



The Schizotypal Personality Questionnaire – Child (SPQ-C): Psychometric properties and relations to behavioral problems with multi-informant ratings



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ABSTRACT

The Schizotypal Personality Questionnaire (SPQ) is one of the most widely used screening tools for schizotypy in adults. The Schizotypal Personality Questionnaire-Child version (SPQ-C) was recently developed to assess schizotypy in children and has a similar three-factor structure to the adult SPQ (i.e., Cognitive-Perceptual, Interpersonal-Affective, and Disorganization). However, few studies to date have reported on the psychometric properties and the usefulness of the SPQ-C in Eastern populations, including Mainland China. This study presents the first psychometric assessment of the Chinese SPQ-C in Mainland China. Exploratory factor analysis and confirmatory factor analysis were used to assess the factor structure of the SPQ-C in 1668 children ($M = 12.10$, $SD = 0.60$ years) from the China Jintan Child Cohort Study. Our findings document a three-factor structure and partial measurement invariance across residential location and gender, replicating the psychometric properties of the SPQ-C in English. The Chinese SPQ-C further correlates with standard behavioral problems (i.e., Child Behavior Checklist, Youth Self-Report and Teacher Report Form), demonstrating construct validity and utility as a child psychopathology assessment tool. Our findings provide the first robust psychometric evidence for a three-factor structure of the Chinese SPQ-C in a large Mainland Chinese sample, and suggest that the SPQ-C is suitable as a screening tool for schizotypy in community children who may be at risk for behavioral problems and later psychosis.

1. Introduction

Schizotypal personality disorder (SPD) or schizotypy is thought to be a premorbid condition for psychosis (Lenzenweger, 2018; Meehl, 1962, 1990) that exists on a continuum between schizotypal traits (phenotypic expression) and schizophrenia-spectrum disorder (latent liability) (Debbané and Barrantes-Vidal, 2014; Fonseca Pedrero and Debbané, 2017; Raine, 2006). For these reasons, research interest in schizotypy has grown over the years in the hope of better understanding the etiology of schizophrenia (Bedwell and Donnelly, 2005; Kline and Schiffman, 2014; Mason, 2015; Raine, 2006).

Schizotypy is characterized by three-factors and nine underlying symptoms: Cognitive-Perceptual (Factor 1: magical thinking or odd

beliefs, unusual perceptual experiences, ideas of reference, paranoid ideation or suspiciousness); Interpersonal (Factor 2: lack of close friends or confidants, detached or flattened affect, undue social paranoid ideation); and Disorganized features (Factor 3: odd or eccentric behavior, and odd speech) (Association, 2013; Ettinger et al., 2014). All three inter-correlate but distinct factors have utility in identifying unique neurocognitive and behavioral profiles that may inform the etiology of schizophrenia (Barrantes-Vidal et al., 2015; Chen et al., 1997; Cohen et al., 2015; Fonseca-Pedrero et al., 2018; Kline and Schiffman, 2014; Raine, 2006; Stotesbury et al., 2018). Thus, it is important to develop an assessment tool in the general community population to identify early signs of schizotypal personality disorder.

To date, for adults the 74-item self-report Schizotypal Personality

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Questionnaire (SPQ) (Raine, 1991) and its subsequent 22-item brief version (Schizotypal Personality Questionnaire-Brief: SPQ-B) (Raine and Benishay, 1995) have been the most widely used screening tools for schizotypy and its three-factor structure (Fonseca-Pedrero et al., 2017b; Mason, 2015). Numerous studies have repeatedly demonstrated excellent psychometric properties for the three-factor structure of the SPQ across cultures (Compton et al., 2007; Ma et al., 2015; Moreno-Izco et al., 2015; Ortuño-Sierra et al., 2013; Reynolds et al., 2000; Venables and Raine, 2015) and more recently, the three factor structure of the SPQ-B across 14 countries, omega coefficient = 0.86–0.92 (Fonseca-Pedrero et al., 2017a). The full-length adult version has also been administered to Dutch children (van Rijn and Swaab, 2011). An important advantage of the SPQ over other scales which led to its selection in this study is that it represents all nine DSM features of schizotypal personality, and as such has higher content validity than other scales. The SPQ and SPQ-B have high internal consistency ($SPQ_{\alpha} = 0.91$; $SPQ-B_{\alpha} = 0.72$ – 0.80), test-retest reliability ($SPQ_r = 0.82$; $SPQ-B_r = 0.86$ – 0.095), convergent validity ($SPQ_r = 0.59$ – 0.81), discriminant validity and criterion validity with the SCID-II ($SPQ_r = 0.63$ and 0.68) (Bedwell et al., 2006; Compton et al., 2007; Fonseca-Pedrero et al., 2009; Mason, 2015; Mata et al., 2005). Although the adult 74-item SPQ has already been demonstrated to be reliable in Chinese populations ($N = 538$) (Guo et al., 2011), the availability of a reliable and easily-administered screening instrument for children is lacking. While there are issues regarding early detection and prevention of mental health in the general population (Costello, 2016), a schizotypy measure for children may still be of interest to clinicians monitoring symptom conversion to psychosis and researchers working with younger samples.

