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Trajectories of schizotypy and their emotional and social functioning: An 18-month follow-up study

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ABSTRACT

Schizotypy is a set of personality traits that convey liability to develop schizophrenia. Studying schizotypy in healthy individuals may facilitate the understanding of the psychopathological processes underlying schizophrenia. The present study aimed to examine the developmental trajectories of schizotypy over time using a longitudinal study design. The Chapman Scales for Psychosis Proneness were administered to 1541 college students at baseline, and subsequently at six-monthly intervals up to 18 months. Latent class growth analysis was conducted to track the different trajectories. In addition, self-reported scales were used to measure idea of reference, emotional experiences and expression, stress and coping, as well as social functioning. We identified four latent classes with distinct trajectories: “nonschizotypy” group (LC1), “stable high schizotypy” group (LC3), “high reactive schizotypy” group (LC2) and “low reactive schizotypy” group (LC4). These findings suggest that there may be distinct developmental trajectories for schizotypy. Two groups may be of particular interest: the “stable high schizotypy” group that displayed the worst clinical and functioning outcomes on almost all measures and the “high reactive schizotypy” group characterized by a relatively rapid decline in functioning.

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1. Introduction

Schizotypy is a set of personality traits that convey liability to develop schizophrenia (Meehl, 1962, 1989). More recently, the full-dimensional model assumes that schizotypy is a set of traits distributed in the general population with its extreme exhibited in patients with schizophrenia (Claridge and Beech, 1995; Nelson et al., 2013). Because schizotypy can be psychometrically identified in the general population, investigating schizotypy may provide a unique opportunity to better understand the underlying psychopathological process of psychosis while avoiding the confounding effect of antipsychotic medications

and duration of the illness. In previous studies, researchers used different terms in order to refer to schizotypal traits. In a review by Nelson et al. (2013), the authors suggested that “the schizotypy, schizotypal personality, ‘SPD-proneness’ and ‘non-clinical dimensions of psychosis’ are all subsumed under the umbrella of schizotypy”. In the current study, we chose to use the term “schizotypy” while at the same time, keeping the terms that different researchers used in their studies.

Cross-sectional investigations of individuals with schizotypy indicate that they are characterized by impairments in neurocognition (Ettinger et al., 2015), emotion and social cognition (Cohen et al., 2015) as well as social functioning (Wang et al., 2013). Schizotypal individuals have also been found to have social occupational impairment (Fonseca-Pedrero et al., 2010; Jahshan and Sergi, 2007). Studies also found that within the schizotypal group, individuals with negative schizotypy had poorer social functioning than those with positive schizotypy (Blanchard et al., 2011; Henry et al., 2008).

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Longitudinal studies of psychometrically-defined schizotypal individuals have been conducted to examine individuals with psychometrically-defined schizotypy in order to better understand the heterogeneous developmental outcomes of schizotypy. For example, Kwapiil (1998) found that 24% of psychometrically defined social anhedonia high scorers were diagnosed with schizophrenia-spectrum disorders 10 years later, compared to 1% in the control group, suggesting that social anhedonia may be a predictor of schizophrenia spectrum disorders. Further reanalysis of the Chapmans' longitudinal data set (Kwapiil et al., 2013) showed that both positive and negative dimensions of schizotypy could predict psychosocial adjustment and the presence of psychotic-like and schizotypal symptoms. In particular, positive schizotypy was associated with mood and substance use disorders, whereas negative schizotypy was associated with schizoid symptoms and social functioning at 10-year follow-up (Kwapiil et al., 2013). In their independent replication of psychometric high-risk individuals, Gooding et al. (2005, 2007) observed that individuals with elevated social anhedonia scale scores at baseline were significantly more likely to meet diagnostic criteria for schizophrenia-spectrum personality disorders at the five-year follow-up, relative to the other high-risk and control groups. Gooding et al. (2005) also found that at follow-up, individuals with social anhedonia reported more frequent and more severe psychotic-like experiences than healthy controls. The Maryland Longitudinal Study of Schizotypy (MLSS) indicated that individuals with social anhedonia showed poorer attention and processing speed at the three-year follow-up compared to controls (Cohen et al., 2012).

