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Psychometric properties of the Brief Version of the Schizotypal Personality Questionnaire in relatives of patients with schizophrenia-spectrum disorders and non-psychiatric controls

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Abstract

The Schizotypal Personality Questionnaire-Brief Version (SPQ-B), which includes *cognitive-perceptual*, *interpersonal*, and *disorganized* domains, was developed as a concise, self-report measure of schizotypy. This analysis was conducted to: (1) determine the internal consistency reliability of SPQ-B total and subscale scores, (2) use confirmatory factor analysis to assess the three-factor model as well as a single-factor solution, and (3) examine a measure of concurrent criterion validity of SPQ-B scores. The study was conducted at a large, urban, university-affiliated, public-sector health system in the southeastern United States. Data were obtained from 118 participants, including 61 biological relatives of patients with schizophrenia, schizoaffective disorder, or schizophreniform disorder, and 57 non-psychiatric controls. Relatives and controls did not differ significantly on SPQ-B total or subscale scores (or on the full 74-item SPQ total or subscale scores). Internal consistency reliability was adequate for the total SPQ-B score and the *interpersonal* subscale but was less than ideal for the *cognitive-perceptual* and *disorganized* subscales. Regarding the confirmatory factor analysis, though the three-factor solution yielded reasonably good fit to the data, the single-factor solution provided equal fit. Correlations between the three subscales ranged from .63 to .74. With regard to criterion validity, correlations between the SPQ-B total and subscale scores and schizotypy scores derived from a semi-structured, interview-based assessment revealed correlations generally ranging from .40 to .60. The SPQ-B may be a useful brief screening measure of schizotypy, though some limitations in its psychometric properties were evident in this sample. It may be advisable to use total SPQ-B scores rather than subscale scores in some situations, or to use factor analytic techniques to study the instrument's latent structure in specific samples.

Keywords: Psychosis proneness; Reliability; Schizotypal Personality Questionnaire; Schizotypy; Validity

1. Introduction

Schizotypy is a multidimensional construct – characterized by odd and eccentric cognitions and behaviors and interpersonal deficits – that represents a mild imitation of the symptoms of schizophrenia (Vollema and Postma, 2002). Schizotypy also has been defined by its indication of liability for developing schizophrenia (Fanous et al., 2001; Lenzenweger, 1994). Although schizotypy is the core feature of schizotypal personality disorder (SPD), it is thought to be a continuous or dimensional, rather than a

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categorical, construct (Irwin, 2001). Previous research using self-report and interview-based measures has shown that schizotypy is genetically related to schizophrenia (Kendler et al., 1993) and that individuals with higher levels of schizotypy are at elevated risk for developing psychotic disorders including schizophrenia (Catts et al., 2000; Fanous et al., 2001; Vollema and Postma, 2002). Furthermore, studies have shown that first-degree relatives of persons with schizophrenia have higher rates of schizotypal traits (Kendler et al., 1993; Kendler and Gardner, 1997) as well as SPD (Calkins et al., 2004; Chen et al., 1997) compared to the general population.

In the Roscommon Family Study, Fanous and colleagues used clinician interview-based assessments and found that positive and negative symptoms in schizophrenia were predictive of corresponding schizotypal symptoms in relatives (Fanous et al., 2001). Similarly, Mata et al. (2000, 2003) reported a relationship between positive and negative symptoms in patients with psychotic disorders and positive and negative schizotypal features in their healthy biological relatives. It should be noted, however, that other reports do not support homotypy between schizotypal symptoms in relatives and symptom dimensions in patients (Prado et al., 2005).

In addition to clinician/researcher-administered measures of schizotypy, a number of self-report rating scales have been developed to measure the construct. Since the 1960s, Loren and Jean Chapman and their colleagues have developed a battery of self-administered rating scales intended to capture the various facets of schizotypy. These include the Perceptual Aberration Scale (Chapman et al., 1978), the Magical Ideation Scale (Eckblad and Chapman, 1983), the Social Anhedonia Scale (Chapman et al., 1976), and the Physical Anhedonia Scale (Chapman et al., 1976). Albeit these scales have proven to be useful measures for susceptibility to psychosis with satisfactory reliability and validity (Lenzenweger, 1994), they do not directly reflect the nine traits of schizotypal personality outlined in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV) (Raine and Benishay, 1995). Some of the other well-established self-administered scales include the Oxford-Liverpool Inventory of Feelings and Experiences (Burch et al., 1998; Mason et al., 1995; Mason et al., 2005), the Rust Inventory of Schizotypal Cognitions (Rust, 1988; Rust and Chiu, 1988), the Schizophrenia Proneness Scale of the Minnesota Multiphasic Personality Inventory-2 (Bolinskey et al., 2001, 2003), and the Schizophrenism Scale (Venables et al., 1990).

