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The Chapman psychosis-proneness scales: Consistency across culture and time

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ABSTRACT

The purpose of the present study was to examine the factor structure and the temporal stability of the Chapman psychosis-proneness scales in a representative sample of nonclinical Chinese young adults. The four psychosis-proneness scales evaluated were the Perceptual Aberration (PAS), Magical Ideation (MIS), revised Social Anhedonia (RSAS), and revised Physical Anhedonia (RPAS) scales. The sample consisted of 1724 young adults with a mean age of 18.8 years (S.D.=0.84). The results of the confirmatory factor analyses indicated that the best fitting model was a two-factor model with positive schizotypy (PER and MIS) scales and negative schizotypy (RSAS and RPAS) scales. The data add to the growing literature indicating that the measurement of schizotypal traits is consistent across cultures. In addition, the results support the measurement invariance of the Chapman psychosis-proneness scales across time, i.e., there was ample evidence of test–retest reliability over a test interval of 6 months.

1. Introduction

Schizotypy, as a personality organization, is associated with a latent liability for schizophrenia, and can be detected through various psychological, neurological, and psychophysiological measures (Ettinger et al., 2015). There are two main conceptualizations of the relationship between schizotypy and schizophrenia. In dimensional models (see Claridge and Beech (1995); Beauchaine et al. (2008)), the latent structure of schizotypy is on a continuum between normal psychological functioning and extreme dysfunction in the form of psychosis and schizophrenia. In contrast, Meehl's (1962), (1990) model of schizotypy is a taxonic model (Gooding and Iacono, 1995, Lenzenweger, 2010). Thus in Meehl's model, an individual may be categorized as possessing the hypothesized latent trait (taxon) or not. Regardless of whether one advocates the dimensional approach or the taxonic approach, research on schizotypy is valuable because it enables investigation into the etiology of schizophrenia-spectrum disorders and other psychotic disorders without the confounds associated with psychosis, such as medication effects, chronic illness, and institutionalization or hospitalization.

Psychometric assessment of psychosis-proneness in general, and in particular, schizotypy, has proven to be a viable means of screening large numbers of individuals from community (Blanchard et al., 2011) and college populations (e.g., Chapman et al., 1994; Gooding et al., 2005) who are at heightened risk for the later development of schizophrenia and schizophrenia-spectrum disorders. Longitudinal research (Gooding et al., 2007) has demonstrated that the psychometric high-risk method may identify some individuals at risk who might otherwise not be detected by the genetic high-risk paradigm. The Chapman scales are arguably the most widely used psychometric scales used in studying individual differences in risk for the later development of schizophrenia and schizophrenia-spectrum disorders. Indeed, the Chapman scales were originally designed with Meehl's (1962, 1964) definition of schizotypy in mind.

Descriptions of the factorial structure of schizotypy vary. Some investigators (Kelly and Coursey, 1992; Vollema and van den Bosch, 1995; Kerns, 2006;Brown et al., 2008; Kwapil et al., 2008, 2012) maintain that schizotypy is best described as consisting of two factors, whereas others assert that three or more factors (Reynolds et al., 2000; Venables and Rector, 2000; Stefanis et al.,

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2004; Wuthrich and Bates, 2006; Compton et al., 2009) are better able to account for the variance underlying the latent construct. The most consistently reported factors are positive and negative schizotypy, (sometimes referred to as cognitive–perceptual and interpersonal factors, respectively) though other frequently mentioned factors include disorganization and nonconformity (Kwapil et al., 2008; Asai et al., 2011). The identification and characterization of a multidimensional structure of schizotypy is advantageous in that it helps account for the phenotypic heterogeneity observed among individuals with schizotypy and schizophrenia-spectrum disorder. To the extent that schizotypy is multidimensional, the ability to relate different dimensions of schizotypy to various biobehavioral and/or neuroimaging correlates will enhance our ability to search for hypothesized etiological pathways and mechanisms (Reynolds et al., 2000). Moreover, longitudinally studying individuals who are differentially characterized by different dimensions may lend greater insights regarding the developmental ontogeny of schizophrenia-spectrum disorders (cf. Gooding and Iacono, 1995; Gooding et al., 2005).