Though less well-researched, the equivalent modified child version consists of the Schizotypal Personality Questionnaire-Child (SPQ-C) (Raine and Baker, 2003). It has minor wording adjustments and has also been found to be reliable ($\alpha = 0.80$ – 0.92) and suitable for use in young children and adolescents. To date, only three published studies have investigated the SPQ-C. Ericson et al. (2011) showed in a longitudinal twin study ($n = 1457$) in the US that each of the three factors was moderately heritable ($h^2 = 42$ – 53% , age 11–13 years; $h^2 = 38$ – 57% , age 14–16 years) and stable across a 3-year period ($r = 0.26$ – 0.48). In Hong Kong, Raine et al. (2011) administered a Chinese translated version of the SPQ-C to a large sample of 8–16 year olds ($n = 3804$) and found a three factor structure of schizotypy. In another study of Singaporean adolescents (mean age = 13.99 years), self-reported SPQ-C total scores were positively associated with both self-reported aggression (more strongly for reactive than proactive) and anxiety (Seah and Ang, 2008). However, all three of these studies relied on child self-report; thus, observed relationships with other child report scales may be inflated. Few studies to date have examined the SPQ's convergent validity with other behavioral assessments completed by different informants. This remains to be investigated and has important implications for clinician's decisions on informant selection to confirm the child assessment of schizotypy and the structure of the SPQ-C in a Mainland Chinese sample. Although the SPQ-C has already been applied to a Chinese youth population in Hong Kong, it is of interest to examine it within a Mainland Chinese sample because personality disorders may vary widely within the context of culture (Ronningstam et al., 2018). Furthermore, the predominant language in Hong Kong is not Mandarin Chinese but Cantonese. Other differences between mainland China and Hong Kong include individuals' perceptions of personalities and psychopathologies, social norms, political structure, economic development and level of modernization (Lin, 1997). As such, the two regions could be expected to have varying levels of psychopathology. Developing culturally-appropriate assessment tools could help test for true differences in the presence of schizotypal traits in these regions and test for generalizability of findings to, in this case, mainland Chinese children in the community.

As evidenced by the growing benefits of early intervention and the

increasing feasibility of detecting mental deterioration 5 years prior to a clinical diagnosis (Gafoor et al., 2010; McGorry et al., 2002; van der Gaag et al., 2013), both of which can improve clinical outcomes for psychosis (Singh, 2010), there is a clear advantage in developing culturally-appropriate screening tools such as the SPQ-C to assess large community samples of children at a relatively early stage of development (Barrantes-Vidal et al., 2015). Currently, higher scores on the adult SPQ have been found to reflect greater neurobiological and genetic vulnerabilities (Avramopoulos et al., 2002; Barrantes-Vidal et al., 2015; Ettinger et al., 2014, 2015; Fonseca-Pedrero et al., 2018; Vollema et al., 2002). High incidence rates have also been associated with a number of neuropsychiatric syndromes such as obsessive-compulsive disorder (Aycicegi et al., 2005; Barrantes-Vidal et al., 2015; Cohen et al., 2015; Ettinger et al., 2015; Fonseca-Pedrero et al., 2018). In children, there is initial evidence to suggest that higher scores on the SPQ-C have been related to higher levels of childhood aggressive behaviors, specifically reactive aggression, and that peer victimization mediates 56% of this relationship (Raine et al., 2011). Clearly, early detection of schizotypal traits holds important implications for our understanding of the correlates and etiology of schizophrenia and has the potential to identify children at risk for high levels of schizotypal traits as well as other behavioral problems early in development.

