

Confirmatory Factor Analysis of Schizotypal Personality Traits in University Students

Emre BORA¹, Leyla Baysan ARABACI²

Abstract

Objective: Investigating the factor structure of schizotypal traits in normal population is important to describe the clinical phenotypes associated with susceptibility to schizophrenia. Schizotypal Personality Questionnaire (SPQ) is a commonly used self-rated measure to assess schizotypal traits. While Raine's three-factorial model is most commonly supported model explaining factor structure of schizotypal traits, there is also evidence supporting alternative models. The aim of this study is compare the goodness-of-fit of various models about factor structure of the SPQ in a substantial number of university students.

Method: 1059 university students were participated in the study. Alternative models regarding factor structure of the SPQ were compared with confirmatory factor analysis (CFA). The effect of gender on the factor structure of schizotypal traits is also studied.

Results: The 4 factorial model that included cognitive-perceptual, paranoid, interpersonal and disorganized dimensions fit the data the best. Raine's three factorial model did not fit the data adequately. However, after minor modifications, Raine's model also had a satisfactory goodness-of-fit. Gender had no effect on the factor structure of the SPQ.

Conclusion: Results of these study supported 4-factorial model of Stefanis and modified version of Raine's model to explain factor structure of schizotypal traits. The structure of schizotypal traits is in parallel with structure of symptom dimensions in schizophrenia. This outcome is compatible with the views seeing schizotypal traits in general population in continuum with schizophrenia spectrum disorders.

INTRODUCTION

In contemporary practice schizophrenia and other psychotic disorders are diagnosed according to such categorical classification systems as DSM-IV and ICD-10. In recent years there has been increased emphasis on the use of dimensional systems to obtain a better understanding of mental illnesses. According to the dimensional approaches, clinical symptoms of patients with schizophrenia are extensions of subclinical features observed in the general population (Verdoux and Van Os, 2002). The schizotypy concept has been used to describe personality features and subclinical signs associated with susceptibility to schizophrenia (Meehl, 1962). Defining phenotypes that are related to susceptibility to schizophrenia

is essential for understanding the etiology of psychotic disorders, as these phenotypes might be related to illness-associated genetic, neurobiological, and environmental factors. To date, various psychometric scales based on several different approaches have been developed to assess schizotypic features in non-clinical populations. One of these approaches is related to Meehl's theory (Meehl, 1962) and Chapman developed several scales, such as magical ideation and social anhedonia, based on this theory (Chapman et al., 1982). Another approach more commonly used is to assess schizotypal personality disorder (SPD)-like characteristics in the general population. One of the most commonly used scales based on the SPD approach is the Schizotypal Personality Question-

Received: 18.07.2008 - Accepted: 02.12.2008

¹Uzm., MNC, Melbourne. ²Hemşire., Ege Ü Hemşirelik Yüksekokulu, Psikiyatri Hemşireliği, İzmir.
Emre Bora MD., e-mail: emrebora@hotmail.com

TABLE 1. Alternative models used to explain the factor structure of schizotypal personality features in the normal population.

	Refer	Social anxiety	Odd belief	Unusual percept	Odd behav	Close friend	Odd speech	Affect	Paranoia
Siever et al. 2 factors	P	N	P	P	P	N	P	N	P
Kendler et al. 2 factors	P	P, N	P	P	P, N	N	P	N	P, N
Battaglia et al. 3 factors	P	N	P	P	G	N	O	O	P
Bergmann et al. 3 factors (paranoia)	Par	Par	P	P	N	N	N	N	Par
Raine et al. 3 factor	P	N	P	P	D	N	D	N	P, N
Stefanis et al. 4 factor	Par	Par, N	P	P	D	N	D	N	Par, N

P: Positive (cognitive-perceptual); N: negative (interpersonal); Par: paranoid; D: disorganization; O: odd; Refer: reference; Unusual percept.: unusual perceptual experiences; Odd behav: odd behavior; Close friend: no close friends; Affect: constricted affect.

naire (SPQ). The SPQ was developed to assess DSM-IV SPD criteria (Raine, 1991).