Brown et al. (2008) observed that the revised Social Anhedonia Scale cross-loaded on both positive and negative schizotypy factors. This small-scale study of approximately 400 undergraduates was followed up by a study of over 6000 Caucasian and African–American nonclinical young adults. Using confirmatory factor analysis, Kwapil et al. (2008) found empirical support for a two-factor structure of schizotypy that was largely invariant across gender and ethnicity. However, because they noted that the revised Social Anhedonia Scale loaded on both the positive and negative schizotypy factors, they concluded that the revised Social Anhedonia Scale was a multidimensional measure of schizotypy. Kwapil et al. (2012) conducted confirmatory factor analyses separately on a Spanish sample and an American sample to compare the structure of psychometric schizotypy across cultures. In both samples, the authors found that an alternative model in which the revised Social Anhedonia Scale cross-loaded on positive and negative schizotypy factors provided the best fit for the data, consistent with their earlier work. The findings of Kwapil et al. (2012) are noteworthy because they provide some evidence of cross-cultural factor invariance.

As measures of putative latent traits, it is important that such individual differences in status be consistent over time. That is, if a measure of individual differences is to be useful, then the scores indicating the individual differences for a given trait should be relatively unchanging (Cronbach, 1947). There are few studies of the temporal stability of the Chapman psychosis-proneness scales. A prior study (Chapman et al., 1982) based upon a test–retest interval of 6 weeks in an undergraduate student sample consisting of 178 males and 333 females reported test–retest reliabilities for the Perceptual Aberration, Magical Ideation, and Physical Anhedonia scales which were in the 70s and 80s. However, the test–retest reliability of the Social Anhedonia Scale was not measured in that investigation. In later reports, Chapman et al. (1994) stated that the test–retest reliabilities for the psychosis-proneness scales (including the revised Social Anhedonia Scale) ranged from 0.75 to 0.85. A 2-year study of the temporal stability of the scales in a German community sample revealed lower test–retest reliabilities for the Perceptual Aberration ($r_{tt}=0.43$), Magical Ideation ($r_{tt}=0.41$) and Physical Anhedonia scales ($r_{tt}=0.65$); (Meyer and Hautzinger, 1999).[1] Over a test–retest interval of 5 years, Erlenmeyer-Kimling et al. (1993) observed that their New York High-Risk Project sample displayed temporally stable Physical Anhedonia Scale scores ($r_{tt}=0.62$).

When Winterstein et al. (2010) calculated the traditional test–retest reliabilities for all four Chapman psychosis-proneness scales on two independent samples, they found that both the revised Social Anhedonia Scale and the revised Physical Anhedonia Scale were temporally stable (the r's$=0.81$). However, the reliability coefficients for the Magical Ideation Scale (0.73 and 0.79) and those for the Perceptual Aberration Scale (0.63 and 0.76) for the two samples were lower. This group also conducted generalizability analysis (Hoyt and Melby, 1999). Generalizability analysis is largely a descriptive statistical method based on score dependability coefficients. Their results suggested that only the revised Social Anhedonia Scale accounted for an acceptable level of variance, in terms of pointing out real differences between study participants. However, their total samples were relatively small (N's of 160 and 102). In summary, a review of the literature suggests that, nearly all reports of the test–retest reliability of the revised Social Anhedonia and revised Physical Anhedonia scales show generally moderate to high temporal stability, ranging from 0.62 to 0.85. The Perceptual Aberration Scale has shown low to moderate temporal stability, with retest reliabilities ranging from0.43 to 0.76, and the Magical Ideation Scale performing similarly, with retest reliabilities ranging from 0.41 to 0.82.

The increasing globalization of psychological assessment makes cross-cultural investigations of the psychometric properties of frequently-used schizotypy measures quite valuable (Fonseca-Pedrero et al., 2008). The aims of the present study are two-fold: the first goal is to examine the factor structure of the Chapman psychosis-proneness scales in a cross-cultural context. Although there have been investigations of the factor structure of the Chapman scales in American (Kwapil et al., 2008, 2012), German (Meyer and Keller, 2001) and Spanish (Kwapil et al., 2012) samples, to date, there has not been a comparable study conducted using the Chinese translations of the scales. We hypothesized that the factor structure of the Chapman psychosis-proneness scales would be invariant across culture; that is, we expected to replicate earlier findings reported in American, Spanish, and German samples, in Chinese students. More specifically, we expected that a two-factor solution would provide the best fit for the data. The second purpose of this investigation was to evaluate the temporal stability of the four most commonly used Chapman scales in a large sample of nonclinical adults. We hypothesized that the Chapman scale scores would be invariant over time, thereby indicating temporal stability. To our knowledge, this investigation is the first examination of the retest stability of the Chapman psychosis-proneness scales in a Chinese population.