To our knowledge, only three studies to date have used the SPQ-C (Ericson et al., 2011; Raine et al., 2011; Seah and Ang, 2008), with none utilizing a mainland Chinese sample. The current study addresses this gap by providing the first assessment of the psychometric properties of the Chinese SPQ-C in a large community sample of 1668 children (aged 12 years). The aims of this study were three-fold: first, exploratory and confirmatory factor analyses were conducted to examine the structure of the Chinese SPQ-C; second, we tested the measurement invariance of the SPQ-C across gender and residential location in order to ensure that the construct is stable across groups; and third and finally, we tested the convergent validity of the SPQ-C with standardized measures of child behavioral problems (social, thought, attention, internalizing, and externalizing) reported by the child's parents and teachers.

2. Method

2.1. Participants and procedure

A total of 1668 6th grade students ($M = 12.10$, $SD = 0.60$, range = 11–14 years) from Jintan (part of Changzhou City) in the Jiangsu province of China participated in this study over a two year period (from 2011 to 2012). Of these, 660 children forming the original cohort were recruited as part of the prospective longitudinal Jintan Cohort Project investigating early health risk factors for child behavior problems (Liu et al., 2015, 2009). The remaining 1008 children were the original cohort's classmates (non-cohort classmate). All study participants were from different schools across the Jintan city, suburbs, and rural areas that were representative of the general population. The data were collected when all children were in the 6th grade and across 2 years (2011–12). The children from the original cohort completed questionnaires assessing their schizotypal personality and own behaviors. We also collected teacher and parent ratings on children's internalizing/externalizing behaviors. However, it was not feasible to collect teacher and parent ratings for the non-cohort classmates due to the large sample size. The recruited non-cohort classmates completed questionnaires assessing only their schizotypal personality. All participants' parents provided written informed consent with adolescents assent. IRB approval was obtained from the University of Pennsylvania and the Ethical Committee for Research at the Jintan Hospital in China. The participants received financial compensation based on the IRB guidelines. Rather than compensating with money, we provided different types of payment suggested by their parents such as study materials (e.g., pencil box), movie theater coupons, or food or snack coupons.

2.2. Measurements

2.2.1. Schizotypal Personality Questionnaire – Child (SPQ-C) and its Chinese translation

Schizotypal Personality Questionnaire-Child (SPQ-C) is a 22-item yes/no child-report inventory developed to assess schizotypal personality in children by the co-author (Raine et al., 2011). Like the previous adult SPQ versions, the SPQ-C contains three subscales: a cognitive perception, a disorganization, and an interpersonal dimension. Summing the relevant items create total and subscale scores, where a higher value denotes more schizotypal traits.

To translate the English SPQ-C to Chinese, we conducted a forward- and backward-translation procedure based on both the standard translation procedures suggested by Brislin (1986) and our previous experience on instrument translations (Liu et al., 2011b, 2018). Specifically, the original English instrument was first translated into Chinese. This Chinese version was then reviewed by a monolingual reviewer for ambiguity or incomprehensibility and back-translated into English. This version was then compared to the original English version to assess inconsistencies and to determine whether the discrepancies could be attributed to the forward translation or the back-translation. Any error in the forward- or backward-translation processes meant repeating the entire procedure again and if necessary, going through a second backward-translation. Data were available on all 1668 children in this study.

2.2.2. Children's behavioral problems

Children's behavioral, emotional and social competencies and problems were assessed by three questionnaires from the Chinese versions of the Achenbach System of Empirically Based Assessment (ASEBA) school-age forms. These were: the Youth Self-Report (YSR), the Teacher Report Form (TRF), and the Child Behavior Checklist (CBCL)/6-18. The psychometric properties of the Chinese YSR, TRF, and CBCL have been well documented in previous studies (Achenbach and Rescorla, 2001; Leung et al., 2006; Liu et al., 2011a) and the instruments have been used in our previous cohort studies (Cui et al., 2017; Liu et al., 2012). Items on the YSR, TRF, and CBCL are rated on a 3-point scale (0 = not true, 1 = sometimes true, or 2 = often true) and summed to produce externalizing and internalizing scores as well as separate scores for social problems, thought problems, and attention problems. These behavioral problems have been found to be strongly correlated with child psychopathology (Achenbach and Rescorla, 2001), social difficulties and thought problems in individuals with schizotypal personality disorder (Wickline et al., 2012). In the present study, we used raw scores on all behavioral problems for the analysis. Data were only available for the original 660 cohort children. Cronbach's α for the total scores of the YSR, TRF, and CBCL in the current study were 0.88, 0.86, and 0.88, respectively.

2.3. Demographic information

Children reported on sociodemographic factors, including gender (male and female), age, residence (city, suburban, and rural), and parental education (primary school and below, middle school, high school, occupational school and above). 99% of the sample was Han-Chinese. Data were available on 1668 children.

