linguistic contexts (e.g., Barron et al. 2018b; Tsaousis et al. 2015), we expected that SPQ scores would demonstrate full sex invariance. Assuming invariance would be achieved, we also hypothesised that men would have significantly higher scores than women on the negative and/or disorganised schizotypal domains. Finally, we also examined associations between SPQ scores and scores on measures of quality of life, self-esteem, and life satisfaction. Evidence of construct validity would be established to the extent that SPQ scores are significantly and negatively associated with scores on the additional

measures, whereas evidence of concurrent validity would be established insofar as SPQ scores significantly predict scores on the additional measures.

2. Method

2.1 Participants

A total of 711 participants (488 women, 223 men) were recruited on voluntary basis from among the student population at a university in Timiș County in the west of Romania. Participants ranged in age from 18 to 55 years ($M = 24.54$, $SD = 8.14$). The majority of participants identified as heterosexual (90.4%; bisexual = 3.0%, gay/lesbian = 1.7%, other = 4.9%). In terms of relationship status, 33.5% of participants were single, 27.2% were partnered but not married, 12.2% married, and the remainder were of some other status. In terms of educational level, 17.9% had completed secondary schooling, 56.4% were completing an undergraduate degree, 14.3% were completing a postgraduate degree, and the remainder had some other qualification. As for religious beliefs, 74.1% identified themselves as orthodox Christians, 11.4% as atheist or as having no religious beliefs, 5.3% as Protestant, 5.3% as Catholic, and 3.8% towards other religious identities.

2.2 Measures

Schizotypy. Participants were asked to complete the 74-item SPQ (Raine 1991) using a dichotomous response format (*yes/no*). The SPQ measures 9 schizotypal factors that align with SPD symptomatology, namely no close friends, constricted affect, ideas of reference, odd beliefs and magical thinking, unusual perceptual experiences, odd or eccentric behaviour, odd speech, suspiciousness, and excessive social anxiety. Each *yes* response counts as 1 point and subscale scores were computed as the total score for all items associated with each subscale. These subscales represent the primary, pseudo-continuous, data in our analytical models *vis-à-vis* schizotypy. The hypothesised higher-order models that were selected for testing – specifically, the higher order 3-factor solution (Raine et al. 1994), 4-factor structure

(Stefanis et al. 2009), and the nested alternative 4-factor model (excessive social anxiety loads only onto the Negative factor; Compton et al. 2009) – are displayed in Figure 1. The translational procedure and subscale internal consistency coefficients are reported below.

Self-esteem. Participants were also asked to complete the Rosenberg Self-Esteem Scale (RSES; Rosenberg 1965; Romanian translation: Schmitt and Allik 2005). This is a widely-used, 10-item measure of global self-evaluations of worth as a human being. All items were rated on a 4-point scale (1 = *definitely disagree*, 4 = *definitely agree*) and an overall score was computed as the mean of all 10 items, following reverse-coding of 5 items. Higher scores on this scale reflect greater self-esteem. The Romanian version of the RSES has a 1-dimensional factor structure (Schmitt and Allik 2005) and adequate patterns of convergent validity (e.g., Sava et al., 2011). In the present study, McDonald's ω for scores on this scale was .88 (95% CI = .86, .89).

Satisfaction with life. Participants completed the 5-item Satisfaction with Life Scale (SWLS; Diener et al. 1985; Romanian translation: Lambru et al. 2012), which taps global assessments of life satisfaction. Items on this scale were rated on a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*) and an overall score was computed at the mean of all 5 items. Higher scores on this scale reflect greater life satisfaction. Scores on the Romanian version of the scale have been shown to have a 1-dimensional factor structure and adequate convergent validity (Lambru et al. 2012). In the present study, McDonald's ω for SWLS scores was 0.88 (95% CI = 0.86, 0.89).

Quality of life. To measure quality of life, we used the 8-item EUROHIS-Quality of Life index (EUROHIS-QOL; Schmidt et al. 2006), which measures quality of life in the psychological, physical, social, and environmental domains. All items were rated on a 5-point scale (1 = *not at all*, 5 = *completely*) and an overall score was computed as the mean of all 8 items. Higher scores on this measure reflect better overall quality of life. The Romanian

version of the EUROHIS-QOL has been shown to have a 1-dimensional factor structure and adequate convergent and discriminant validity (Schmidt et al. 2006). In the present study, McDonald's ω for EUROHIS-QOL was 0.86 (95% CI = 0.83, 0.87).

Demographics. Participants provided their demographic details, consisting of sex, age, sexual orientation, relationship status, highest educational qualification, and religious beliefs.