The Schizotypal Personality Questionnaire (SPQ), another self-report instrument, was developed by Raine and colleagues (Raine, 1991) to measure all nine DSM criteria for SPD (ideas of reference, odd beliefs/magical thinking, unusual perceptual experiences, odd thinking/speech, suspiciousness/paranoid ideation, inappropriate/constricted affect, odd or eccentric behavior/appearance, lack of close friends, and excessive social anxiety). The questionnaire consists of 74 statements in a dichotomous (yes/no) response format. The SPQ has been used as a screening instrument for the identification of individuals with schizotypal traits in a variety of studies, including those assessing undergraduate college students (Raine, 1991), clinical populations (Vollema and Hoijtink, 2000), first-degree relatives of individuals with schizophrenia (Calkins et al., 2004; Kremen et al., 1998; Vollema and Postma, 2002; Yaralian et al., 2000), as well as general population samples (Raine, 1991). Through factor analytic studies, the nine major DSM criteria for SPD were condensed into three schizotypal dimensions: positive-like symptoms (i.e., ideas of reference, odd beliefs/magical thinking, unusual perceptual experiences, and suspiciousness/paranoid ideation), negative-type symptoms (i.e., suspiciousness/paranoid ideation, inappropriate/constricted affect, lack of close friends, and excessive social anxiety), and disorganized symptoms (i.e., odd thinking/speech and odd or eccentric behavior/appearance). In the SPQ, these dimensions are termed *cognitive-perceptual*, *interpersonal*, and *disorganized*, respectively, and are analogous to widely recognized dimensions of symptoms of schizophrenia (Arndt et al., 1991).

Several factor analytic studies, both exploratory and confirmatory, have verified the initial three theoretical subscales of the SPQ (Chen et al., 1997; Claridge et al., 1996; Raine et al., 1994; Reynolds et al., 2000; Rossi and Daneluzzo, 2002; Vollema and Hoijtink, 2000; Vollema and Postma, 2002). For example, Reynolds et al. reported results from a factor analysis of the SPQ with a sample of 1201 Mauritians that suggested a three-factor model (*cognitive-perceptual*, *interpersonal*, and *disorganized*) of schizotypal personality, with invariance across culture, gender, religious affiliation, family adversity, and psychopathology (Reynolds et al., 2000). Chen and colleagues confirmed the three-factor structure of the SPQ in community samples of Taiwanese adults and adolescents (Chen et al., 1997). Similarly, a factor analysis conducted by Rossi and Daneluzzo (2002) also found that the three factors of *cognitive-perceptual*, *interpersonal*, and *disorganized* deficits underlay individual differences. These factors were present in both clinical samples (e.g., samples composed

of patients with schizophrenia or bipolar disorder) as well as healthy non-psychiatric samples.

In order to create a quicker, more convenient measure for assessing the three main factors of SPD, Raine and coworkers distilled the most reliable items of the 74-item SPQ into an abbreviated instrument-the Schizotypal Personality Questionnaire-Brief Version (SPQ-B) (Raine and Benishay, 1995). This instrument is a 2-min, 22-item, self-report measure that has been used in a number of studies to date, though predominantly in samples including undergraduate college students (Aycicegi et al., 2005; Bailey and Swallow, 2004; Houran et al., 2001; Mata et al., 2005; Schiffman et al., 2005).

In terms of the factorial structure of the SPQ-B, three studies have conducted exploratory factor analyses. In a clinical sample of adolescent psychiatric inpatients, Axelrod et al. (2001) demonstrated that the three-factor SPQ-B solution accounted for 43% of the variance and generally converged with the *cognitive-perceptual*, *interpersonal*, and *disorganized* scales. Aycicegi et al. (2005) examined the SPQ-B in undergraduate students in Turkey and the U.S. They found that a two-factor solution, reflecting negative symptoms and positive-type schizotypal symptoms (with the *disorganized* symptom items loading on these two factors) best explained their data. Among undergraduate students in Spain who were administered a Spanish version of the SPQ-B, Mata et al. (2005) showed that a three-factor solution, resembling the three subscales, accounted for 35% of the variance. To date, there have been no published reports of a confirmatory factor analysis of the SPQ-B, though its presumed subscales, representative of the original subscales of the SPQ, are being used in some research studies (Bailey and Swallow, 2004; Bedwell and Donnelly, 2005; Houran et al., 2001; Schiffman et al., 2005). Furthermore, there has been little research on the general psychometric properties of the SPQ-B.