2.4. Data analysis

Given that only three studies have used the SPQ-C to date (Ericson et al., 2011; Raine et al., 2011; Seah and Ang, 2008), we first conducted an exploratory factor analysis (EFA) and then a confirmatory factor analysis (CFA) for the 22 SPQ-C items to examine the latent structure of schizotypal traits for our Mainland Chinese sample. First, an EFA was conducted to determine the best-fitting factor structure among non-cohort classmates ($N = 1008$). Second, the structure was confirmed by a CFA on the cohort students ($N = 660$).

To determine the suitability of our sample size for EFA analysis, the Kaiser-Meyer-Olkin (KMO) index (>0.70) and Bartlett's test (<0.05) were conducted (Munro, 2005). A Scree plot of eigenvalues was used to determine the number of factors to extract. It was hypothesized that the factors would be inter-correlated and therefore an EFA was carried out using maximum likelihood and direct oblimin rotation. For the extraction of components, eigenvalues higher than 1 and factor loadings higher than 0.30 were acceptable (Munro, 2005). Using these criteria, each item loaded most highly on one distinct factor.

To assess the construct validity of the SPQ-C in the Jintan Study, the 22-item SPQ-C was tested using a CFA. Model fit was assessed with the following goodness-of-fit indices: χ^2/df (<3.0), the Comparative Fit Index (CFI >0.95 = good fit; >0.90 = adequate fit), the Tucker-Lewis Index (TLI >0.95 = good fit; >0.90 = adequate fit), the Root Mean Squared Error of Approximation (RMSEA <0.06 = good fit; <0.08 = adequate fit), and the Standardized Root Mean Square Residual (SRMR <0.10 = good fit) (Hooper et al., 2008). The model fit was also determined by comparing the Akaike Information Criterion (AIC), where a lower value indicates the most parsimonious model fit balanced by the number of parameters (Akaike, 1987). A last model selection statistic was the Bayesian Information Criterion (BIC), where increasingly negative values corresponds to increasingly better fitting models (Raftery, 1995). The omega index was then used to estimate scale reliability (Dunn et al., 2014).

Within model fit, three levels of measurement invariance (MI), including configural, metric, and scalar invariance were used to test invariance of the SPQ-C across gender and residence separately (McArdle, 2015). The first level of measurement invariance is configural invariance, which implies that the same factor structure holds for all groups, but parameter estimates may vary across groups. Configural invariance is tested by fitting the hypothesized factor model in each of the gender or residence groups separately. If the model fits well, metric invariance is tested next by constraining the factor loadings to be equal across groups. This is satisfied when the latent factor scores predict the item responses equally well across groups, i.e., the common factors have the same meaning across groups. The third level of MI is scalar invariance, which implies that comparisons of group means are meaningful, i.e., that differences in latent response means reflect differences in factor means. Scalar invariance holds if factor loadings and intercepts can both be constrained to be equal across groups. Configural invariance is established by assessing the overall model fitness. Invariance at the metric and scalar level was evaluated using the χ^2 difference test. MI of the SPQ-C was tested sequentially in this order: configural, metric and scalar invariance. While full measurement invariance is established by meeting all MI levels, partial measurement invariance is generally more commonly met.

Finally, two-tailed independent t-tests, Pearson correlations and chi-squared tests ($\alpha = 0.05$) were used to compare differences between demographic groups and to examine the relationship between SPQ-C and the associated factors. The data were analyzed using R 3.3.3 for all descriptive statistics (M , SD , Cohen's d) and exploratory (EFA) and confirmatory factor analyses (CFA) detailed in this study. According to Cohen (1988), $r \geq 0.50$ is high, $r = 0.30$ is medium, $r = 0.10$ is small. Listwise deletion was used for missing values and missing values across demographic variables are detailed in Table 1. No significant outliers were detected in the dataset.

3. Results

3.1. Characteristics of the cohort children and non-cohort classmates

A total of 660 cohort children ($M = 2.10$, $SD = 1.05$, range = 11–14 years) and 1008 non-cohort classmates ($M = 12.20$, $SD = 0.60$, range = 11–14 years) completed the SPQ-C. Table 1 presents the socio-demographic characteristics of the participants. Non-cohort classmates and cohort children did not differ in age ($t = 0.22$,

Table 1
Characteristics of cohort students and non-cohort classmates.