The above longitudinal studies highlighted the importance of identifying potential risk factors, which are important for the early identification and intervention for schizophrenia spectrum disorders. Consistent with Meehl's (1962) model of schizotypy, most of the individuals in the aforementioned longitudinal studies were not expected to transition to psychosis. Thus, the focus of these studies was on the detectable manifestations of the latent schizotypy, i.e., psychotic-like symptoms and functional impairments. Moreover, the fact that transition to psychosis did not occur for most of the individuals with schizotypy in these studies suggests that the developmental trajectory of schizotypy is consistent with the developmental principle of multifinality (Gooding and Iacono, 1995). Given the heterogeneity of outcomes associated with schizotypy, it is important to examine the development of schizotypal individuals and determine whether there may be schizotypal subgroups that show distinct developmental trajectories. To date, few studies had examined the developmental trajectories of schizotypy.

The ontogeny of schizotypy in the general population is still unclear. Geng et al. (2013) examined the change in schizotypal features measured by the Schizotypal Personality Questionnaire (SPQ) (Raine, 1991) in college students in an 18-month follow-up study and identified three classes with different trajectories: a low schizotypy group presented the lowest scores that kept decreasing over time; a high schizotypy group with the highest scores that kept increasing over time; and a medium schizotypy group with moderate scores that remained stable over time. Furthermore, the three groups showed significant differences in terms of paranoid symptoms, emotional experiences and expression, and cognitive functions (Geng et al., 2013).

The purpose of the present study was, therefore, to examine the trajectories of schizotypy over time using a longitudinal design. Similar to Hallquist and Lenzenweger (2013), we expected to observe individual differences in outcomes over time. Based on the prior work (Geng et al., 2013), we hypothesized that there would be at least three latent classes with high, medium and low levels of schizotypy. We chose latent class growth analysis to differentiate the sample into latent classes in order to observe schizotypy across four time points. We were also interested in changes in the behavioural manifestations of psychotic symptoms, emotional experiences, and social functioning. We predicted that within the distinct latent classes, schizotypy would differ in terms

of their patterns of associations with psychotic-like symptoms, emotional processing as well as social functioning.

2. Method

2.1. Participants

Study participants were 1541 (595 male, 946 female) college students (mean age = 18.8 years; SD = 0.85; years of education: mean = 12.3 years; SD = 0.66) out from an original sample of 1600 students at baseline. The attrition rate of 3.7%. Participants were assessed at six-month intervals up to 18 months (four times in total). They were tested in a group format with 30 to 100 participants per group. The total test administration time was about 40 min. Participants received monetary remuneration (about two US dollars each time) in return for questionnaire completion. The present study was approved by the Ethics Committee of the Institute of Psychology, the Chinese Academy of Sciences. Written informed consent from all participants was obtained before the study began.

2.2. Measures

2.2.1. The chapman psychosis proneness scales

We administered the Chinese versions of Chapman psychosis-proneness scales, namely: the Revised Physical Anhedonia Scale (Chapman et al., 1976) and Revised Social Anhedonia Scale (Chapman et al., 1976; Eckblad and Chapman, 1983) for the negative dimension of schizotypy, and the Magical Ideation Scale (Eckblad and Chapman, 1983) and Perceptual Aberration Scale (Chapman et al., 1978) for the positive dimension of schizotypy. On all four scales, a higher score indicates greater severity of the respective schizotypal features. We have validated the Chinese scales in previous studies with their factor structure reported (Chan et al., 2012a; Chan et al., 2015; Wang et al., 2012). In the current study, the sum of all four scales ("total schizotypal trait score") was used for the latent class growth modeling analysis.

2.2.2. The idea of reference scale

The **Idea of Reference (IOR) scale** was adopted from the paranoia checklist developed by Freeman et al. (2005), which consists of 15 items measuring paranoid ideation. For each item, participants were asked to rate psychotic-like experiences involving paranoia on a five-point scale for three dimensions: frequency, degree of conviction and degree of distress. A higher score indicates either higher frequency, greater conviction or more distress caused by the respective experience. The validity and reliability of the Chinese version have been established in a previous study (Chan et al., 2011). This measure was used for the last three time points but not at the baseline.

2.2.3. Temporal experience of pleasure scale

The Chinese version of the Temporal Experience of Pleasure Scale (TEPS; Chan et al., 2012b) is a self-report questionnaire designed to measure individual trait dispositions in both anticipatory and consummatory pleasure experiences. The original TEPS consists of a 10-item anticipatory pleasure scale and an 8-item consummatory pleasure scale (Gard et al., 2006). In this study, we adopted the validated 19-item Chinese version of the TEPS (Chan et al., 2012b), which includes 19 items and has a four-factor structure in the Chinese context (abstract anticipatory, contextual anticipatory, abstract consummatory, and contextual consummatory factors).