The current analysis, which relied on data from biological relatives of patients with schizophrenia-spectrum disorders and non-psychiatric controls, was driven by a three-fold objective related to the psychometric properties of the SPQ-B. First, internal consistency reliability coefficients were calculated for the SPQ-B and its three subscales. Second, confirmatory factor analysis was conducted to assess the three-factor solution, as well as a single-factor solution, to determine whether the three-factor solution provided better fit to the data in this sample. It was decided *a priori* to test these two models (the three-factor solution and the single-factor solution) based on the observation that researchers are already using the three proposed subscales of the SPQ-B. Competing models such as the two two-factor solutions reported by Aycicegi and colleagues (2005) were not tested. Also, because researchers are using the three proposed SPQ-B subscales, we confined the scale's items to load on their respective subscales in accordance with the scoring of the SPQ-B subscales, even though in prior factor analyses of the full SPQ (Raine et al., 1994), and the SPQ-B (Axelrod et al., 2001) items representing paranoid ideation have been found to load on both cognitive-perceptual and interpersonal factors. Thus, we chose to examine the SPQ-B as it is currently being used. Third, concurrent criterion validity was examined using the nine clinician/researcher-assessed items of the SPD module of the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (First et al., 1997a). Investigating the reliability, factorial structure, and validity of the SPQ-B will benefit future research that uses this instrument and its subscales.

2. Methods

2.1. Setting and sample

The study took place at a large, urban, university-affiliated, public-sector health system in the southeastern United States. This health system provides medical and psychiatric services for a predominantly uninsured, low-income, African American population. Data for this analysis were obtained from two ongoing studies. The first, which contributed data from 87 participants, examines associations between several putative risk markers for schizophrenia (including schizotypy, olfactory identification deficits, verbal memory impairments, neurological soft signs, and minor physical anomalies) (Compton et al., 2006a,b). The second, which contributed data from 31 participants, assesses determinants of the duration of untreated psychosis in hospitalized first-episode patients. Both studies use the SPQ to assess self-reported schizotypy in relatives of patients, and the first study also uses the instrument with non-psychiatric control participants.

Exclusion criteria for all participants were: (1) inability to speak English fluently, (2) active substance dependence defined as a substance dependence diagnosis not in early or sustained full remission, (3) known mental retardation, (4) history of neurological disease or clinically significant head injury, and (5) presence of any active major medical condition or disability that could interfere with the assessment (e.g., blindness). In the first study, exclusion criteria for first-degree relatives also included a personal history of a psychotic or mood disorder. Controls were excluded if they endorsed any personal or family history (in first- or second-degree

relatives) of psychotic or mood disorders. Diagnoses among the controls themselves were ruled-out using the Structured Clinical Interview for DSM-IV Axis I Disorders (First et al., 1997b).

The mean age of participants ($n=118$) was 46.2± 12.2 years. Most of the participants ($n=111$, 94.1%) were African American, and the majority was female ($n=77$, 65.3%). Just over half of the group of relatives consisted of mothers of patients ($n=33$, 54.1%). Other relatives included: 11 sisters, 6 fathers, 2 brothers, 2 daughters, 1 aunt, 1 uncle, 1 grandmother, 3 half-sisters, and 1 half-brother.

2.2. Materials

The SPQ-B is an easy-to-administer, 22-item instrument derived from the 74-item SPQ. The instrument is designed to be used in research protocols that do not allow for use of the longer SPQ, or alternatively for screening of large numbers of participants for predisposition to SPD prior to a more extensive confirmatory diagnostic interview. Each item presents a statement or question to the respondent, who then circles "yes" or "no." All affirmatively endorsed items count one point toward the total score, which ranges from 0 to 22, with higher scores indicating higher levels of self-reported schizotypy. Items representing each of the three subscales of the SPQ (*cognitive-perceptual*, *interpersonal*, and *disorganized*) are included in the SPQ-B: items from the first and second subscales and six items from the disorganized domain. Internal consistency reliability, test–retest reliability, and criterion validity of the SPQ-B have been documented to be acceptable in college students (Aycicegi et al., 2005; Raine and Benishay, 1995) and adolescent psychiatric patients (Axelrod et al., 2001).