2.3 Procedure

Once ethics approval for this project was obtained from the relevant university ethics committee, the study was advertised on campus locations between May and July 2018. Interested individuals were screened based on inclusion criteria (of the age of majority, citizens of Romania, and fluent in Romanian) and were provided with an information sheet that contained brief information about the project. Those who met inclusion criteria and agreed to participate in the study provided written informed consent. They then completed an anonymous paper-and-pencil questionnaire in a private cubicle. The questionnaire took approximately 20 minutes to complete and the order of presentation of the measures above was counter-balanced for each participant. All participation was voluntary and participants were not remunerated. Upon return of completed questionnaires, participants were provided with written debrief information.

2.4 Translation

A Romanian translation of the SPQ was prepared using a combination of the back-translation and committee approaches (Brislin 1970, 1976). First, a bilingual translator blindly forward-translated the SPQ items, instructions, and response categories from English to Romanian. A second bilingual translator then independently back-translated the SPQ from Romanian to English. The two versions of the SPQ were then compared for conceptual (i.e., measures the same constructs which retain the same meaning), item (i.e., individual items tap

the construct), semantic (i.e., the meaning of concepts tapped in the original measure are retained), and operational equivalence (i.e., characteristics of the instrument remains the same) (see Swami and Barron 2019). Where there were discrepancies, a third bilingual translator retranslated the items from English to Romanian. This process continued until all translators agreed that the two versions of the SPQ were identical in meaning. Separately, the second, fourth, and fifth authors – all of whom are bilingual – forward-translated the SPQ from English to Romanian. This version was compared to the final back-translated version described earlier and minor item-level discrepancies were resolved through consensus. The final version of the Romanian SPQ is available from the second author.

2.5 Analytic Strategy

Little (1988)'s Missing Completely at Random (MCAR) test showed the data were not missing completely at random, $\chi^2 = 3882.161$, $df = 3653$, $p = 0.004$. However as missing data only accounted for 0.5% of the data, individual missing data points was imputed using the mode replacement technique for categorical values (Acuna and Rodriguez 2004). The *Lavaan* package (Rosseel 2012) with *R* (R Development Core Team 2014) was used to conduct CFA, where the higher-order factor structure of SPQ scores was examined. Proactive Monte Carlo simulations (Marcoulides and Chin 2013) indicated that a sample size of 490 would be sufficient for this analysis, which was surpassed in our study. Shapiro-Wilk tests for normality were violated across all subscales in the present sample, with Mardia's multivariate coefficient for SPQ score skewness (1129.02) and kurtosis (11.08) also violated ($ps < 0.001$). For this reason, parameter estimates were obtained using the robust maximum likelihood method with the Satorra-Bentler correction (Satorra and Bentler 2001). To assess goodness-of-fit, we used the normed model chi-square (χ^2/df), with values < 3.0 considered indicative of good fit (Hu and Bentler 1999) and values up to 5.0 considered adequate (Wheaton et al. 1977). The Steiger-Lind root mean square error of approximation (RMSEA)

and its 90% confidence interval provide a correction for model complexity. RMSEA values approximating 0.06 demonstrate good fit, with values ranging to 0.10 revealing mediocre fit (Hu and Bentler 1999). The standardised root mean square residual (SRMR) and the weighted root mean square residual (WRMR) assesses the mean absolute correlation residual and is a badness-of fit index: the smaller the values, the better the model fit. A cut-off value for SRMR indicating a reasonable fit is recommended to be < 0.09 and < 0.08 for WRMR (Brown 2015; Hu and Bentler 1999). The comparative fit index (CFI) measures the proportionate improvement in fit by comparing a target model with a more restricted, nested baseline model. The CFI reflects a goodness-of-fit index and is recommended to be close to or > 0.95 for adequate fit (Hu and Bentler 1999). The Tucker-Lewis index (TLI) is indicative of a level of relative fit, with values close to or > 0.95 for good fit (Hu and Bentler 1999). Bollen's Incremental Fit Index (BL89) was also used with values close to or > 0.95 signifying an acceptable fit (Hu and Bentler 1999). The Akaike information criterion (AIC) and Bayesian information criterion (BIC) was used to compare non-hierarchical factor structures, with preference given to the lowest values.