Characteristics	Cohort students (N = 660)	Non-cohort classmates (N = 1008)
Age (mean \pm SD, range)	12.10 \pm 1.05, 11–14 years	12.20 \pm 0.60, 11–14 years
Gender, n		
Male	355	521
Female	305	487
Residence, n		
City	262	339
Suburban	273	279
Rural	125	387
Missing	–	3
Father's occupation, n		
Unemployed	9	
Unskilled labor	84	
Skilled labor	305	
Professional work	109	
Missing	153	
Mother's occupation, n		
Unemployed	51	
Unskilled labor	77	
Skilled labor	189	
Professional work	144	
Missing	199	
Father's education, n		
Primary school and below	9	45
Middle school	189	261
High school	193	305
Occupational school and above	266	270
Missing	3	127
Mother's education, n		
Primary school and below	18	83
Middle school	261	317
High school	157	273
Occupational school and above	221	208
Missing	3	127

$p = 0.40$) or gender ($\chi^2 = 0.71$, $p = 0.83$), but differed in residence ($\chi^2 = 49.57$, $p < 0.05$), father's education ($\chi^2 = 16.54$, $p < 0.05$), and mother's education ($\chi^2 = 7.02$, $p = 0.03$).

3.2. Structure of the SPQ-C

3.2.1. Exploratory factor analysis (EFA)

Our analysis showed that the data and sample size of the non-cohort classmate were suitable for conducting factor analysis (KMO = 0.875, Bartlett's test < 0.001). An examination of the Scree plot showed a one to five factor solution based on the point of inflection. We retained factors based on the average eigenvalues and used eigenvalues greater than 0.70 as the cut off. As a result, a three-factor model seemed to best fit the data (Yong and Pearce, 2013). These three factors, presented in Table 2, accounted for 35.83% of the total variance in the model (eigenvalues = 4.99, 1.64 and 1.25, respectively). We extracted a three factor model and further rotated the factor loading solution, with all except 4 items (item 1, item 5, item 18, and item 20) having only one factor loading greater than 0.30. As our EFA results differed somewhat from Raine et al. (2011) three factor solution of schizotypy (cognitive-perceptual, disorganized, and interpersonal features) we decided to rename our three factors to perceptual and speech deficits, odd behavior, and the interpersonal-affective factor.

3.2.2. Confirmatory factor analysis (CFA)

CFA of the schizotypy data from the cohort children demonstrated an adequate fit for a three-factor model: $\chi^2/df < 3.0$, RMSEA < 0.06 and SRMR < 0.08 , CFI = 0.87, TLI = 0.85 (supplement Table 1S).

Factor loadings are detailed in the supplementary Table 2S. Medium to high factor loadings (0.35–0.76) were observed for all items except for items 5(0.27) and 8(0.29). Even though the factor loadings of these items were < 0.30 in the CFA, we decided to include them to maintain consistency with the original English SPQ.

The Omega value for the total SPQ-C was 0.83 and the Omega for the three subscales was 0.53 for interpersonal-affective factor, 0.65 for perceptual and speech deficits and 0.70 for odd behavior.

3.3. Measurement invariance of the SPQ-C across gender, age, and residence

Separate measurement invariance tests were conducted to test whether the three-factor SPQ-C model was invariant across gender, age and residence. Fit indices for these models are reported in supplementary Tables 3S and 4S. For gender invariance, configural invariance was met because the overall model fit was acceptable (Hooper et al., 2008). However, metric invariance was not established as the p -value was less than 0.05 for boys and girls ($\Delta\chi^2 = 37.58$, $p = 0.007$), thus indicating partial measurement invariance. For the residence invariance, both configural and metric invariance were established as the p -value was greater than 0.05 ($\Delta\chi^2 = 32.79$, $p = 0.71$). Nevertheless, scalar item invariance was not established ($\Delta\chi^2 = 57.65$, $p < 0.05$), which indicates partial measurement invariance.

3.4. Inter-subscale correlations and t tests with demographic variables

The SPQ-C inter-subscale correlations were medium to high (r range = 0.36–0.72) and high with the SPQ-C total score (r range = 0.67–0.94). Boys scored significantly higher than girls on all subscales as well as for the total SPQ-C score, and boys reported significantly higher odd behavior scores than girls, although the effect size was small ($d = 0.19$) (see Table 3). SPQ-C and father's education and mother's education were non-significant across gender and age (all p -values > 0.05).