In a subsample of 58 participants (24 first-degree relatives and 34 controls), the SPD module of the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II) (First et al., 1997a) was administered by a clinical psychologist, unaware of self-reported schizotypy results from the SPQ. The module contains questions directed at assessing the nine criteria for SPD (ideas of reference, odd beliefs/magical thinking, unusual perceptual experiences, odd thinking/speech, suspiciousness/paranoid ideation, inappropriate/constricted affect, odd or eccentric behavior/appearance, lack of close friends, and excessive social anxiety). Participants' responses to questions during the interview are scored for each criterion as a "1" meaning the symptom is absent, "2" indicating the symptom is present at a subthreshold level, or "3" meaning the symptom is definitely present. In this report, SPD criteria scores were summed to yield a possible range of scores of 9–27.

2.3. Data analysis

Internal consistency reliability was assessed with the Kuder-Richardson formula 20 (KR-20) reliability coefficient for dichotomous items (Streiner and Norman, 2001; Streiner, 2003). As is true for Cronbach's alpha internal consistency reliability coefficient, values typically range from 0 to 1, and the preferred value is usually considered to be .70–.90. The KR-20 can be thought of as the mean of all possible split-half reliabilities. Mean corrected item–total correlations (the correlation between the given item and the total score if that item is not included in the total score calculation) also were assessed.

Two confirmatory factor analyses were conducted to determine whether the three-factor solution provided better fit to the data than a single-factor solution. Several indices were selected *a priori* to assess the fit of the measurement model to the data. First, the normed model chi-square is reported (χ^2_M/df_M). Smaller values of the overall model chi-square (χ^2_M) indicate goodness-of-fit (with $p>.05$ suggesting that the null hypothesis that the model fits the data is not rejected), and the normed χ^2_M reduces the sensitivity of χ^2_M to sample size. Generally, values <3.0 indicate good fit. Second, the Steiger–Lind root mean square error of approximation (RMSEA) and its 90% confidence interval (CI) provide a correction for model complexity. Small values are desired, with values ≥.10 indicating poor fit. The 90% CI of the RMSEA generally should not include .10. Third, the standardized root mean square residual (SRMR) assesses the mean absolute correlation residual. SRMR values <.10 are considered acceptable.

To compare hierarchical (nested) models, the chi-square difference (χ^2_D) test was used, in which the χ^2_M for the trimmed model is subtracted from that of the initial model, and this value is divided by the difference in degrees of freedom (*df*). A non-significant value indicates approximately equal fit when comparing the two models (suggesting that the simpler model has not been oversimplified), and the more parsimonious model is preferred. Because the purpose of the confirmatory factor analysis was not to find the best-fitting model in an attempt to derive new subscales (but rather to test model fit comparing the three-factor solution to a single-factor solution), modification indices were not used for empirical trimming or to improve the fit of the model to the data. The Linear Structural Relations Program (*LISREL 8.72*) was used for confirmatory factor analyses.

Table 1
Means±SD of SPQ-B scores and full 74-item SPQ scores, in first-degree relatives and control participants

	First-degree relatives (n=54)	Non-psychiatric comparison participants (n=57)
22-item SPQ-B		
Cognitive-perceptual	1.38±1.53	1.75±1.71
Interpersonal	2.74±2.09	2.73±2.12
Disorganized	.98±1.37	1.13±1.37
Total score	5.00±4.05	5.64±4.21
74-item SPQ		
Cognitive-perceptual	6.00±5.22	7.13±5.34
Interpersonal	9.04±5.95	8.96±6.00
Disorganized	3.04±3.54	3.26±3.27
Total score	17.98±12.82	19.54±12.90

Correlations between the factors were assessed with Pearson product–moment correlation coefficients. Criterion validity was evaluated with Spearman correlation coefficients, given the non-normal nature of the SCID-II SPD criteria scores. Aside from the confirmatory factor analyses, all other statistical tests were computed using the *SPSS 13.0* statistical software package.

3. Results

3.1. Total, subscale, and item scores

In the overall sample (n=118), the mean SPQ-B score was 5.23±4.11 (median=4.00; mode=1; range=0–17). Mean values of the total SPQ-B score and the three subscales, in first-degree relatives and control participants are shown in Table 1. These two groups did not differ significantly on any of these mean scores. Furthermore, the two groups did not differ in terms of subscale and total scores of the full 74-item SPQ (Table 1). Of note, though the two groups did not differ with respect to mean age (46.0±12.7 and 46.4±12.2 years in first-degree relatives and controls, respectively), the two groups did differ in terms of gender composition (85.2% and 45.6% female in first-degree relatives and controls, respectively). However, like age,