2.2.4. Emotional expressivity scale

The 17-item Emotional Expressivity Scale (EES) was developed to capture individual differences in the outward display of emotion regardless of valence (Kring et al., 1994). Participants rated themselves on a six-point Likert scale from 1 (never) to 6 (always) in terms of how often they expressed their emotions. The Chinese version of the

EES has a two-factor structure with good internal consistency (Chan et al., 2010). We chose to administer both the Chinese TEPS and the EES to glean information about participants' negative affective experiences and behavior. This measure was used for the last three time points but not at the baseline.

2.2.5. Depression, anxiety, and stress scale-21

The Chinese Depression, Anxiety, and Stress Scale-21 (Wang et al., 2016) is a simplified version of the full version (Taouk et al., 2001) and English short form version of the DASS (Lovibond and Lovibond, 1995). The Chinese DASS-21 is a self-report measure that requires participants to rate each of the seven items in the depression, anxiety and stress subscales on a four-point Likert scale in terms of the frequency and severity of symptoms over the previous week.

2.2.6. Ways of coping checklist

The Ways of Coping Checklist (WOC) is a questionnaire developed to measure individual differences in coping strategies based on Xiao and Xu's (1996) theory of coping in the Chinese context. Six strategies (problem solving, self-blame, help seeking, fantasy, avoidance and rationalization) were measured. Problem solving and help seeking were considered positive coping while avoidance and self-blame were considered negative coping strategies. In the WOC, participants were asked to respond to each of the 62 items on Likert scale, if they used the respective coping strategy, further questions were asked on whether the strategy was "valid", "relatively valid" or "not valid".

2.2.7. Social functioning scale (SFS), Chinese version

The Chinese version of the Social Functioning Scale was developed by Lecomte et al. based on the First Episode Social Functioning Scale (FESFS) (Lecomte et al., 2005; Lecomte et al., 2014). It measures eight domains of social functioning: living skills, social interaction, social activity, friends, intimacy, family, school and work. The participants rated each item on a four-point Likert scale, from 1 (totally disagree) to 4 (totally agree). The total score were used in the present study. The Chinese version of the FESFS had been validated in a previous study (Wang et al., 2013). We used this measure to examine social functioning.

2.3. Data analysis

Descriptive statistics and repeated measure ANOVA were conducted for the Chapman Scale scores at each time point. Latent class growth analyses (LCGA) were then conducted for the longitudinal data of schizotypal traits (i.e., the total scores on the Chapman scales) to identify the different trajectories of schizotypy. In the current study, the software Mplus (version 6.12) was used to estimate the models. The analyses examined models with two through five expected classes, all with random starting values. To evaluate the model, the Bayesian Information Criterion (BIC), the Akaike's Information Criterion (AIC), the Lo-Mendell-Rubin Likelihood Ratio Test (LMR-LRT) and entropy were taken as indices. With comparison between expected values and real values, lower AIC and BIC values indicated a better model. For the LMR-LRT, a low p -value meant rejection of the model with one class less. Entropy quantifies classification accuracy, with values >0.8 indicating good separation of classes. The method we used here was similar to a previous study (Geng et al., 2013).

Following the LCGA, firstly we compared the identified classes on the demographic variables, including age, gender and education in years using ANOVA or chi-square test; second, using repeated-measures ANOVA, we examined the main effect of time and latent class, as well as the interaction effect of time and latent class on the total and dimension scores of the Chapman scales. Finally, we conducted ANOVAs to examine group differences on idea of reference, psychological distress, emotion experience and expression and social function at each time point.

3. Results

3.1. Descriptive statistics and repeated measure ANOVA over time

The mean scores and standard deviations on the Chapman scales for each time point are summarized in Table 1. Repeated measure ANOVA was conducted to compare the total scores among four time points. The main effect of time points is significant ($F = 10.49, p = 0.001$), post hoc tests showed that the scores at baseline is higher than the scores of the other three time points.

3.2. Trajectory class analysis of schizotypal traits

The indices (including AIC, BIC, Entropy and LMR) of each model when the number of classes were set as two, three, four, and five are shown in Table 2. Although the AIC and BIC kept decreasing with increasing of the classes, the p value of the LMR for the model with 4 classes is significant, but not significant anymore for the model with 5 classes. Hence, these indices indicated an optimal model with four latent classes compared to the other models.