To determine if the best-fitting model was invariant across sex, measurement invariance was tested using multi-group CFA (Chen 2007). Configural invariance implies that the latent SPQ variables and the pattern of loadings of the latent variable on indicators are similar across sex. Metric invariance implies that the magnitude of the loadings is similar across groups and is tested by comparing two nested models consisting of a baseline model and an invariance model. Because the $\Delta\chi^2$ statistic is overly stringent to determine criterion invariance (Meade et al. 2008), we used $\Delta CFI \geq -0.01$ as an indicator of metric invariance (Cheung and Rensvold 2002; Meade et al. 2008). Finally, scalar invariance implies that both the item loadings and item intercepts are similar across groups and is examined using the same nested-model comparison strategy as with metric invariance (Chen 2007). For scalar

invariance, Chen (2007) suggested that invariance is supported when $\Delta CFI \geq -0.01$ and $\Delta RMSEA < 0.015$ or $\Delta SRMR < 0.03$, although other scholars suggest that $\Delta CFI \geq -0.01$ is sufficient (Cheung and Rensvold 2002). Bivariate associations were considered for the higher-order domains of the best fitting SPQ model and self-esteem, satisfaction with life, and quality of life indices. Finally, concurrent validity was assessed through separate multiple linear regressions with self-esteem, satisfaction with life, and quality of life, respectively, as the criterion variables.

3. Results

Table 1 shows descriptive statistics and internal consistency coefficients (McDonald's ω and its 95% CI) for the 9 subscales of the SPQ (range = 0.68 - 0.84, mean = 0.75). Table 2 shows the fit indices for the models that were tested (i.e., the 3-factor model, 4-factor model, and alternative 4-factor structure). Indices for the 3-factor model (Raine et al. 1994) were found to be below levels of acceptability and had poor fit for our data. The inclusion of the Paranoid factor for the 4-factor model and alternative 4-factor structure improved fit for our data. While the fit indices for the alternative 4-factor structure (Compton et al 2009) were found to be adequate, when using indices of comparison (AIC and BIC) and overall fit indices, the 4-factor model (Stefanis et al. 2004) was deemed have the best fit for the present data (see Figure 2 for model parameters).

3.1 Multi-Group Invariance

We then analysed measurement invariance across sex for the 4-factor model (see Table 3). While configural and metric invariance were achieved, differences between ΔCFI and $\Delta RMSEA$ were above acceptable levels at the scalar level. Therefore, univariate test scores were examined to relax constraints within the model. Excessive Social Anxiety ($\chi^2 = 50.689$, $df = 1$, $p < 0.001$) and Odd or Eccentric Behaviour ($\chi^2 = 28.569$, $df = 1$, $p < 0.001$) were found to have the greatest difference between subsamples for sex. When these

constraints were relaxed, fit indices were found to be acceptable at the partial scalar level. Therefore, support for partial invariance across sex was shown, which allows for latent mean comparisons.

3.2 Between-Group Differences

We examined sex differences in domain scores for the 4-factor model. A multivariate analysis of variance (MANOVA) was conducted, with the 4 factor scores entered as dependent variables and sex as the independent variable. As Box's M test was significant ($p < 0.001$), Pillai's trace criterion was used for interpretation of the MANOVA (Tabachnick and Fidell, 2013). Results indicated a significant omnibus MANOVA result, $F(4, 706) = 19.91, p < 0.001$, Pillai's trace = 0.10, $\eta_p^2 = 0.10$. On the Disorganised factor, men reported significantly higher scores ($M = 4.67, SD = 4.07$) than women ($M = 3.76, SD = 3.21$), $F(1, 709) = 10.44, p < 0.001, \eta_p^2 = 0.02$. For the Paranoid factor, women reported significantly higher scores ($M = 9.30, SD = 5.62$) than men ($M = 7.47, SD = 5.11$), $F(1, 709) = 17.27, p < 0.001, \eta_p^2 = 0.02$. For the Cognitive-Perceptual factor, women reported significantly higher scores ($M = 3.33, SD = 3.18$) than men ($M = 2.80, SD = 3.17$), $F(1, 709) = 4.32, p < 0.001, \eta_p^2 = 0.01$. There was no significant sex difference on scores of the Negative factor (women $M = 9.71, SD = .30$; men $M = 9.45, SD = 0.44$), $F(1, 709) = 0.24, p = 0.63, \eta_p^2 < 0.001$.

3.3 Construct and Concurrent Validity

Bivariate correlations between the 4 domains of the SPQ and measures of quality of life, satisfaction with life, and self-esteem are reported in Table 4. As can be seen, all SPQ factors were significantly and negatively correlated with all additional measures, which is supportive of construct validity. To examine the predictive power of schizotypy, we computed three separate multiple linear regressions with the 4 SPQ domain scores entered as predictors. As the MANOVA results indicated significant differences between women and men across most of the higher-order factors, sex was entered in the first step of the multiple

regression analyses. In the first regression with quality of life as the criterion variable, we found a significant result in the second step of the regression, $F(5, 707) = 40.93, p < 0.001$, $\text{Adj. } R^2 = 0.22$. As reported in Table 5, the Negative domain emerged as the strongest predictor, with Paranoid and Disorganised scores also significant predictors. In the second regression with satisfaction with life, the second step of the regression was again significant, $F(5, 707) = 31.84, p < 0.001$, $\text{Adj. } R^2 = 0.18$. The Negative domain emerged as the strongest predictor, with Paranoid the only other significant predictor (see Table 5). Finally, the second step of the regression with self-esteem was also significant, $F(5, 707) = 48.39, p < 0.001$, $\text{Adj. } R^2 = 0.25$, with the Negative domain as the strongest predictor and the Paranoid domain being the only other significant predictor (see Table 5).