3.5. The associations between SPQ-C and behavioral problems

All associations between the SPQ-C total score, SPQ-C subscale scores and the ASEBA child behavioral outcome measures assessed by child-, teacher- and parent-reports are shown in Table 4. Higher levels of total schizotypy were related to higher levels of behavioral problems reported across different informants (r range = 0.11–0.31, $p < 0.05$), except for parent-reported social problems (r range = 0.58–0.81, $p > 0.05$) and teacher-reported attention problems (r range = 0.67–0.82, $p > 0.05$). In addition, each of the three schizotypal factors were positively and significantly related to internalizing and externalizing behavior problems reported by the three informants (YSR 0.180–0.308; TRF 0.097–0.199; CBCL 0.107–0.153), except for the interpersonal-affective factor on parent-reported internalizing behavior ($p > 0.05$). All three child-reported factors of schizotypy were positively related to social, thought and attention problems. However, no associations were observed between child-reported odd behavior and teacher-reported social, thought and attention problems. Similarly, both cognitive-perceptual and interpersonal-affective factors were not related with parent-reported social and thought problems.

4. Discussion

This study evaluated the psychometric properties of the Chinese version of the SPQ-C in a large community sample of 1668 6th-grade children in Jintan, China. The main findings of this study for the Chinese version of the SPQ-C were that: (1) the EFA broadly replicated the English three-factor structure with the exception that odd speech loaded on the cognitive-perceptual factor, (2) the CFA documented a reasonably good fit to the three-factor model, (3) adequate psychometric properties were obtained together with males showing higher

Table 2
EFA pattern matrix with three factors.

	Factor		
	Perceptual and speech deficits	Odd behavior	Interpersonal-affective
12. I have had experiences like seeing flying saucers, or knowing something will happen before it does.	0.435		
9. I often pick up on hidden threats or put-downs from what people say or do.	0.413		
13. I sometimes use words in unusual ways.	0.408		
2. I have sometimes felt that there was a person or ghost around me, even though there was no-one there.	0.401		
16. I sometimes feel distracted by far-off sounds that I'm not normally aware of.	0.347		
10. I get the feeling that other people are watching me when I am out playing or shopping.	0.311		
8. I sometimes ramble on when I am talking.	0.311		
4. I sometimes think that other people can read my mind.	0.306		
5. I sometimes find that common events or objects have a special message for me.	0.299		
20. I find it hard getting people to understand what I am saying.	0.286		
1. I am a bit unfriendly and cold.	0.207		
3. I sometimes act oddly.		-0.321	
6. I am a strange person.		-0.82	
19. I am an odd, unusual person.		-0.774	
21. I feel very uneasy talking to people I do not know well.			-0.624
11. I feel very uncomfortable in social situations involving people I don't know.			-0.609
15. I often keep in the background on social occasions.			-0.453
17. I often have to stop people from taking advantage of me.			-0.365
14. I find it best not to let other people know too much about me.			-0.347
22. I tend to keep my feelings to myself.			-0.325
7. I feel I have to be on my guard even with friends.			-0.308
18. I find it hard to make close friends.			-0.192

^aThe three factor model explains 35.83% of the total variance in the data (before rotation).

scores than females, (4) partial measurement invariance was achieved across gender and residence; and (5) good construct validity with other standardized parent- and teacher-rated measures of child behavioral problems was shown. This is the first study to establish structural equivalence of the SPQ-C across gender, age, and residence in a large community sample of mainland Chinese children, and importantly, convergent validity with standard child behavioral assessment tools across informants (i.e., CBCL, YSR and TRF). Each of these findings will now be discussed in turn.

With respect to factor structure, both EFA and CFA confirmed that, to a large extent, the Chinese 22-item SPQ-C mirrors the three factor structure of the English SPQ-C. However, some minor differences in item loadings were observed in this first study of a mainland Chinese community youth sample. In particular, item loadings were highest for the Odd / Eccentric Behavior (F3) factor, ranging from 0.55 to 0.75, compared with the Cognitive-Perceptual (F1; range = 0.27–0.52) and Interpersonal factor (F2; range = 0.37–0.62), with all three factors explaining 35.83% of the total variance in the model. Furthermore, odd speech items (e.g., “I sometimes ramble on when I am talking”) loaded on the Cognitive-Perceptual factor rather than on Disorganization, which in this east Asian sample could, for example, be due to cognitive abnormalities (cognitive-perceptual) resulting in having too many thoughts to communicate (rambling). Further studies on mainline Chinese populations could assess whether this alteration in factor structure is a cultural phenomenon, or whether it represents a developmental difference between children and adults.