Questions, however, remain concerning the factor structure of schizotypal personality features. If schizotypal personality features observed in the general population are extensions of the schizophrenia spectrum, schizophrenia and schizotypal personality features should have a similar factor structure. Generally, schizophrenia and SPD symptoms are accepted as clustered on 3 factors (positive and negative symptoms, and disorganization). Various studies suggest that schizotypal features are also clustered on 3 factors in the general population (Gruzelier et al., 1996; Chen et al., 1997; Reynolds et al., 2000). In most instances, these studies support Raine's 3-factor model (Raine et al., 1994). This model suggests a very similar structure to the 3-dimensional model of schizophrenia (cognitive-perceptual, interpersonal, and

disorganization). While few studies support a 2-factorial structure (Kendler et al., 1991), others suggest alternative 3-factor structures (Bergmann et al., 1996; Battaglia et al., 1997). Bergmann's model (1996) of cognitive-perceptual, interpersonal, and paranoid dimensions is the most well known among these alternative 3-factor models. Stefanis et al. (2004) suggest a model with 4 factors (cognitive-perceptual, paranoid, interpersonal, and disorganization). Wutrich and Bates (2006) support Stefanis et al.'s model, not Raine's model; however, the same study showed that some alterations to Raine's original model could improve its goodness of fit. Alternative models of the factor structure of schizotypal personality characteristics are summarized in Table 1.

Studies that have examined the factor structure of SPQ used both exploratory (EFA) and confirmatory factor analysis (CFA). EFA is, generally, very important in

TABLE 2. The effect of sex on schizotypal personality features.

	Female		Male		t	P
	Mean	SD	Mean	SD		
SPQ	26.07	12.45	28.28	12.74	2.82	0.005
Reference	3.80	2.31	3.65	2.16	1.07	0.28
Social anxiety	4.16	2.50	3.84	2.35	2.13	0.03
Odd beliefs	2.70	1.75	2.26	1.87	3.97	< 0.001
Unusual perceptual experiences	3.14	2.19	3.31	2.27	1.23	0.22
Odd behaviour	1.59	2.03	2.45	2.19	6.46	< 0.001
No close friends	2.98	2.13	3.60	2.19	4.65	< 0.001
Odd speech	2.75	2.24	3.28	2.39	3.65	< 0.001
Constricted affect	2.12	1.82	2.76	1.95	5.47	< 0.001
Paranoia	2.83	2.03	3.12	1.98	2.39	0.02

TABLE 3. CFA of alternative models of the factor structure of schizotypal personality characteristics.

Model	χ^2	df	AIC	CFI	RMSEA	RMSEA 90% CI
Single factor	1283	27	1319	0.77	0.21	0.20-0.22
Siever et al. 2-factor	539	26	576.83	0.91	0.135	0.13-0.14
Kendler et al. 2-factor	222.55	22	274.85	0.96	0.093	0.082-0.104
Battaglia et al. 3-factor	728.33	24	770.33	0.87	0.164	0.15-0.17
Bergmann et al. 3-factor (paranoia)	792.17	24	1066.05	0.86	0.20	0.19-0.21
Raine et al. 3-factor	215.58	23	274.56	0.96	0.089	0.081-0.101
-female	124.36	23	168.36	0.97	0.084	0.070-0.099
-male	98.49	23	142.49	0.97	0.087	0.069-0.10
Stefanis et al. 4-factor	131.79	19	183.79	0.98	0.075	0.065-0.089
-female	62.11	19	134.11	0.98	0.073	0.057-0.090
-male	51.05	19	103.05	0.99	0.062	0.042-0.083
Modified Raine	80.69	20	130.69	0.99	0.054	0.042-0.066

the early phases questionnaire development. CFA is another method that is important in later phases of psychometric instrument development. CFA is used to test different models suggested in earlier studies. With CFA alternative models are chosen prior to analysis and then goodness of fit for these models are compared. The chi-square test is commonly used for this purpose; however, the test is limited because it is nearly always significant for large populations. Therefore, other fitness indexes are also used to test the models. Another commonly used index is the root mean square of approximation (RMSEA). While RMSEA values < 0.05 indicate very good goodness of fit, RMSEA values > 0.1 are a sign of poor goodness of fit. For many authors RMSEA values between 0.05 and 0.08 are acceptable for a sufficient goodness of fit (Hu and Bentler, 1999; Schmelleh-Engel et al., 2003). Akaike Information Criteria (AIC) is another measure of goodness of fit and smaller AIC values are a sign of improved goodness of fit (Akaike, 1987). The Comparative Fit Index (CFI), Goodness of Fit Index (GFI), and Tucker Lewis Index (TLI) are other commonly used indexes of goodness of fit (Hu and Bentler, 1999). According to some authors, values > 0.90 on all 3 indexes (CFI, GFI, and TLI) are sufficient to support a good fit; however, others think that the value of 0.90 is too liberal and suggest that CFI should be > 0.95 for a good fit (Hu and Bentler, 1999).