4. Discussion

Previous studies assessing the dimensionality of SPQ scores point to a lack of consensus as to its higher-order structure, with early work (e.g., Reynolds et al. 2000) supporting Raine and colleague's (1994) 3-dimensional model and more recent work – particularly outside English-speaking, North American populations – supporting 4-factor models (e.g., Fonseca-Pedrero et al. 2018). Here, we tested the higher-order dimensionality of scores on a fresh translation of the SPQ in Romanian-speaking adults. Our results showed that the 4-factor model proposed by Stefanis and colleagues (2004) had the best fit to the data, although it should be noted that adequate fit was also obtained for the hierarchically-related 4-factor model (Compton et al. 2009). Conversely, Raine and colleague's (1994) 3-factor model showed less-than-adequate fit. Taken together, the present results suggest that the inclusion of a higher-order Paranoid factor improves fit of Romanian SPQ scores, which is consistent with previous investigations in distinct national settings (e.g., Barron et al. 2018a, 2018b; Compton et al. 2009; Rabella et al. 2018).

The main implication of the present findings *vis-à-vis* the higher-order factor structure of Romanian SPQ scores is that 4-dimensional models – particularly the 4-factor model introduced by Stefanis and colleagues (2004) – presents greater factorial validity than the more commonly-used 3-factor model conceptualised by Raine and colleagues (1994). This is particularly important in the Romanian context, where use of the SPQ is marked by analytic deficiencies. More precisely, Mihalca and colleagues (2011) translated 6 of the 9 SPQ subscales into Romanian and reported that, based on the results of principal-components analysis (PCA) with adolescents and young adults, scores reduced to 4 factors (Oddness of Behaviour and Speech, Perception Disorders, Constricted and Suspicious Communication, and Ideas of Reference and Suspiciousness). Even setting aside conceptual concerns (e.g., that only 6 SPQ subscales were included, the use of PCA rather than EFA, sole use of forward-translation) in Mihalca et al. (2011), our results suggest that it is possible to conceptualise Romanian SPQ scores as consisting of 4 higher-order dimensions. Of course, one might argue that this 4-factor higher-order dimensionality masks lower-order dimensional ambiguity, which would be useful for future studies to investigate using larger samples.

Our results also showed that measurement invariance was not fully supported across participant sex; rather, based on the 4-factor model, we found evidence of partial scalar invariance across sex. The non-equivalence in scoring for sex was primarily found on the Cognitive Perceptual domain, particularly through the Odd or Eccentric Behaviour factor. Further, non-equivalence was also highlighted on the Negative domain, with Excessive Social Anxiety. Similar non-equivalence concerns have been found in previous investigations (e.g., Barron et al. 2018b) and suggests particular adaptational problems with these lower-order factors. Therefore, any between group differences should be interpreted with caution for scores on these domains. Nevertheless, based on between-group analyses, we found that

men scored significantly higher than women on the Disorganised domain, which is consistent with previous work (e.g., Raine 1992). Conversely, we found that women had significantly higher scores on the Paranoid and Cognitive-Perceptual dimensions and that there was no significant sex difference on the Negative domain. It is important to note, however, that the effect sizes of the significant differences were very small and probably negligible in real-world terms.

Beyond issues of factorial validity and sex invariance, the results of the present study also provide evidence of construct validity, insofar as scores on the 4 SPQ dimensions were significantly and negatively associated with quality of life, self-esteem, and satisfaction with life. This follows previous research which has indicated moderate-to-large negative correlations between schizotypy and these self-reported measures (e.g., Brosey and Woodward 2015; Cohen and Davis 2009). In terms of concurrent validity, while SPQ scores significantly predicted all additional measures in the present sample, the Negative dimension of schizotypy appeared to account for most of the unique variance in quality of life, self-esteem, and satisfaction with life. This is similar to the findings of studies in other linguistic and cultural groups (Abbott and Byrne 2012; Cohen and Davis 2009), and may suggest that diminished subjective well-being and quality of life are characteristic along the schizophrenia spectrum, particularly for individuals who score highly on the Negative domain. For example, it has been suggested that individuals who lack social contact or who are deeply suspicious of others – characteristics of high Negative scores – will be unhappy about multiple dimensions of their lives, which affects self-reported quality of life and subjective well-being (Abbott and Byrne 2012).