2. Method

2.1. Participants

The participants were 1849 college students who were recruited from three universities in Beijing, Shanghai and Guangzhou. This was a naturalistic study of nonclinical young adults whose only requirement was age over 18 years old. Refusals per class were not documented, but response rate per school, when compared to class sizes, suggests that the refusal rate was negligible.

2.2. Materials

All participants were administered a set of questionnaires, including four Chapman psychosis proneness scales (namely, the revised Social Anhedonia (Eckblad et al., 1982), revised Physical Anhedonia (Chapman et al., 1976), Magical Ideation (Eckblad et al., 1983) and Perceptual Aberration Scales (Chapman et al., 1978)), and other checklists to capture general mental health status. The Chapman scales were designed to tap personality traits that assess a predisposition to psychosis. The psychometric properties of these scales have been reported elsewhere (see, for example, Chapman et al., 1995). Validated Chinese translations of the four scales (Wang et al., 2012) were used. The Perceptual Aberration Scale taps transient body image and perceptual distortions, with items such as "I have sometimes felt that some part of my body no longer

[1] It is noteworthy that Meyer and Hautzinger used a shortened version of the Physical Anhedonia scale, which may have resulted in a lower estimate of stability over time.

belongs to me" (keyed true). The Magical Ideation Scale assesses belief in causality that is not valid (e.g., "Good luck charms don't work"; keyed false).

The revised Social Anhedonia Scale measures social withdrawal, a lack of interest in social relationships and/or a lack of pleasure derived from interpersonal relationships (e.g., "I sometimes become deeply attached to people I spend a lot of time with", keyed false). The revised Physical Anhedonia Scale was designed to measure a deficit in the ability to experience sensory and esthetic pleasure. It included items such as "The beauty of sunsets is greatly overrated" (keyed true).

2.3. Procedures

Written informed consent was obtained before the participants began the questionnaires. The participants completed the questionnaires in groups of approximately 60 students each. The questionnaires took 30 to 40 min to complete, and the length of the entire assessment was 1 h. The participants were paid for their participation. All the subjects were re-administered the Chapman scales 6 months later. The study was approved by the ethics committee of the Institute of Psychology, Chinese Academy of Sciences.

2.4. Data analysis

Structural equation modeling, specifically, confirmatory factor analysis (CFA), was conducted to examine the factor structure. In order to reduce the likelihood of estimation errors while examining the structural relations between the latent variables, we used an item parceling technique (Sass and Smith, 2006). Item parceling is frequently performed in order to yield more robust estimates for subsequent confirmatory factor analyses (CFAs), particularly when the data consists of dichotomously categorized items and/or nonnormally distributed items (Bandalos, 2002). Due to the large number of items in each of the Chapman scales, the items of the four scales were divided into three "parcels", according to Little et al. (2002). So that each parcel would have similar items, we conducted the item-total correlation first, then listed the items from largest correlation with the total scale to the smallest correlation. Finally, the items were assigned to the first, second and third parcel in sequence forward and backward, so parcels included a balanced proportion of items from each third of the scale. Cronbach's (1951) alpha coefficients were computed to determine the internal consistency of each of the Chapman scales.

Different factorial models were tested to examine the factor structure of the Chapman psychosis-proneness scales. Each of the models was a variation of three basic models first tested in Kwapil et al.'s (2008) previous work, namely: a unidimensional model, in which all the variables loaded onto a single schizotypy factor; a two-factor model in which there was a positive schizotypy factor (with loadings from the Perceptual Aberration and Magical Ideation Scale parcels) and a negative schizotypy factor (with loadings from the revised Social Anhedonia and revised Physical Anhedonia Scale parcels); and a two-factor model in which the revised Social Anhedonia Scale loaded on both the positive and negative schizotypy factors (see Table 2).