The aim of the present study was to examine the goodness of fit of alternative models of the factor structure of SPQ in a large population of university students. Additionally, we investigated the effect of gender on the factor structure of the SPQ.

METHOD

Participants

The study sample consisted of students that were recruited from Ege University. In all, 1101 students from the faculties of medicine, literature, dental medicine, education, nursing, and Turkish music voluntarily participated in the study between 2004 and 2008. In total, 42 of these students were excluded from the study because they did not complete the questionnaire that was administered. The study sample was composed of 1059 students (620 female and 439 male) that completed the SPQ. Participants were not assessed for mental disorders. Mean age of males (21.53 ± 2.23 years) and females (21.50 ± 2.23) was similar.

Schizotypal Personality Questionnaire

The SPQ is a self-rated instrument with 74 items (Raine et al., 1991). Respondents are instructed to choose between "yes" and "no" answers. While "yes" is scored as 1 point, "no" is given no points. The instrument consists of 9 subscales that examine DSM-IV criteria for SPD. The subscales of this instrument are as follows: (1) reference, (2) social anxiety, (3) odd beliefs/magical ideation, (4) unusual perceptual experiences, (5) odd behavior, (6) no close friends, (7) odd speech, (8) constricted affect, and (9) paranoia. There are 7-9 items on each subscale.

The reliability of the Turkish version of the scale was previously established (Şener et al., 2006). In the present study, Cronbach's α value for the entire scale was 0.91

and Cronbach's α values for the subscales were between 0.66 and 0.83. The test-retest reliability of the scale was reported as 0.84. EFA suggested a factor structure that supports Raine's model. Cronbach's α values (0.91) and test-retest reliability ($r=0.82$) of the original study were very similar to the findings reported for the Turkish version (Raine et al., 1991). A 22-item brief version of the scale was shown to be a reliable instrument for use with the Turkish population (Ayçiçeği et al., 2005) and was reported to differentiate between healthy relatives of patients with schizophrenia and controls (Bora and Veznedaroglu, 2005). The original version of SPQ (74 items) was used in the present study.

Statistical analysis

SPSS v.13.0 was used for descriptive and comparative analyses. The effect of sex on SPQ subscale scores was analyzed with the t-test.

CFA was conducted by LISREL. All models in Table 1 were analyzed and a single factor model was also examined for comparison with the alternative models. Minimum conditions for a model with a sufficient goodness of fit were a RMSEA score < 0.08 and CFI score > 0.95 . Goodness of fit for alternative models were compared with AIC and chi-square test results. Modification indexes were used to review Raine's original model.

RESULTS

Mean SPQ score was 27.01 ± 12.59 (range: 2-62). Sex had a significant effect on SPQ total score and subscale scores (Table 2). Males scored significantly higher than females on total SPQ. While males scored higher on the no close friends, constricted affect, paranoia, odd speech, and odd behavior subscales, females scored higher on the social anxiety and odd belief subscales.

Confirmatory Factor Analysis

A very poor goodness of fit for the single factor model supported the multifactorial structure of SPQ (Table 3). Bergmann and Battaglia's models of goodness of fit were poor. While the CFI value for Kendler's model was > 0.95 , RMSEA showed insufficient goodness of fit for this model. Like Kendler's model, the CFI value for Raine's model was > 0.95 and the RMSEA value was < 0.10 , but > 0.08 . Stefanis' 4-factor model was the only model with a sufficient goodness of fit. Chi-square and AIC analyses also confirmed the advantage of Stefanis' model over its alternatives.

The effect of sex on the factor structure of SPQ was analyzed by recalculating the CFA for Raine's and Stefanis' models for males and females separately (Table 3). Once again, only Stefanis' model had sufficient goodness of fit for both sexes.

Modification indexes of Raine's model suggested 3 changes that would improve the goodness of fit of this model. The first suggested change was adding a negative association between the odd beliefs and interpersonal subscales (50.4 decrease in chi-square value) and the second change was addition of an error covariance between the reference and paranoia subscales (41.3 decrease in chi-square value). The final suggestion was the addition of an error covariance between the social anxiety and reference subscales. Following these 3 changes, the goodness of fit for Raine's model was better than all other alternatives, including Stefanis' model (Table 3).