Table 2
Means±SD of the 22 SPQ-B items (mean score represents the proportion of participants endorsing that item); and coefficients and t-values in relation to the three factors

Item	Means±SD	λ parameter*	t**
Cognitive-perceptual			
2. Have you ever had the sense that some person or force is around you, even though you cannot see anyone?	.30±.46	.43	4.32
4. Are you sometimes sure that other people can tell what you are thinking?	.03±.18	.17	(ns)
5. Have you ever noticed a common event or object that seemed to be a special sign for you?	.20±.40	.63	6.63
9. Do you often pick up hidden threats or put-downs from what people say or do?	.23±.42	.68	7.29
10. When shopping do you get the feeling that other people are taking notice of you?	.21±.41	.17	(ns)
12. Have you had experiences with astrology, seeing the future, UFOs, ESP or a sixth sense?	.09±.29	.21	2.01
16. Do you ever suddenly feel distracted by distant sounds that you are not normally aware of?	.15±.36	.62	6.47
17. Do you often have to keep an eye out to stop people from taking advantage of you?	.38±.49	.50	5.11
Interpersonal			
1. People sometimes find me aloof and distant.	.19±.39	.57	5.95
7. I feel I have to be on my guard even with friends.	.30±.46	.38	3.80
11. I feel very uncomfortable in social situations involving unfamiliar people.	.30±.46	.58	6.07
14. Have you found that it is best not to let other people know too much about you?	.67±.47	.43	4.27
15. I tend to keep in the background on social occasions.	.31±.46	.53	5.50
18. Do you feel that you are unable to get “close” to people?	.11±.31	.51	5.28
21. I feel very uneasy talking to people I do not know well.	.31±.46	.57	5.91
22. I tend to keep my feelings to myself.	.48±.50	.55	5.68
Disorganized			
3. People sometimes comment on my unusual mannerisms and habits.	.27±.44	.57	5.82
6. Some people think that I am a very bizarre person.	.12±.33	.40	3.85
8. Some people find me a bit vague and elusive during a conversation.	.16±.37	.53	5.28
13. I sometimes use words in unusual ways.	.22±.42	.57	5.84
19. I am an odd, unusual person.	.15±.36	.51	5.09
20. I find it hard to communicate clearly what I want to say to people.	.15±.35	.41	3.97

*The λ parameter refers to the path coefficient from the latent variables (factors) to the observed variables (questionnaire items). **All t-values are statistically significant except the two indicated with (ns).

gender was not associated with the mean SPQ-B score in the overall sample, or in relatives or controls.

Means of the 22 individual items of the SPQ-B are shown in Table 2. As such, mean scores represent the proportion of participants endorsing each item. The most commonly endorsed items included two *interpersonal* items: "Have you found that it is best not to let other people know too much about you?" (endorsed by 67%), and "I tend to keep my feelings to myself." (endorsed by 48%). The least commonly endorsed items included two *cognitive-perceptual* items: "Are you sometimes sure that other people can tell what you are thinking?" (endorsed by only 3%), and "Have you had experiences with astrology, seeing the future, UFOs, ESP or a sixth sense?" (endorsed by 9%). Among the eight items in the *cognitive-perceptual* subscale, six were endorsed by less than one quarter of participants. *Disorganized* subscale items also were relatively uncommonly endorsed—five of six items were endorsed by less than one quarter. On the other hand, six of the eight items of the *interpersonal* subscale were endorsed by ≥30% of participants.

3.2. Internal consistency reliability

Before calculating internal consistency reliability coefficients, item–item correlations were examined (data not shown). The strongest correlations included those between: (1) item #20 from the *disorganized* subscale (finding it hard to communicate clearly to people) and item #21 from the *interpersonal* subscale (feeling very uneasy talking to people who are not well known) ($r=.58$; $p<.001$), (2) item #18 from the *interpersonal* subscale (feeling unable to get close to people) and item #20 from the *disorganized* subscale ($r=.50$; $p<.001$), and (3) item #11 from the *interpersonal* subscale (feeling very uncomfortable in social situations involving unfamiliar people) and item #21, also from the *interpersonal* subscale ($r=.46$; $p<.001$).