Latent class 1 (LC1) consists of the most participants ($n = 1113$, 72.2% of the whole sample); latent class 2 (LC2) includes 142 participants (13.8%); latent class 3 (LC3) includes 73 participants (4.74%); and latent class 4 (LC4) consists of 213 participants (13.8%). These four latent classes did not show significant differences on age ($F(3,1537) = 0.78, p > 0.1$) and education in years ($F(3,1537) = 1.51, p > 0.1$) tested by ANOVA. Significant differences were found in terms of the gender proportion (chi-square = 124.13, $p < 0.001$) as shown in Table 3.

The mean scores for individual Chapman psychosis proneness scales, as well as mean total schizotypal trait scores for each of the latent classes are provided in Table 3. Repeated-measures ANOVA on the total scores of Chapman scales revealed a significant main effect of time ($F(3,1535) = 366.31, p < 0.001$); a significant main effect of latent class ($F(3,1537) = 588.95, p < 0.001$) as well as a significant interaction between time and latent class ($F(9,4611) = 164.61, p < 0.001$), suggesting different trajectories for the four latent classes.

Table 1

Mean Chapman psychosis-proneness scale scores at each time point.

	Males		Females		Total sample	
	M	SD	M	SD	M	SD
Time 1 (Baseline)						
RSAS	8.50	5.67	7.95	5.12	8.16	5.35
RPAS	15.33	8.26	14.23	6.73	14.66	7.37
MIS	11.97	4.58	11.93	4.82	11.95	4.73
PER	7.34	6.52	6.63	5.26	6.90	5.79
Time 2						
RSAS	9.18	6.54	7.30	5.02	8.02	5.73
RPAS	15.23	10.00	12.37	7.02	13.47	8.41
MIS	11.03	4.89	10.44	4.57	10.67	4.70
PER	7.85	7.82	5.40	5.00	6.34	6.35
Time 3						
RSAS	9.84	6.49	7.66	5.59	8.50	6.05
RPAS	14.80	9.95	12.51	7.88	13.40	8.80
MIS	11.13	5.34	10.14	4.78	10.52	5.02
PER	7.73	7.78	5.28	5.72	6.23	6.70
Time 4						
RSAS	10.66	6.84	7.84	5.71	8.93	6.32
RPAS	16.32	11.17	12.47	8.47	13.96	9.78
MIS	11.08	5.53	9.68	4.83	10.22	5.15
PER	8.54	8.66	5.08	5.79	6.42	7.24

Note. RSAS = Revised Social Anhedonia Scale; RPAS = Revised Physical Anhedonia Scale; PER = Perceptual Aberration Scale; and MIS = Magical Ideation Scale. Mean and standard deviation (SD) for each of the Chapman psychosis-proneness scales are provided for the male participants ($n = 595$), female participants ($n = 946$), and total sample ($N = 1541$) at each time point.

Table 2
Indices of the latent class growth analyses for four models.

Model	AIC	BIC	Entropy	LMR-LTR	p of LMR
2 Class	51,480.962	51,545.044	0.913	513.074	<0.0001
3 Class	51,315.556	51,395.659	0.889	163.96	<0.0001
4 Class	51,247.053	51,343.176	0.865	71.267	0.0022
5 Class	51,207.016	51,319.160	0.875	44.037	0.4539

Note. The Mplus v6.12 was used to estimate the models with different expected classes. BIC: the Bayesian Information Criterion; AIC: the Akaike's Information Criterion; LMR-LRT: the Lo-Mendell-Rubin Likelihood Ratio Test.

Using ANOVAs, we examined the differences between the four groups on total schizotypal traits scores at each time point. As shown in Table 3 and Fig. 1, individuals represented by LC3 presented high levels of schizotypal traits over time, while the LC1 group showed a low level of schizotypal traits across time points. LC2 showed similar levels of schizotypal scores as the LC1 at baseline, but increased over time and approached the same level as the LC3 at the last time point.

3.3. Other longitudinal changes over time

The trajectories of the four latent classes as identified by LCGA in terms of ideas of reference, emotion experiences and expression, stress and coping, and social functioning are shown in Fig. 2. Detailed scores of all latent classes at each time point and results of the ANOVA analysis can be found in the Supplementary tables.