DISCUSSION

In the present study alternative models for the factor structure of SPQ were analyzed with CFA. The findings support a 4-factor model in which paranoid features were separated from the cognitive-perceptual dimension; however, modifications to Raine's 3-factor model substantially improved the goodness of fit of this model. Results of the study suggest that the factor structure of the Turkish version of SPQ is very similar to the reported factor structures for other cultures. While sex had a significant effect on schizotypal features, the factor structure of the schizotypal characteristics did not differ between the sexes.

The findings of the present study that suggest a fourth factor (paranoia) were very similar to the findings of Stefanis et al. (2004) and Wutrich and Bates (2006). In previous studies that supported Raine's 3-factor model, 4-factor models that include the paranoid factor were not investigated. In clinical settings it is common to observe paranoid ideation and reference thoughts, without other positive symptoms. In delusional disorder and in many paranoid schizophrenia cases it is common to observe paranoid symptoms without co-occurring hallucinations or other symptoms. Our findings suggest that this could be also the case for schizotypal features in the general population, suggesting that different positive symptoms might be associated with different neurobiological and genetic factors.

Findings of the current study also show that several modifications of Raine's model might increase its goodness of fit. Previously, Wutrich and Bates (2006) re-

ported a very similar finding. In both studies, 2 of the 3 suggested modifications to Raine's model were identical. The first of these changes was adding an error covariance between the reference and paranoia subscales. This finding suggests that SPQ is not able to distinguish between reference and paranoid ideas effectively. Respondents seem to provide similar answers to questions on these 2 subscales. The second modification was a negative relationship between the odd beliefs and interpersonal subscales. To explain this finding, Wutrich and Bates (2006) suggested some socially acceptable superstitions, like the belief in UFOs, might be associated with higher social functioning. Alternatively, this finding could indicate the possibility that poor insight and high odd beliefs scores could explain the association between better social functioning and odd beliefs. The final modification suggested in the present study was the addition of an error covariance between the reference and social anxiety subscales. In fact, this modification was very similar to the suggestion of adding a positive correlation between the social anxiety and positive symptoms subscales by Wutrich and Bates. Other authors previously reported the possible association between social anxiety and positive symptoms. This relationship is natural, as there is an apparent similarity between some questions on the SPQ reference and social anxiety subscales.

In the present study, sex had no effect on the factor structure of SPQ. This result confirms previous findings (Raine et al., 1994; Fossati et al., 2003; Badcock and Dragovic, 2006). Males in the present study had higher negative and disorganized schizotypal features subscale scores, whereas females scored higher on the social anxiety and odd beliefs subscales. This result is in line with previous findings (Fossati et al., 2003; Badcock and Dragovic, 2006). Moreover, the fact that negative symptoms and disorganization were more severe in male schizophrenia patients might support the dimensional model suggesting that schizophrenia symptoms are a part of the same spectrum as schizotypal features. While males had

higher scores on the paranoia subscale, they had lower scores on the odd beliefs subscale. This finding also supports the notion that paranoid and cognitive-perceptual features could be separate factors of schizotypy.

CFA of the Turkish version of SPQ gave very similar results as those from other cultures. Factor analytic studies conducted in Turkish and in other countries revealed some problems with the original form of the scale. Neither Stefanis' nor Raine's models suggest an excellent factor structure. This finding seems partly related to similarities between the questions on different subscales. Despite these findings, SPQ is a valid instrument for measuring schizotypal characteristics. Reported findings about an association between high SPQ scores and the COMT high activity allele (Avramopoulos et al., 2002; Schurhoff et al., 2007), impaired smooth eye movements (Smyrnis et al., 2007), and P50 (Wang et al., 2004) support the validity of the scale.

The present study sample included only university students, which is a limitation because age is reported to influence schizotypal features (Fossati et al., 2003; Badcock and Dragovic, 2006). As such, it would be advisable to study the characteristics of SPQ in adolescent and older adult sample populations. Furthermore, we did not screen the study sample for mental disorders. It is possible that some of the participants might have had schizophrenia spectrum disorders or cluster A personality disorders; however, we do not expect this limitation to significantly affect our findings because the study sample was large.

Results of the present study support the notion that schizotypal characteristics in the general population are extensions of the schizophrenia spectrum. It is clear that schizotypal personality features are multi-factorial. Examination of genetic, electrophysiological, brain imaging, and neuropsychological correlates of the suggested factors of schizotypy might help us better understand the nature of susceptibility to schizophrenia.