Goodness of fit was assessed using multiple indicators, including the Comparative Fit Index (CFI), Tucker-Lewis index (TLI) (non-normed fit index (NNFI)) and its confidence interval, Root Mean Square Error of Approximation (RMSEA), and the chi-square statistic. However, absolute indices used to evaluate overall model fit such as the chi-square test are sensitive to sample size and may yield misleading findings (Milfont and Fischer, 2010). In addition, we also evaluated the goodness of fit using the Standardized Root Mean Square Residual (SRMR), Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). The CFA and cross-time invariance analysis were conducted in Mplus (Muthén and Muthén, 2011).

3. Results

3.1. Descriptive statistics

Participants whose questionnaires were incomplete were omitted from further analyses. This resulted in 6.76% (125 of 1849) participants being dropped, for a final sample of (645 male, 1079 female) 1724 students. The mean age of the students was 18.81 ($\pm$0.84) years. At the time of initial testing, they had a mean of 12.31 ($\pm$0.74) years of education.

The mean scores for the Perceptual Aberration Scale was 6.93 and 6.43 for the two time points respectively (S.D.=5.85, 6.49; range, 0–35 for both times), and 12.01 and 10.82 for the Magical Ideation Scale (S.D.=4.73, 4.83; range, 2–27, 1–29). In this sample, the mean scores for the revised Social Anhedonia Scale was 8.17 and 8.16 (S.D.=5.42, 5.85; range, 0–32, 0–30), and 15.45 and 14.35 for the revised Physical Anhedonia Scale (S.D.=7.26, 8.25; range, 2–49,1–42) for Time 1 and Time 2, respectively. The internal consistencies of the Chapman scales, before and after parceling, are presented in Table 1. The internal consistencies of all the scales were moderately high (Cronbach α's ranging from 0.75 to 0.885 and 0.768 to 0.917 for Time 1 and Time 2, respectively).

Table 1
The reliability of the Chapman psychosis-proneness scales before and after being parceled.

		RSAS	RPAS	MIS	PAS
Sample	*N*	α	α	α	α
Time 1	1724	0.82	0.83	0.75	0.89
Time 2	1724	0.85	0.87	0.77	0.92
STUt1parceled	1724	0.81	0.83	0.77	0.89
STUt2parceled	1724	0.84	0.87	0.79	0.92

Note: All the participants are undergraduate students. RSAS=revised Social Anhedonia Scale; RPAS=revised Physical Anhedonia Scale; MIS=Magical Ideation Scale; PAS=Perceptual Aberration Scale; Time 1=the first test administration of the Chapman scales, Time 2=the second administration of the Chapman scales. α=Cronbach's alpha.

3.2. Assessing goodness of fit for competing models

Table 2 contains the multiple indicators for the fitness of each model. As can be seen, the models which showed the best fit on the basis of the chi-square were the 2factor complete correlate model (i.e., two-factor model where positive schizotypy and negative schizotypy were correlated), 2factor complete correlate biloading model (i.e., two-factor model where RSAS items loaded on both negative schizotypy and positive schizotypy factors), 2factor partial correlate model (i.e., two-factor model where positive and negative schizotypy factors correlated but were independent), and 2factor partial correlate biloading model (i.e., two-factor model where revised Social Anhedonia Scale items loaded on both negative and positive schizotypy factors and both revised Social Anhedonia Scale and revised Physical Anhedonia Scale items were independent models). However, only three of those models also fulfilled the criterion of having the CFI value higher than 0.95 and the RMSEA lower than 0.06.

Although the 2factor partial correlate model's fitness indexes were slightly lower than the other three models as shown in the Table 2, we selected the 2factor partial correlate model as the best model. There were several reasons for the selection of that model. First, theoretically, the revised Social Anhedonia Scale is a measure of negative schizotypy. Secondly, the revised Social Anhedonia Scale loadings on the positive schizotypy factor were very small, namely, −0.095, 0.156, and 0.012. The third reason for choosing the 2factor partial correlate model is that it was simplest of the 4 best fit models, and only slightly decreased the fitness. Finally, the other three models all have a non-positive definite loading problem, which occurs when the covariance matrices contain zero or negative eigenvalues and/or there are high correlations between some of the underlying constructs; either way, these alternative models are less than optimal (Wothke, 1993). Fig. 1 shows the standardized coefficients for the best fitting model. This is a model showing the Chapman psychosis proneness scales for a 2-factor model with negative schizotypy (revised Social Anhedonia and revised Physical Anhedonia Scales) and positive schizotypy (Magical Ideation Scale and Perceptual Aberration Scales).