Repeated measures ANOVAs on IOR scale scores showed significant main effects for time and group. There was an interaction effect between time and group (see Supplementary materials for details). Post-hoc analysis showed that LC3 consistently exhibited the highest scores

on IOR frequency, conviction and distress among the four groups. The LC2 exhibited similar scores as the LC1 at Time 2 and then increased to a higher level than LC1 at Time 4 in both IOR conviction and distress.

In terms of emotional experiences and expression, repeated measure ANOVAs of the TEPS total scores showed significant main effects for time and group, as well as a significant interaction between time and group. On the EES scale, only data for the last three time points were available. The results showed significant main effects for time and group, whereas the interaction between time and group was not significant. Post-hoc analysis showed that LC1 had the highest total TEPS scores across all time points, while LC3 exhibited the lowest scores. Although LC2 did not differ from LC1 in terms of total TEPS scores at baseline, by the final assessment (18 months following the initial assessment), the total TEPS scores of LC2 did not differ from those of LC3.

Repeated-measures ANOVAs of the DASS scores and coping styles showed significant main effects for time and group. There was a significant interaction effect between time and group for the DASS subscales and for both positive and negative coping. Post-hoc analysis showed that LC3 exhibited the highest levels of depressive and anxiety symptoms across time, while LC1 had the lowest level of these symptoms longitudinally. For LC2, there was an increasing trend of depressive and anxiety symptoms, which rose to a level between LC1 and LC3. In terms of coping styles, LC1 tended to adopt more positive coping than the other three groups. Latent Class 2 exhibited less positive coping and an increase in negative coping.

Repeated-measures ANOVAs for social functioning showed a significant main effect for group and an interaction effect between time and group. On the social functioning scale, LC3 and LC1 exhibited the highest and the lowest scores respectively, while LC4 showed intermediate level scores. LC2 exhibited a rapid decline in social functioning scores between the first two time points.

Table 3
Comparison of Latent Classes in terms of Mean Chapman scale scores and Schizotypal trait score at each time point.

	LC1 (n = 1113)		LC2 (n = 142)		LC3 (n = 73)		LC4 (n = 213)		F/Chi-square
	M	SD	M	SD	M	SD	M	SD	
Age	18.84	0.85	18.80	0.94	18.81	0.74	18.74	0.80	0.78
Gender (male/female)	345/768		97/45		54/19		99/114		124.13***
Education (years)	12.29	0.63	12.37	0.79	12.40	0.81	12.35	0.66	1.51
Time 1 (Baseline)									
RSAS	7.69	4.97	6.91	4.40	16.78	6.00	8.51	5.35	
RPAS	13.98	6.97	13.10	6.78	24.34	8.50	15.91	7.37	
MIS	11.81	4.66	10.65	4.32	15.90	4.31	12.17	4.73	
PER	6.54	5.45	5.37	4.27	14.08	7.38	7.36	5.79	
Total schizotypy	40.03	14.59	36.02	13.31	71.11	13.95	43.94	14.40	115.26***
Time 2									
RSAS	6.79	4.72	9.72	6.30	17.55	6.05	10.09	6.10	
RPAS	11.68	7.06	16.41	9.31	26.39	8.62	16.47	8.97	
MIS	9.96	4.40	11.92	4.82	15.72	4.69	11.79	4.73	
PER	4.92	4.81	9.17	8.06	16.03	7.67	8.56	7.47	
Total schizotypy	33.35	14.79	47.23	24.04	75.69	18.36	46.90	19.72	185.65***
Time 3									
RSAS	6.74	4.70	13.54	6.86	17.55	5.57	11.27	6.23	
RPAS	10.83	7.09	20.65	10.14	25.11	8.13	17.98	8.37	
MIS	9.45	4.52	14.25	5.33	14.79	4.70	12.19	5.05	
PER	4.32	4.60	12.80	9.18	14.78	8.30	8.86	7.46	
Total schizotypy	31.34	14.61	61.23	26.73	72.23	16.94	50.30	18.70	287.64***
Time 4									
RSAS	6.07	3.89	19.08	3.91	19.16	4.03	13.57	5.07	
RPAS	9.39	5.86	30.12	3.88	29.22	5.52	21.80	8.26	
MIS	8.48	3.88	17.17	4.66	16.53	4.39	12.49	5.06	
PER	3.31	2.79	20.90	6.90	19.14	6.63	8.63	6.43	
Total schizotypy	27.26	9.98	87.27	11.78	84.05	7.44	56.49	8.34	2396.76***

Note. The mean (M) and standard deviation (SD) are provided for each of the four latent classes, that were identified as a result of the Latent class growth analyses. RSAS = Revised Social Anhedonia Scale; RPAS = Revised Physical Anhedonia Scale; PER = Perceptual Aberration Scale; and MIS = Magical Ideation Scale. ***: $p < 0.001$. Total schizotypy = sum of all four Chapman psychosis proneness scale scores.