There are a number of limitations of the present work, which should be considered. First, we did not include a measure of urbanicity and thus were unable to assess the impact of this variable on SPQ scores. Indeed, in studies of European adults (e.g., van Os et al. 2001

2002), it has been suggested that urbanicity is associated with increased risk of expression of non-clinical psychosis. Thus, it will be useful to include a measure of urbanicity in future studies of the SPQ with Romanian-speaking populations, particularly as Romania is one of the least urbanised nations in Europe, with 43.6% of the population living in rural areas (Ichim et al. 2016). A further limitation of the present study was the lack of additional measures to assess the construct validity of SPQ scores, though we were careful to select instruments that have evidence of adequate psychometric properties in the Romanian context. Similarly, we did not include any measure to determine the extent to which participants responded randomly, pseudo-randomly, or dishonestly. Including appropriate measures (e.g., the Oviedo Infrequency Scale; Fonseca-Pedrero et al. 2008) would be useful in future research.

Further, as the data in the present study were based on self-reports, they are susceptible to false-positive ratings (see van Os et al. 2001). Nevertheless, false positive ratings in self-assessment measures does not necessarily attenuate the risk for psychosis. Finally, generalisability of the findings may be limited as these data report on healthy, high-functioning students. While the use of this sample is practical and relevant for non-pathological schizotypy, this population is regarded as conservative; that is, they are more likely to have milder traits and protective factors given their ability to participate in higher education (Kwapil and Barrantes-Vidal 2015). Indeed, to understand the expression of schizotypy across the continuum, it is important to assess it in a broader community sample that includes pathological schizotypy and to examine the performance of scales that were developed using college students on such samples (Chan et al. 2019; Kwapil and Barrantes-Vidal 2015).

In summary, the findings from the present study suggest that the inclusion of the Paranoid domain to the 3-factor solution – as suggested by Stefanis et al. (2004) – should be

endorsed in future applications of the Romanian SPQ. By extension, this study adds to the growing literature that scores on the SPQ are suited to a 4-factor solution with the additional Paranoid domain included. Future work needs to consider a larger comparison group and to also consider the dimensionality of the SPQ in Romania at the level of items rather than higher-order factors; that is, confirming the nine lower-order subscales. Notwithstanding the limitations and future directions of this measure, we recommend that scholars intending to use the SPQ in Romania consider scoring the instrument based on the 4-factor higher-order dimensionality. We expect that the Romanian SPQ will become an important tool for scholars wishing to conduct schizotypy-related research in Romanian-speaking populations. It is hoped that scholars will continue to advance this measurement tool in Romania, allowing for it to be used in community studies and in parallel with endophenotypes for the early detection of schizophrenia.

Compliance with Ethical Standards

- There are no conflicts of interest. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
- All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.
- Informed consent was obtained from all individual participants included in the study.

Data Availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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Table 1. *Inter-Scale Correlations, Descriptive Statistics, Internal Consistencies and Normality for the 9 Schizotypal Personality Questionnaire (SPQ) Subscales in the Present Study (n = 711).*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Ideas of Reference		0.32	0.48	0.56	0.26	0.25	0.44	0.27	0.61
(2) Excessive Social Anxiety			0.10	0.24	0.25	0.58	0.45	0.50	0.37
(3) Odd Beliefs or Magical Thinking				0.56	0.25	0.18	0.28	0.15	0.34
(4) Unusual Perceptual Experiences					0.39	0.31	0.52	0.29	0.47
(5) Odd or Eccentric Behaviour						0.37	0.50	0.40	0.31
(6) No Close Friends							0.43	0.67	0.39
(7) Odd Speech								0.50	0.46
(8) Constricted Affect									0.36
(9) Suspiciousness									
<i>M</i>	3.08	2.69	1.50	1.67	1.24	2.19	2.80	1.80	2.96
<i>SD</i>	2.43	2.41	1.74	1.87	1.82	2.03	2.25	1.77	2.19
Shapiro-Wilk Univariate Normality	0.93	0.89	0.82	0.83	0.72	0.89	0.93	0.87	0.94
ω	0.77	0.82	0.73	0.73	0.84	0.70	0.75	0.68	0.73
95% Confidence Interval	0.74-0.79	0.80-.084	0.69-0.76	0.69-0.76	0.81-0.86	0.67-0.74	0.72-.078	0.63-0.72	0.70-0.76