3.3. Invariance across time

The results of the cross-time invariance test are presented in Table 3. Nested models were tested to determine whether components in the factorial structure of the Chapman psychosis proneness-scales were operating equivalently across time. Since the sample was too

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Table 2
The fitness indicators of the models in all participants (n=1724).

Model	χ^2	d.f.	P	CFI	TLI	RMSEA	RMSEA CI90	SRMR	AIC	BIC
1factor	4317.79	54	< 0.001	0.572	0.477	0.214	0.209 0.219	0.171	86,294.727	86,491.013
1factor complete correlate	593.52	42	< 0.001	0.945	0.913	0.087	0.081 0.094	0.099	82,594.456	82,856.171
2factor complete independent	1863.61	54	< 0.001	0.818	0.778	0.139	0.134 0.145	0.128	83,840.546	84,036.832
2factor and item independent	1740.77	53	< 0.001	0.831	0.789	0.136	0.130 0.141	0.086	83,719.703	83,921.442
2factor complete correlate*	297.13	41	< 0.001	0.974	0.959	0.060	0.054 0.067	0.046	82,300.072	82,567.240
2factor complete correlate biloading*	190.27	38	< 0.001	0.985	0.973	0.048	0.042 0.055	0.036	82,199.209	82,482.734
2factor partial correlate	332.34	47	< 0.001	0.971	0.96	0.059	0.053 0.065	0.047	82,323.273	82,557.727
2factor partial correlate biloading	228.65	44	< 0.001	0.981	0.972	0.049	0.043 0.056	0.036	82,225.583	82,476.394

Note: d.f.=Degrees of freedom; CFI=Comparative Fit Index; TLI=Tucker Lewis Index; RMSEA=Root Mean Square Error of Approximation; CI90=90% Confidence Interval; AIC=Akaike Information Criterion; BIC=Bayesian Information Criterion.
Different theoretical models of schizotypy being tested: 1 factor=all 12 independent parceled items measure one factor Schizotypy. 1factor complete correlate=12 parceled items correlated in each subscales and all measure one factor. 2factor complete independent=12 parceled items were independent, revised Social Anhedonia Scale (RSAS) and revised Physical Anhedonia Scale (RPAS) measured negative schizotypy and Magical Ideation Scale (MIS), and f (PAS) measured positive schizotypy, the correlation between negative and positive schizotypy is zero. 2factor and item independent=equal to 2factor complete independent model, except negative and positive schizotypy were allowed to correlate. 2factor complete correlate=equal to 2factor and item independent model, except 12 parceled items correlated in each subscales. 2factor complete correlate biloading=equal to 2factor complete correlate model, except RSAS items also measured positive schizotypy. 2factor partial correlate=equal to 2factor complete correlate model, except RSAS, PAS items were independent. 2factor partial correlate biloading=equal to 2factor complete correlate biloading, except RSAS, PAS items were independent.

* One lambda was not significant, and the lambdas were all less than 0.2.

large for the Chi-square tests to be insignificant, we used the fitness indicator difference test (Cheung and Rensvold, 2002; Meade et al., 2008). When the difference of the fitness indicator is smaller than 0.01, it indicates no significant difference. When the difference is between 0.01 and 0.02, it indicates there is a slight difference. If the difference of the fitness is larger than 0.02, it indicates a significant difference. As we constrained more and more parameters, the fitness index only changed slightly (< 0.01, except from Metric invariance to Scalar invariance= 0.01) suggesting the Chapman psychosis proneness scales have measurement invariance and structure invariance across time.

4. Discussion

The present study provides ample evidence of psychometrically validated positive and negative dimensions of schizotypy, as measured by the Chapman psychosis-proneness scales, in a non-Western culture. This is the first investigation to do this using confirmatory factor analysis. The present Chinese undergraduate student sample was characterized by a two-factor structure. These results are largely consistent with what is observed in Western cultures. That is, in this sample of 1724 Chinese students, the best fitting model was a two-factor model with positive and negative schizotypy dimensions.