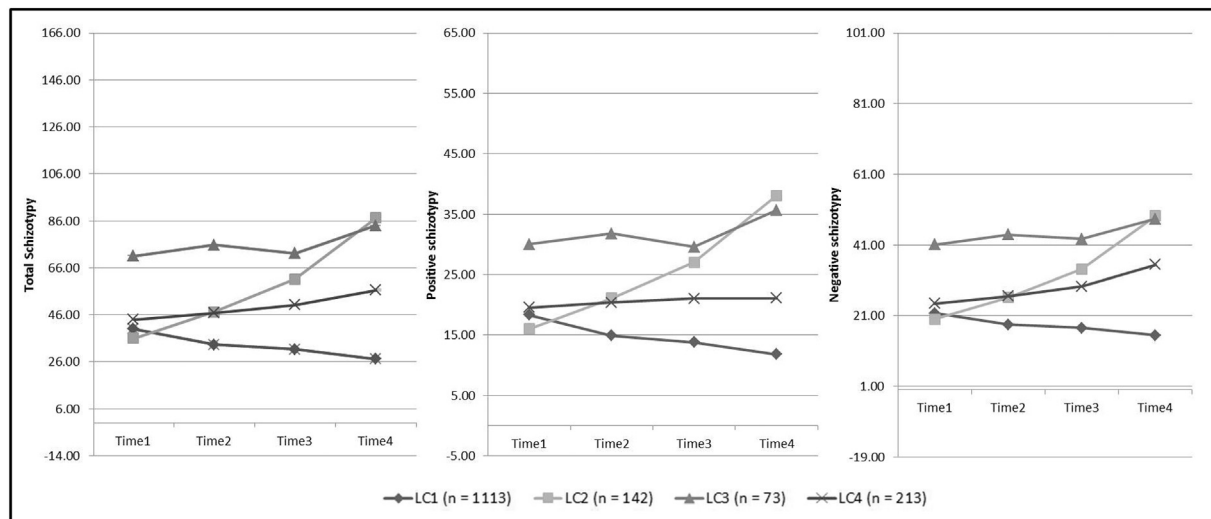


Fig. 1. The mean scores for total schizotypal trait scores and dimensional schizotypal trait scores. Four latent classes were identified using the total schizotypal trait scores. Total schizotypy = sum of all four Chapman psychosis proneness scale scores. Positive schizotypy = sum of Magical Ideation and Perceptual Aberration scale scores. Negative schizotypy = sum of revised Social Anhedonia and revised Physical Anhedonia scale scores.

4. Discussion

Most of the existing longitudinal studies on schizotypy have focused on clinical outcomes at follow-up and have not examined the trajectory of schizotypal traits over time. In the present study, we performed latent

class growth analysis to examine the trajectory of schizotypal traits over 18 months. We demonstrated heterogeneity in the longitudinal course of schizotypal traits in a large sample of young adults. We identified four distinct groups: Latent class 1 (LC1), a nonschizotypy group, presented a low level of schizotypal scores over time; LC2 displayed a low