Regarding demographic variables, interesting gender differences

were found, with boys being more likely to endorse ‘acting strange and odd’ compared with girls on F3 ($d = 0.19, p < 0.01$). This finding is consistent with the existing literature that males report significantly more odd behavior (F3) than females (Fossati et al., 2003). However, the boys and girls in this sample did not differ on F1 and F2, which is somewhat consistent with a study of adolescents where they found gender invariance across all three factors at 11–13 years and 14–16 years (Ericson et al., 2011). Findings from the current study are based on children who are younger than in prior studies, yet they lend support to the sex difference previously found for F3 (Fossati et al., 2003). This sex difference reflects the conclusions of other researchers that such differential relationships may be observed early in child development and sustained into adulthood (Fossati et al., 2003), while the sex differences for F1 and F2 (where females score higher than males) does not develop until later in adolescence and early adulthood. Future studies including a wider developmental period could help confirm of disconfirm this conclusion.

Regarding tests of invariance, partial rather than full measurement invariance for gender and residence was established for the Chinese SPQ-C. This is not uncommon for measures of childhood behavior (Wong et al., 2014). Partial invariance for gender, satisfying the configural but not the metric invariance, reflects non-uniform levels of schizotypal traits for boys and girls at the mean level. This suggests that the latent factor scores on the SPQ-C do not predict the item responses equally well across genders, and it is possible that gender is associated with the severity of schizotypal features in the normal population (Raine, 1992). Regarding residence, satisfying both the configural and

Table 3
Sex differences in SPQ scores with means (M), standard deviation (SD), range and effect sizes (Cohen's d).

Scales	Males M ± SD (range)	Females M ± SD (range)	t test	p	d
SPQ-C total	7.05 ± 4.83 (0–22)	6.57 ± 4.37 (0–22)	1.34	0.18	0.10
Perceptual and speech deficits	3.78 ± 2.54 (0–15)	3.57 ± 2.38 (0–15)	1.08	0.28	0.085
Odd behavior	0.64 ± 0.96 (0–3)	0.46 ± 0.89 (0–3)	2.57	0.01**	0.19
Interpersonal-affective	2.66 ± 2.19 (0–8)	2.62 ± 2.04 (0–8)	0.29	0.77	0.019

Notes: Males (N = 355, age 11–14), Females (N = 305, age 11–14).

** p < 0.01.

Table 4
Correlations between SPQ-C and multi-informant ASEBA.

	Social problems		Thought problems		Externalizing behavior		Internalizing behavior	
	YSR	TRF	YSR	TRF	YSR	TRF	YSR	TRF
M ± SD	3.56 ± 2.85	1.44 ± 2.36	3.61 ± 3.52	.70 ± 1.56	2.14 ± 2.35	3.72 ± 5.36	10.52 ± 7.16	4.61 ± 6.12
SPQ-C total	.280**	.176**	.261**	.150**	.081	.141**	.313**	.078
Perceptual and speech deficits	.227**	.153**	.208**	.131**	.058	.136**	.308**	.072
Odd behavior	.174**	.067	.235**	0.066	.092*	.097*	.180**	.067
interpersonal-affective	.249**	.173**	.201**	.147**	.081	.101**	.220**	.082
M ± SD								
SPQ-C total								
Perceptual and speech deficits								
Odd behavior								
interpersonal-affective								

Notes: SPQ-C, Schizotypal Personality Questionnaire-Child; YSR, Youth Self-Report; TRF, Teacher Report Form; CBCL, Child Behavior Checklist (CBCL)/6-18.

** $p < 0.01$.

* $p < 0.05$.

metric but not scalar invariance, suggests differences across residence location on schizotypal traits at the item level. Schizotypy has been found to be higher in urban areas compared to rural areas (Masiak et al., 2014) and could conceivably contribute to scalar invariance. These findings need to be replicated on further samples, and should to be taken into consideration when interpreting and making direct comparisons of SPQ-C scores across genders and residential categories.

Regarding validity, this study demonstrates for the first time the behavioral correlates of childhood schizotypy using a multi-informant approach. There was evidence for construct validity based on significant positive correlations (0.26–0.31) between the SPQ-C and the child self-reported behavioral problems on the YSR. While these relationships may be inflated due to the single-informant nature, associations in the same direction were found with all five teacher- and parent-reported behavioral problems, albeit at a lesser magnitude (0.10–0.15), providing additional support for the construct validity of SPQ-C and its relationships with both parent and teacher reported behavioral problems. All child-reported schizotypal traits were positively correlated with parent-reported Attention Problems (r range = 0.08–0.17) but not with teacher reports except for Social Problems and Thought Problems. This is likely due to parents and teachers being attuned with different child behaviors given the contexts of home and school, and furthermore parent-child and teacher-child reporting disagreement is relatively common (Jepsen et al., 2012). Childhood schizotypal traits may be expressed differently in different environments, as children are engaged in more socializing activities with peers and problem-solving learning activities in the classroom than in the home, and thus differential correlates could be expected (Wong et al., 2014). Given the differential magnitudes of the parent-child and teacher-child relationships, studying inter-rater disagreement may be of particular relevance from clinical and research standpoints (Cleridou et al., 2017).