REFERENCES

- Akaike H (1987) Factor analysis and AIC. *Psychometrika*, 52: 317-332.
- Avramopoulos D, Stefanis NC, Hantoumi I et al. (2002) Higher scores of self reported schizotypy in healthy young males carrying the COMT high activity allele. *Mol. Psychiatry*, 7:706-711.
- Ayçiçeği A, Dinn VM, Harris CL et al. (2005) Validation of Turkish and English versions of the schizotypal personality questionnaire-B. *Eur. J. Psychol. Assess*, 21:34-43.
- Badcock, JC, Dragovic M (2006) Schizotypal personality in mature adults. *Pers. Ind. Diff*, 40:77-85.
- Battaglia M, Cavallini M, Macciardi F et al. (1997) The structure of DSM-III-R schizotypal personality disorder diagnosed by direct interviews. *Schizophr. Bull*, 23: 83-92.
- Bergmann AJ, Harvey PD, Mitropoulou V et al. (1996) The factor structure of schizotypal features in a clinical population. *Schizophr. Bull*, 22, 501-509.

- Bora E, Veznedaroglu B (2007) Temperament and the character dimensions of the relatives of schizophrenia patients and controls: the relationship between schizotypal features and personality. *Eur Psychiatry*, 22, 27-31.
- Chapman LJ, Chapman JP, Miller EN et al. (1982) Reliabilities and intercorrelations of eight measures of proness to psychosis. *J Consult. Clin. Psychol*, 50: 187-195.
- Chen WJ, Hsiao CK, Lin CC et al. (1997) Schizotypy in community samples: The three-factor structure and correlation with sustained attention. *J Abnorm. Psychol*, 106 (4):649-654.
- Fossatti A, Raine A, Carretta I et al. (2003) The three-factor model of schizotypal personality: invariance across age and gender. *Pers. Ind. Diff*, 34:1-13.
- Gruzelier JH. Factor structure of schizotypy: I. Affinities with syndromes of schizophrenia. *Schizophr. Bull*, 22(4): 611-620.
- Hu L, Bentler PM (1999) Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Equat. Model*, 6:1-55.
- Kendler KS, Ochs AL, Gorman AM et al. (1991) The structure of schizotypy: A pilot multitrait twin study. *Psychiatry Res*, 36:19-36.
- Meehl PE (1962) Schizotaxia, schizotypy and schizophrenia. *Am. Psychol*, 17:827-838.
- Raine A (1991) The SPQ: A scale for the assessment of schizotypal personality based on DSM-III-R criteria. *Schizophr. Bull*, 17:556-564.
- Raine A, Reynolds CA, Lencz T et al. (1994) Cognitive perceptual, interpersonal and disorganized features of schizotypal personality. *Schizophr. Bull*. 20 (1), 191-201.
- Reynolds CA, Raine A, Mellingen K et al. (2000) Three-factor model of schizotypy personality: Invariance across culture, gender, religious affiliation, family adversity and psychopathology. *Schizophr. Bull*, 26(3): 603-618.
- Schmelleh-Engel K, Moosbrugger H, Muller H et al. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods Psychol. Res*, 8:23-74.
- Schürhoff F, Szöke A, Chevalier F et al. (2007) Schizotypal dimensions: An intermediate phenotype associated with the COMT high activity allele. *Am. J. Med. Genet. B*. 144: 64-68.
- Siever LJ, Gunderson JG (1983) The search for a schizotypal personality: historical origins and current status. *Compr. Psychiatry*, 24:199-212.
- Smyrnis N, Evdokimidis I, Mantas A et al. (2007) Smooth pursuit eye movements in 1087 men: effects of schizotypy, anxiety and depression. *Exp. Brain Res*, 179:397-408.
- Stefanis NC, Smyrnis N, Avramopoulos D et al. (2004) Factorial composition of self rated schizotypal traits among young males undergoing military training. *Schizophr. Bull*, 30:335-350.
- Şener A, Bora E, Tekin I et al. (2006) Şizotipal Kişilik Ölçeğinin üniversite öğrencilerinde geçerlik ve güvenirliği. *Klinik Psikofarmakoloji Bülteni*, 16(2): 84-92.
- Verdoux H, Van Os J (2002) Psychotic symptoms in non-clinical populations and the continuum of psychosis. *Schizophr. Res*, 54:59-65.
- Wang J, Miyazato H, Hokama H et al. (2004) Correlation between P50 suppression and psychometric schizotypy among non-clinical Japanese subjects. *Int. J. Psychophysiol*, 52:147-157.
- Wuthrich VM, Bates TC (2006) Confirmatory factor analysis of the three factor structure of the Schizotypal Personality Questionnaire and Chapman Schizotypy Scale. *J Pers. Ass*, 87(3): 292-304.