We differ somewhat from Kwapil and colleagues (Brown et al., 2008; Kwapil et al., 2008, 2012) in that while we also noted the small factor loadings of the revised Social Anhedonia Scale on both positive and negative schizotypy factors in the present sample, we found empirical support for a simpler two-factor model. It is noteworthy that the present investigation included a relatively high proportion of males (37%), compared to prior reports of Western college students, in which the proportions of males ranged from 19 to 26% of the entire sample. We also noted that the mean scores on the Perceptual Aberration, Magical Ideation, and Physical Anhedonia Scales for the Chinese students were somewhat higher than the means reported by Kwapil et al. (2008) for the American college students or the Spanish college students. In contrast, the mean Social Anhedonia Scale scores in our sample were somewhat lower than the mean scores of the American students in either of the Kwapil samples reported earlier (Kwapil et al., 2008, 2012). These sample differences may have influenced the resultant confirmatory factor analyses.

Given that the mean scores for our sample were slightly different from those produced by Western (American) samples, we were also interested in whether differences in variances might account for the differences in factor loadings. We compared our observed score variances to those published in reports of American students. The variance (σ) in Perceptual Aberration Scale scores for the present Chinese sample (σ=34) fell within the range previously reported for American samples (range, 23–35). Similarly, the observed variance in revised Physical Anhedonia Scale scores (σ=53) fell within the range of variances previously reported for American samples (σ's ranged from 36 to 60). There was smaller variance overall in the Magical Ideation Scale scores produced by the Chinese sample (σ=22), relative to all of the American samples (range, 26–33). Given that the results of our confirmatory factor analysis differed only in terms of the revised Social Anhedonia Scale, we were particularly interested in comparing the variance in the scores produced by our sample and those reported based on Western samples. We found, however, that the variance in the revised Social Anhedonia Scale scores in our sample (σ=29) was quite similar to the variances previously reported in American samples (σ's ranged from 28.5 to 39.3). Thus, differences in variance do not account for the differences in factor loadings.

Indeed, there is ample reason to believe that the constructs being measured by the Chapman psychosis-proneness scales in Chinese culture are the same constructs that are measured in American culture. Other investigations, in which the Chapman psychosis-proneness scales have been used to operationally define schizotypy and/or psychosis-proneness in Chinese samples, have yielded similar findings as investigations using these scales in American samples (see, for example, the findings of Wang et al. (2012)). Wang et al. (2012) demonstrated that the clusters of schizotypy observed in Western samples were also observed in a large sample of nonclinical Chinese students. Our finding that the factor structure of schizotypy was invariant though the loading scores were different due to cultural factors seems wholly consistent with the overall observation that, similar to Western cultures, positive and negative symptom dimensions of schizophrenia can be reliably measured in Chinese patients (Phillips et al., 1991).

This study includes the largest sample to date in terms of investigating the temporal stability of all four of the most commonly used Chapman scales. Moreover, our test–retest interval, namely, 6 months, was relatively longer than many of the previous studies. Using a longer time interval than most other investigators, we were able to demonstrate the relative invariance of the Chapman psychosis proneness scales over time. The results of the cross-time invariance test suggest that reliable measures of positive and negative schizotypy may be obtained using the Chapman psychosis-