In the present sample, the KR-20 internal consistency reliability coefficient for the full SPQ-B was .83 (.82 in biological relatives and .83 in non-psychiatric comparison participants). For the 8-item *cognitive-perceptual* subscale, the KR-20 statistic was .65 (.60 in biological relatives and .65 in controls). For this subscale, the mean corrected item-total correlation was .34, and the individual correlations ranged from .11 (for item #4) to .51 (item #16). For the 8-item *interpersonal* subscale, the KR-20 statistic was .73 (.72 in biological relatives and .73 in controls). For this subscale, the mean corrected item–total correlation was .43, with individual correlations ranging from .28 (for item #7) to .51 (item #11). For the 6-item *disorganized* subscale, the KR-20 statistic was .64 (.67 in biological relatives and .63 in controls). For this subscale, the mean corrected item–total correlation was .38, and these correlations ranged from .19 (for item #20) to .45 (item #13).

3.3. Confirmatory factor analysis

The three-factor model of the SPQ-B was fitted to the data with the maximum likelihood method of *LISREL*, and a converged, admissible solution was obtained. Pattern coefficients (λ) for the individual SPQ-B items in relation to the three factors are shown in Table 2. In general, these coefficients, which can be interpreted as factor loadings, were quite high and statistically significant. For the *cognitive-perceptual* subscale, coefficients for five items ranged from .43 to .68, and the three remaining items had rather low coefficients. Specifically, the items assessing "other people can tell what you are thinking" and "feeling that other people are taking notice of you" had loadings of .17 (and these two coefficients were not statistically significant), and the item on "experiences with astrology/UFOs/ESP/sixth sense" had a loading of .21. Coefficients for the eight items of the *interpersonal* factor ranged from .38 to .58, and those for the six items of the *disorganized* factor ranged from .40 to .57. That a few items had relatively low standardized loadings on the respective factors (particularly regarding the *cognitive-perceptual* subscale), is a further reflection on internal consistency.

For the single-factor solution, a converged, admissible solution again was obtained. All but two coefficients were statistically significant ("other people can tell what you are thinking," $\lambda=.18$, $t=1.78$; and "experiences with astrology/UFOs/ESP/sixth sense," $\lambda=.13$, $t=1.33$). Fit indices for the three-factor solution as well as the trimmed single-factor solution are shown in Table 3. While the three-factor solution provided reasonably good fit to the data, the single-factor solution provided equal fit,

Table 3
Fit indices for the three-factor solution and the single-factor solution

Model	χ^2_M/df_M [a]	RMSEA [b]	RMSEA 90% CI [c]	SRMR [d]	χ^2_D [e]
3 factors	357.81/206=1.74	.080	.066, .094	.096	
1 factor	424.64/209=2.03	.095	.082, .110	.096	22.28 [f]

[a] Normed model chi-square.
[b] Root mean square error of approximation.
[c] 90% confidence interval of the RMSEA.
[d] Standardized root mean square residual.
[e] Chi-square difference (424.64–357.81)/(209–206).
[f] Not statistically significant.

suggesting that the three factors do not significantly improve the fit to the data in this sample.

Correlations between the factors were then assessed. The *cognitive-perceptual* factor was correlated with the *interpersonal* factor ($r=.63$) and the *disorganized* factor ($r=.70$). The latter two factors were correlated as well ($r=.74$).

3.4. Concurrent criterion validity

Correlations between SPQ-B total and subscale scores and the derived SCID-II SPD criteria scores were examined next in a subsample of participants for whom SCID-II data were available (from the first study; $n=58$). The SPQ-B total score was significantly correlated with the SCID-II SPD criteria total score ($\rho=.49$, $p<.001$). Regarding the *cognitive-perceptual*, *interpersonal*, and *disorganized* domains, the correlations were: $\rho=.47$, $p<.001$; $\rho=.52$, $p<.001$; and $\rho=.15$, $p=.270$, respectively. When relatives were considered ($n=24$), SPQ-B total score was significantly correlated with the SCID-II SPD criteria total score ($\rho=.57$, $p=.004$), and criterion validity coefficients for the three subscales ranged from .33 (for *cognitive-perceptual*) to .58 (for *interpersonal*). Among the non-psychiatric controls ($n=34$), SPQ-B total score again was significantly correlated with the SCID-II SPD criteria total score ($\rho=.46$, $p=.009$), and criterion validity coefficients for the three subscales ranged from .02 (for *disorganized*) to .57 (for *cognitive-perceptual*).

4. Discussion

Because the SPQ-B was developed as a brief screening measure for samples that may include participants drawn from the general population and biological relatives of individuals with schizophrenia, this analysis included both controls and relatives. This report represents one of the most detailed assessments of the psychometric properties, and the only published confirmatory factor analytic study, of the SPQ-B to date. Several findings are noteworthy.