This study is not without limitations. These findings are cross-sectional, providing only associations between childhood schizotypy and problem behaviors, and causal direction cannot be determined. It utilizes self-reported measures with multi-informant perspectives to validate the data, potentially leading to response subjectivity and bias. Furthermore, due to the social stigma that still surrounds negative behaviors in the Chinese culture, prevalence rates on the SPQ-C and other behavioral assessments may reflect an under-reporting of true behaviors, despite researchers' efforts to remind participants that their responses are confidential. We also did not perform a correction for multiple analyses for the correlations between SPQ-C and behavioral data, considering that a Type II error may arise. Another limitation of the present study is the limited age range (11–14 years old, with a mean age 12.10 ± 0.60 years). While schizotypal traits are thought to begin increasing during adolescence (Bora and Baysan, 2009; APA, 2013) with schizotypal scores increasing as age increases (Fonseca-Pedrero et al., 2008), this age constraint may preclude our results from being representative of the general children population. Furthermore, findings from this large mainland Chinese community sample of school-children need to be tested against another Western sample to rule out and identify culture-specific and universal behavioral patterns. Lastly, given that we found a different factor structure in that the items of the odd speech load on the cognitive-perceptual factor, further testing of the factor structure is needed.

Notwithstanding these limitations, this study provides the first evidence for the use of the three-factor SPQ-C in a large mainland Chinese sample of community children that is further corroborated by standardized parent- and teacher-reported behavioral assessments. The mean scores observed in this Eastern sample were similar to previous studies (Raine et al., 2011), with the gender contrast for the Odd / Eccentric Behavior factor at this age group being of particular interest for future replication. Importantly, these findings suggest that child-reported schizotypy even as young as 11 years-old is reliable in its own

right. Depending on the behavioral problem assessed, clinicians may consider a more accurate and holistic picture of the child's development by including parent (e.g., Social Problems) and teacher assessments (e.g., Attention Problems) alongside the SPQ-C. We hope that the SPQ-C as a psychometrically robust tool can provide clinicians and researchers alike with an instrument to conduct developmental research into understanding the etiology of schizotypy and its correlates and later schizophrenia-spectrum disorders in different cultures.

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Supplementary materials

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Appendix: Chinese version of SPQ-C

分裂性人格障碍-儿童问卷 (SPQ-C)

请根据你现在或过去半年的情况回答以下每个问题, 如果符合您的情况, 请您在答案“是”上画圈, 如果不符, 则在“否”上画圈. 即使有不确定答案的问题, 也请如实回答完所有的问题. 完成问卷后, 请逐一检查您是否已经回答了所有的问题.

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Disclosure statement

There are no conflicts of interest to disclose.

1.	我有些不友善和冷淡.	是	否
2.	我有时觉得身边有人或鬼魂, 即使周围什么人也沒有.	是	否
3.	我有时行为举止怪异.	是	否
4.	我有时觉得别人能看穿我的想法.	是	否
5.	我有时发现普通的事件或物品对我有特别的含义.	是	否
6.	我是一奇怪的人.	是	否
7.	我觉得即使跟朋友一起也要保持警觉.	是	否
8.	我有时讲话会东拉西扯.	是	否
9.	我经常从别人说的话或做的事中感觉到隐晦的威胁或者羞辱.	是	否
10.	当我出门玩耍或购物的时候我感觉别人在监视我.	是	否
11.	我在有陌生人的社交场合感到非常不自在.	是	否
12.	我曾有过看到飞碟或未卜先知的经历.	是	否
13.	我有时以不同寻常的方式说话.	是	否
14.	我发觉最好不要让别人对我有太多了解.	是	否
15.	在社交场合我经常不在人前露面.	是	否
16.	我有时听到远处传来平时不会察觉的声音, 使我感到困扰.	是	否
17.	我经常提防别人占我便宜.	是	否
18.	我觉得难以交到亲密的朋友.	是	否
19.	我是一个不寻常的人.	是	否
20.	我觉得难以让别人理解我说的话.	是	否
21.	跟不熟悉的人讲话我会觉得很不自在.	是	否
22.	我倾向于将自己的感受隐藏起来.	是	否

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