Note. All $ps < 0.001$

Table 2. *Fit Indices for Each of the Hypothesised Models in the Present Study.*

	$SB\chi^2$	$SB\chi^2_M$	df	Robust RMSEA (90% CI)	Robust CFI	Robust TLI	SRMR	WRMR	BL89	AIC	BIC
3-factor model	160.254	6.933	23	0.098 (0.084-0.113)	0.938	0.903	0.040	1.842	0.934	24952.131	25093.698
4-factor model	89.034	4.692	19	0.077 (0.061-0.094)	0.968	0.940	0.030	1.377	0.966	24879.270	25039.104
Alt 4-factor model	98.184	4.899	20	0.079 (0.064-0.095)	0.965	0.936	0.031	1.44	0.962	24887.117	25042.384

Note: 3-factor model (Raine, 1994); 4-factor model (Stefanis et al., 2004); Alt 4-factor Model (Compton et al., 2009). $SB\chi^2$ = Satorra-Bentler corrected chi-square, $SB\chi^2_M$ = Satorra-Bentler corrected chi-square / df ratio, df = degrees of freedom, robust RMSEA = Satorra-Bentler corrected Steiger-Lind root mean square error of approximation, robust CFI = Satorra-Bentler corrected comparative fit index, robust TLI = Satorra-Bentler corrected Tucker-Lewis index, SRMR = standardised root mean square residual, WRMR = weighted root mean square residual, BL89 = Bollen's incremental fit index, AIC = Akaike information criteria, BIC = Bayesian information criteria

Table 3. *Measurement Invariance Across Sex for the Best-Fitting 4-Factor model.*

Model	χ^2	df	CFI	RMSEA	SRMR	Model Comparison	$\Delta \chi^2$	ΔCFI	$\Delta RMSEA$	Δdf	p	PGFI
Configural	103.987	38	0.974	0.070	0.030							0.345
Metric	131.046	45	0.967	0.073	0.046	Configural vs. Metric	27.059	0.007	0.003	7	< 0.001	0.407
Scalar	231.099	50	0.930	0.101	0.059	Metric vs. Scalar	100.053	0.037	0.028	5	< 0.001	0.443
Partial Scalar	146.900	48	0.962	0.076	0.047	Metric vs. Partial Scalar	15.854	0.005	0.003	3	< 0.001	0.433

Note. χ^2 = chi-square, df = degrees of freedom, CFI = comparative fit index, RMSEA = Steiger-Lind root mean square error of approximation, SRMR = standardised root mean square residual, PGFI = parsimonious goodness of fit index

Table 4. *Correlation Matrix for the Schizotypal Personality Questionnaire Domains, Quality of Life, Self-Esteem, and Satisfaction with Life in the Present Study.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) SPQ – Disorganised		0.48	0.54	0.59	-0.32	-0.32	-0.27
(2) SPQ – Cognitive Perceptual			0.53	0.38	-0.13	-0.13	-0.07
(3) SPQ – Paranoid				0.83	-0.32	-0.35	-0.24
(4) SPQ – Negative					-0.45	-0.49	-0.39
(5) EUROHIS-QoL						0.60	0.76
(6) RSES							0.57
(7) SWLS							
<i>M</i>	4.05	3.16	8.73	9.62	31.34	32.86	26.01
<i>SD</i>	3.53	3.19	5.53	6.54	5.16	5.58	5.67
Omega alpha	0.65	0.72	0.71	0.78	0.86	0.88	0.88

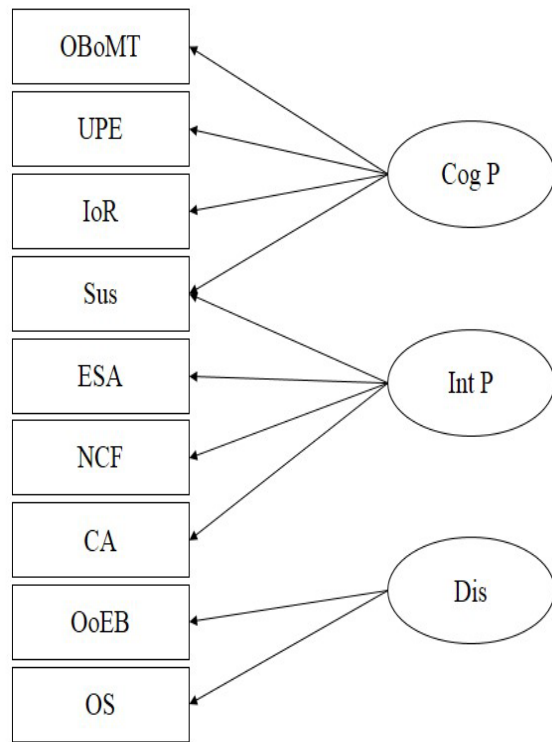
Note. SPQ = Schizotypal Personality Questionnaire, EUROHIS-QoL = quality of life, RSES = self-esteem, and

SWLS = satisfaction with life. All $ps < 0.001$.