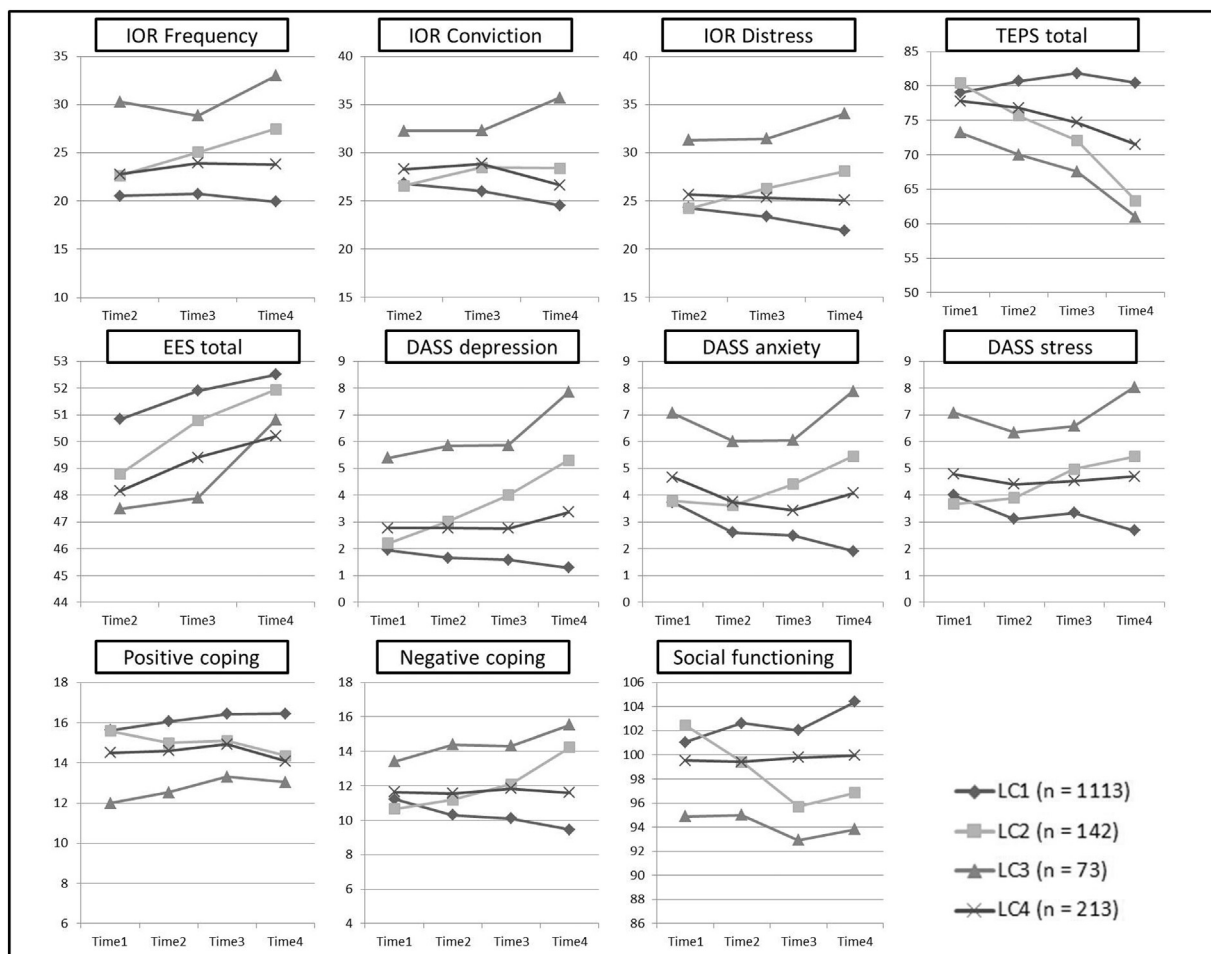


Fig. 2. Trajectory of four latent classes on the idea of reference, emotion experience, emotional expressivity and social functioning. IOR = The Idea of Reference Scale; TEPS = Temporal Experience of Pleasure Scale; EES = Emotional Expressivity Scale; DASS = Depression, Anxiety, and Stress Scale-21.

level of schizotypal scores at baseline and significantly increased to the highest level by the last measurement; LC3 showed a consistently high level of schizotypal scores across all time points; and LC4 displayed a gradual increase in schizotypal scores over time. LC3 was regarded as a “stable high schizotypy” group, whereas LC2 was a “high reactive schizotypy” group and LC4 was a “low reactive schizotypy” group.

We observed that the majority of our participants (72%) presented a low level of schizotypal traits and therefore were classified in LC1. Their schizotypy scores were quite stable at the lowest level compared with the other three groups over the follow-up period. Indeed, the schizotypy scores of the group classified in LC1 were quite similar to the mean values obtained in a prior sample of Chinese college students (Chan et al., 2015) and consistent with normative data for Caucasian undergraduates at American universities. At the same time, their schizotypal scores exhibited a mildly declining trend over time. These results indicate that schizotypal traits are typically enduring. However, despite their trait-like nature, these schizotypal traits may vary somewhat within the same person across time. Geng et al. (2013) and Hallquist and Lenzenweger (2013) have demonstrated that personality disorder symptoms decreased over time. For example, the schizotypal personality features of the medium and low SPD groups were found to be reduced during the 18 month follow-up in Geng et al. (2013)'s study. Given that our participants were first-year college students, the decline in schizotypal scores might reflect the process in which nonschizotypal individuals were gradually adjusting to university life. This is confirmed by the finding that this group was also characterized by more pleasure experience, better emotional expression, more positive coping and less referential thinking over the four time points.