Of interest, the two groups – first-degree relatives and non-psychiatric controls – did not differ significantly on the total or subscale scores of the SPQ-B. Additionally, though not the focus of the present report, the full 74-item SPQ also failed to discriminate between the samples of relatives and controls, which indicates that the failure of discrimination does not reflect specifically on the SPQ-B. No previous investigations of relatives of individuals with schizophrenia and non-psychiatric controls have utilized the SPQ-B, but at least five have used the full SPQ. To date, findings using the SPQ have been mixed. In two separate initial studies in this area, two research groups (Kremen et al., 1998; Yaralian et al., 2000) compared SPQ scores in healthy relatives of patients with schizophrenia and non-psychiatric controls and found that relatives endorsed significantly more *cognitive-perceptual* features than controls. In contrast, more recently, Albeniz et al. (2005), Calkins et al. (2004), and Chang and Lenzenweger (2005) found no difference in SPQ scores between these two groups.

Some researchers explain the lack of a difference between these groups as resulting from defensive reporting in schizophrenia patients' relatives (Calkins et al., 2004; Chang and Lenzenweger, 2005). It may be that these relatives have a heightened awareness of schizophrenia symptoms and associated sociocultural stigma, and as a result present themselves as psychiatrically healthy. Non-psychiatric controls may not feel the need to under-endorse items in this same way. In fact, in one of the two studies that found higher schizotypy features in schizophrenia relatives (Kremen et al., 1998), the participants were told that the study purpose was related to criminal activity and family history, not to schizophrenia, and this may have led to decreased defensiveness in relatives. In the current study, and presumably in previous studies that have found no group differences in SPQ scores, participants were informed that the study purpose was related to schizophrenia and its correlates. This awareness may have increased defensive responding on the SPQ among relatives, thereby masking true differences in schizotypy.

Another potential explanation for the lack of difference on SPQ-B scores between relatives and controls is that relatives recruited into the studies may have had lower levels of schizotypy than relatives who did not participate. In the present studies, patients were asked to refer one relative who would be willing to participate, and this may have biased the group of relatives. Relatives with prominent suspiciousness, significant interpersonal deficits, or subtle thought disorganization may have been less likely than healthier relatives to take part in the research.

It cannot be excluded that unmeasured demographic differences between the relatives and non-psychiatric controls may have contributed to the lack of difference in schizotypy scores between the two groups. However, age was not associated with schizotypy scores, and although there was a significant gender difference in the two groups, gender was not associated with SPQ or SPQ-B scores in the overall sample, or in relatives or controls.

Finally, another reason for the lack of difference in scores could be that the construct validity of scores obtained from the SPQ-B is insufficient to demonstrate known-group differences. However, this conclusion seems premature given the aforementioned considerations. It should be noted also that the subscale and total SPQ-B scores found in this study (among both biological relatives and non-psychiatric controls) were consistently lower than those reported by Raine and Benishay (1995) in their study of college students and by Axelrod et al. (2001) in their study of hospitalized adolescents.

In terms of particular items of the SPQ-B, several findings are worth emphasizing. *Cognitive-perceptual* and *disorganized* items were less commonly endorsed than *interpersonal* subscale items in this sample. Also, some items from different subscales are fairly highly correlated. Indeed, some of the strongest inter-item correlations were between items from different subscales. Internal consistency statistics suggested that while the total SPQ-B and *interpersonal* subscale scores demonstrated adequate reliability, the *cognitive-perceptual* and *disorganized* subscales yielded internal consistency coefficients that were less than ideal. The internal consistency reliability coefficients were clearly more acceptable for the total score than subscale scores. Although internal consistency is influenced by the number of items comprising the scale under study, these findings indicate that at least some items of the *cognitive-perceptual* and *disorganized* subscales may limit the reliability of subscale scores. Axelrod et al. (2001) found better internal consistency coefficients (.74, .76, .75, and .87 for the *cognitive-perceptual*, *interpersonal*, *disorganized*, and total scores, respectively) than did the current study (.65, .73, .64, and .83, respectively). Aycicegi et al. (2005) found these respective internal consistency coefficients to be .58, .66, .60 and .75 among Turkish undergraduate students and .52, .74, .68, and .75 in students in the U.S.

In terms of the confirmatory factor analysis, the three-factor solution did not significantly improve the fit to the data in relation to the single-factor model, suggesting that the single-factor solution (i.e., total SPQ-B without subscales) seems to be as psychometrically supported (if not more so), than the three-factor solution. Two items of the *cognitive-perceptual* subscale did not significantly load on this factor in the three-factor confirmatory factor analysis, and the same was true for the single-factor solution. Additionally, the three factors were meaningfully inter-correlated. This is in contrast to the study by Aycicegi et al. (2005), which found the three correlations to be much more modest, ranging from .28 to .39 in Turkish students and .19 to .42 in U.S. students.