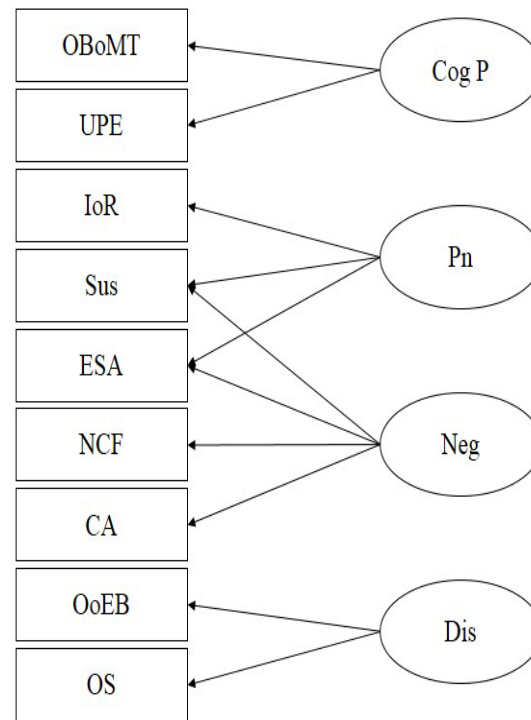
Table 5. *Standardised and Unstandardised Regression Coefficients for the Sex Covariated Regressions with Quality of Life, Satisfaction with Life, and Self-Esteem as Criterion variables.*

Predictor	EUROHIS-QoL				SWLS				RSES				VIF
	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>B</i>	<i>SE</i>	β	<i>t</i>	
Sex	0.98	0.42	0.09	2.37**	1.62	0.45	0.13	3.57**	0.31	0.45	0.03	0.70	-
Cognitive	0.05	0.07	0.03	0.80	0.11	0.08	0.06	1.50	0.07	0.07	0.04	1.01	1.58
Perceptual													
Paranoid	0.13	0.06	0.14	2.11*	0.18	0.07	0.17	2.48*	0.17	0.07	0.17	2.59*	4.16
Negative	-0.42	0.05	-0.53	-8.23**	-0.43	0.06	-0.50	-	-	0.05	-	-	3.82
								7.54**	0.52		0.61	9.61**	
Disorganised	-0.13	0.07	-0.09	-1.97*	-0.14	0.07	-0.09	-1.95	-	0.07	-	-1.54	1.82
									0.11		0.07		

Note. EUROHIS-QoL = quality of life, SWLS = satisfaction with life, and RSES = self-esteem. * $p \leq 0.05$, ** $p \leq 0.001$



3-factor model (Raine et al. 1994).



4-factor model (Stefanis et al. 2004)

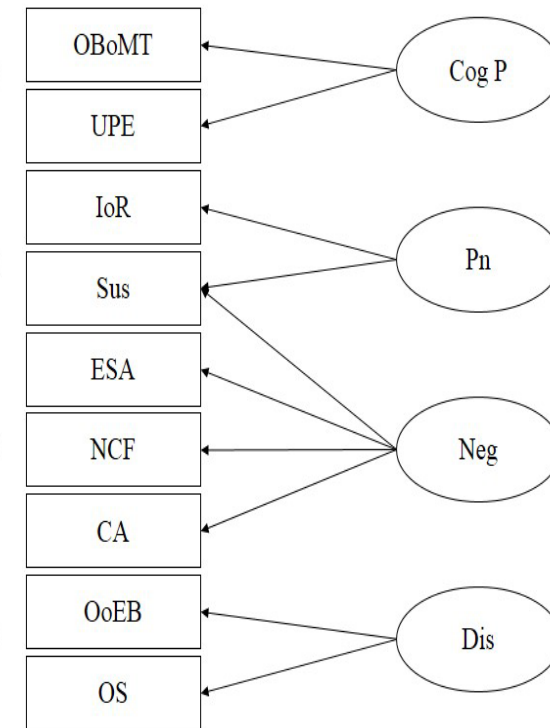
Alt 4-factor (Compton et al. 2009).
Only Sus loads on both the paranoid and negative factors.