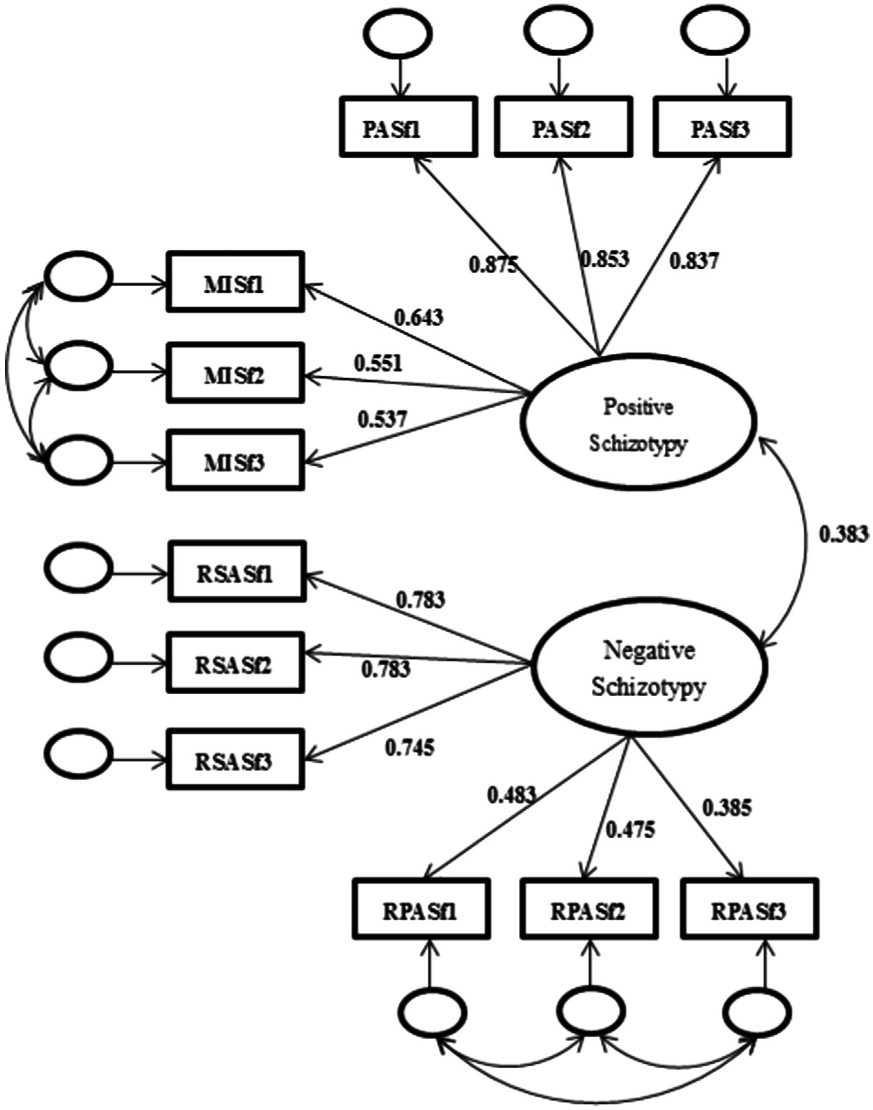

Fig. 1. Two factor model with the items of RSAS, RPAS scales independent and two factors correlated in undergraduates. Note:PASf1, PASf2, PASf3 refer to the three parcels of the Perceptual Aberation (PAS) Scale; MISf1, MISf2, MISf3 refer to the three parcels of the Magical Ideation (MIS) Scale; RSASf1, RSASf2, RSASf3 refer to the three parcels of the revised Social Anhedonia (RSAS) Scale; RPASf1, RPASf2, RPASf3 refer to the three parcels of the revised Physical Anhedonia (RPAS) Scale. This figure shows the result of confirmatory factor analysis, namely, that the three parcels of Perceptual Aberration Scale and the three parcels of Magical Ideation Scale load on the positive schizotypy factor, and the three parcels of revised Social Anhedonia Scale and the three parcels of revised Physical Anhedonia Scale load on negative schizotypy factor, which corresponds with the original theory of the Chapman psychosis proneness scales. The correlation coefficient is 0.383.

Table 3
The fitness indicators of cross-time invariance test.

Model	χ^2	d.f.	χ^2/d.f.	$\Delta\chi^2$/d.f.	P	CFI	ΔCFI	TLI	ΔTLI	RMSEA	RMSEA CI90	p Value of <0.05	SRMR
Form invariance	1355.29	222	6.10490991			0.954		0.942		0.055	0.052–0.058	0.002	0.06
Metric invariance	1415.468	232	6.10115517	6.02	0.0000	0.952	0.002	0.942	0	0.055	0.052–0.058	0.002	0.061
Scalar invariance	1649.715	242	6.81700413	23.42	0.0000	0.942	0.01	0.934	0.008	0.059	0.056–0.061	<0.001	0.063
Error variance invariance	1684.684	254	6.63261417	2.91	0.0005	0.941	0.001	0.936	-0.002	0.058	0.055–0.060	<0.001	0.063
Factor variance invariance	1745.478	256	6.81827344	30.40	0.0000	0.939	0.002	0.934	0.002	0.059	0.056–0.061	<0.001	0.072
Factor covariance invariance	1771.761	257	6.89401167	26.28	0.0000	0.938	0.001	0.933	0.001	0.059	0.056–0.062	<0.001	0.078
Latent mean invariance	1796.182	259	6.93506564	12.21	0.0000	0.937	0.001	0.933	0	0.059	0.057–0.062	<0.001	0.079