Axelrod et al. (2001) pointed out that the psychometric properties of the SPQ-B may vary when examined in community versus clinical settings, and it could be that the less than ideal internal consistency (and failure of the three-factor solution to fit the data better than a single-factor solution) found in the current study relates to variability in psychometric properties of the instrument across samples. In contrast to the present study which used healthy community members and relatives of schizophrenia patients, participants in the Axelrod et al. report were adolescents hospitalized for severe psychopathology (i.e., psychosis, suicidality). It may be that the subscales are more meaningful in samples exhibiting greater levels of schizotypy, like those found in a psychiatrically hospitalized group.

Mata et al. (2005) conducted an exploratory factor analysis on SPQ-B scores among 443 undergraduate students in Spain. Interestingly, similar to the present study, they also found that the item on "feeling that other people are taking notice of you" did not substantially load onto their three factors, though this item did load onto the cognitive-perceptual factor of Axelrod et al. (2001). In the study by Aycicegi et al. (2005), an unrestricted exploratory factor analysis of the SPQ-B resulted in two-factor solutions in both Turkish and American students.

Although coefficients >.60 are generally used to support validity, the moderate correlations between SPQ-B scores and the SCID-II SPD criteria scores reported here (generally in the range of .40 to .60) are not indicative of poor concurrent criterion validity. Correlations between self-report and semi-structured, interview-based assessments of personality traits rarely exceed values of .40; thus, the current findings suggest adequate concurrent criterion validity. Interestingly, although the total score and *cognitive-perceptual* and *interpersonal* subscale scores of the SPQ-B appeared to have reasonable criterion validity in relation to SCID-II SPD criteria, the SPQ-B *disorganized* subscale score was not correlated with the corresponding SCID-II SPD score in controls. Although this may have been due to insufficient variability in scores, too few items assessing disorganization, or the relatively small sample size, further research is needed to elucidate criterion validity, especially regarding the disorganized domain.

Several methodological limitations should be considered when interpreting these findings. First and most importantly, larger sample sizes would give more precise parameter estimates for confirmatory factor analysis. Future confirmatory factor analyses of the SPQ-B should include more participants from both the general population and families of patients with schizophrenia.

Necessary sample sizes for confirmatory factor analysis – and structural equation modeling more generally – are controversial and require further research (Jackson, 2003). The rule of thumb that samples of 100–200 represent a "medium" sample size is not absolute because model complexity also must be considered (Kline, 2005). Clearly, a larger sample size would provide more power for statistical tests. Given the relatively small sample size in the present structural equation modeling (which is considered a "large-sample technique"), the current results should be viewed as preliminary until replication can be conducted in larger samples. Second, generalizability may be limited given the particular sociodemographic characteristics of the study sample, which mainly included urban African Americans. Third, the clinician/researcher-derived SCID-II SPD criteria score was used as the criterion for examining validity, and another self-report measure may have provided higher validity coefficients. Furthermore, if a test is being validated on a group whose scores do not represent the total range of scores, the validity coefficient may be underestimated, and this possibility cannot be excluded in the present study.

Results of the current study suggest that although the SPQ-B may be a useful research instrument, the SPQ-B subscales had some problems in this particular sample of healthy individuals—some subscales had low internal consistency reliability and the confirmatory factor analysis revealed no value of the three-factor solution over a one-factor solution. Thus, the utility of the SPQ-B subscales must be assessed in individual samples before making assumptions about their psychometric properties. It may be advisable to use total SPQ-B scores rather than subscale scores in some situations, or to use factor analytic techniques to study the instrument's latent structure in specific samples. Based on the current findings, future studies with psychiatrically healthy individuals, including relatives of individuals with schizophrenia, should focus on the total score unless subscale scores are shown to be reliable and valid in other samples. Aycicegi et al. (2005) reported a two-factor solution of the English version of the SPQ-B and a two-factor solution of the Turkish version. These solutions could be studied in other samples using confirmatory factor analysis, in addition to the three-factor and single-factor solutions. Alternatively, data from specific samples could be submitted to factor analysis to determine the most appropriate factorial structure, from which subscale scores can be generated. Further analyses could then make use of both the original subscale scores as well as factor analysis-derived subscale scores, as done by Mata et al. (2005).

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