Figure 1. The measurement models under examination. High-order factors: Cog P = Cognitive-Perceptual, Pn = Paranoid, Neg = Negative, Dis = Disorganised, Int P = Interpersonal. Lower-order subscales: OBoMT = odd beliefs or magical thinking, UPE = unusual perceptual experiences, IoR = ideas of reference, Sus = suspiciousness, ESA = excessive social anxiety, NCF = no close friends, CA = constricted affect, OoEB = odd or eccentric behaviour, OS = odd speech

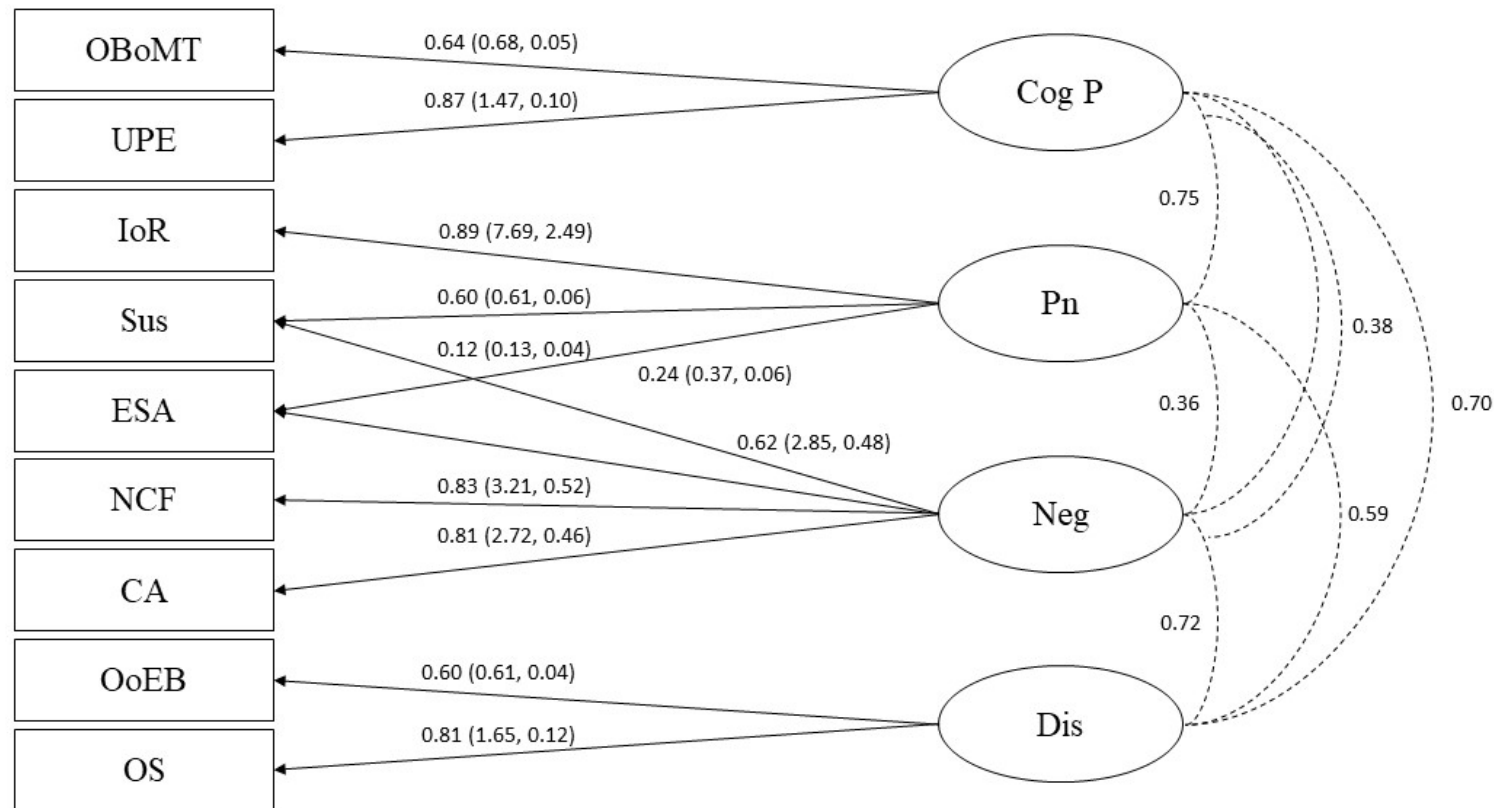


Figure 2. Standardised estimates (unstandardised estimates, standard errors) and latent correlations for the best fitting factor structure (4-factor, Stefanis et al. 2004). Note, dotted line indicates latent correlation; High-order factors: Cog P = Cognitive-Perceptual, Pn = Paranoid, Neg = Negative, Dis = Disorganised, Int P = Interpersonal; Lower-order subscales: OBoMT = odd beliefs or magical thinking, UPE = unusual perceptual experiences, IoR = ideas of reference, Sus = suspiciousness, ESA = excessive social anxiety, NCF = no close friends, CA = constricted affect, OoEB = odd or eccentric behaviour, OS = odd speech