Note. d.f.=Degrees of freedom; CFI=Comparative Fit Index; ΔCFI= change in Comparative Fit Index; TLI= Tucker Lewis Index; RMSEA=Root Mean Square Error of Approximation; CI90=90% Confidence Interval; SRMR=Standardized Root Mean Square Residual Nested models were tested to determine whether the factorial structure of the Chapman psychosis proneness-scales were operating equivalently across time.

proneness scales. Thus, using a statistical technique that is more sophisticated than the Pearson product-moment correlations, we obtained findings that were consistent with earlier results (Chapman et al., 1982), namely, that the Chapman psychosis-proneness scales are temporally stable. We also extended this line of research by demonstrating the reliability of the revised Social Anhedonia Scale. This is particularly useful, given indications that elevated scores on the revised Social Anhedonia Scale may identify individuals at specific risk for the development of schizophrenia-spectrum disorders (Gooding et al., 2005; Kwapil, 1998).

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One limitation of the present research is the failure to include the Chapman Infrequency scale (Chapman and Chapman, 1983), or some other means to rule out participants' random responding. In North American samples, random responding presents a small but significant threat to the validity of the data. The failure to include a random responding or malingering does not allow us to unequivocally rule out the possibility that some students may have engaged in over- or under-reporting of traits, experiences, or attitudinal tendencies. However, for cultural reasons, it appears to be less of an issue in China. Chinese culture emphasizes the internal and external harmonious conditions between the self and the external environment. Chinese people are encouraged to develop into group-oriented and socially dependent beings (Solomon, 1971). Individuals are socialized to feel obligated to conform and maintain their own internal harmonious condition through adjusting themselves to the social norms (King and Bond, 1985). The lack of a measure of social desirability is a limitation of the present study.

A limitation of the present investigation is that we do not directly statistically compare Chapman scale data from Chinese samples with Chapman scale data from Western samples. Fortunately, there is a body of published literature that permits tabular comparison, as we did above. Nonetheless, future investigations would be strengthened by direct comparison of data from the two cultures.

One possible limitation of the present investigation is our reliance on an undergraduate student sample. The factor structure of the Chapman psychosis-proneness scales may be somewhat different in older adults and/or clinical samples. However, it is worth noting that much of the extant data available on the Chapman psychosis-proneness scales has been based upon undergraduate samples. Indeed, the same assertion could be made regarding most of the insights that have been gleaned regarding psychometric schizotypy and its relationship to the later development of schizophrenia and schizophrenia-spectrum disorders.

The extant literature provides support for a cognitive disorganization factor underlying both schizotypy and schizophrenia. The present findings, in which we identified only positive and negative dimensions of schizotypy are reflective of nature of measures used to assess schizotypy, i.e., the Chapman psychosis-proneness scales. Factor analyses of other measures, such as the Schizotypal Personality Questionnaire (Raine, 1991) or Schizotypal Personality Questionnaire-Brief – Revised (Callaway et al., 2014) using a Chinese sample are likely to yield other factor models.

In summary, our findings advance the study of schizotypy by providing further evidence of measurement invariance of schizotypal traits across time and across culture. This serves two purposes: first, by demonstrating temporal stability of the Chapman psychosis-proneness scales, this study helps to insure that investigators can consistently measure schizotypy. Secondly, and equally importantly, as noted earlier by Fonseca-Pedrero et al. (2011), findings such as these help to guarantee the comparability and cross-cultural equivalence of the construct of schizotypy when using various psychometric measures. This area of research would be further advanced by direct comparisons between psychometric schizotypes and patient samples and/or relatives of patients.

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