On the contrary, our longitudinal data also revealed a group (approximately 5% of the entire sample) with consistently high schizotypal scores. Consistent with previous findings, individuals in this “stable high schizotypy” group were characterized by reduced pleasure experiences and affective expressivity, as well as a higher level of referential thinking, depression, anxiety, and poorer social functioning. In Geng et al. (2013)'s study, they found a high SPD feature group that showed worse social functioning, which could be predicted by their pleasure experience, emotional expression and paranoid thoughts. In the current study, individuals in the “stable high schizotypy” group also adopted significantly more negative and less positive coping strategies when they encountered stress which may be related to the higher level of the depression and anxiety. In previous longitudinal studies, individuals with high levels of negative schizotypy were more likely to develop schizophrenia spectrum disorders upon follow-up (Gooding et al., 2005; Kwapil, 1998; Kwapil et al., 2013). Since the “stable high schizotypy” group possessed high scores on both positive and negative dimensions of schizotypy over time and showed the worst manifestations on emotion processing and social functioning, it is a group that requires more attention from mental health professionals.

A novel finding in our study is the identification of two groups, the “high reactive schizotypy” and the “low reactive schizotypy” groups, both of which showed a similarly low level of schizotypal traits at baseline, but subsequently displayed different trajectories over the follow-up period. The “high reactive schizotypy” group showed an abrupt increase in schizotypal traits, whereas the “low reactive schizotypy” group showed a gradual elevation of schizotypal traits. Taken a further look at the individual scales, the “high reactive schizotypy” group showed rapid growing on all schizotypy scales, whereas the “low reactive schizotypy” group only showed a medium increase on social and physical anhedonia scales. We also found that this “high reactive schizotypy” group not only reported increased positive and negative schizotypy scores, but also had more referential thinking, depression and anxiety, negative coping as well as poorer pleasure experiences and social functioning. These “high reactive schizotypy” individuals may also suffer from psychosocial, emotional and neurocognitive problems in their daily lives. More comprehensive studies are needed in this population to examine their clinical outcome. These findings suggest

that this “high reactive schizotypy” group, much like the “stable high schizotypy” group, may also require mental health attention.

It is noteworthy that these “high reactive schizotypy” individuals have not been reported in previous studies. One reason may be the small sample size in previous studies, which may not be large enough to identify these individuals. Hallquist and Lenzenweger (2013) recruited two groups with approximately 120 participants in each group and found a group of individuals ($n = 73$) with low levels of personality disorder symptoms at baseline, whose symptoms increased slightly over time. In the present study, the appearance of high and low reactive schizotypy individuals suggests that there is heterogeneity in schizotypy, similar to patients with schizophrenia. However, in Geng et al. (2013)'s study, the high, medium and low schizotypy groups identified showed different scores since the very beginning and their schizotypal traits remained stable over time. This inconsistency in the literature might be related to the different measures of schizotypy adopted in different studies. Although the SPQ and Chapman scales were both developed to measure schizotypy, they have different conceptual underpinnings. The SPQ, designed largely to detect schizotypal personality disordered features, has three factors (cognitive perceptual, interpersonal and disorganized) (Raine, 1991) and the negative dimension of schizotypy is only loaded on the interpersonal factor. Instead, the Chapman scales focus on psychosis-proneness and measure physical and social anhedonia as the negative dimension of schizotypy.

The present study has several limitations. First, we measured schizotypy, emotional processing, referential thinking and social functioning by self-reported scales. The results may be biased and need to be interpreted with caution. Secondly, the subsequent development of the “high reactive schizotypy” group after 18 months and their clinical outcomes are not known. A longer period of follow-up in future studies would allow further examination of this issue. Finally, we did not identify any protective factors for schizotypy in the present study. Given that most of the previous studies have done a better job at identifying risk factors than protective factors, future study should aim at identifying protective factors or at least incorporate this as a goal for schizotypy research.

In conclusion, the present study highlights the importance of subtyping schizotypy because of their different trajectories and outcomes. It also suggests that the “stable high schizotypy” and the “high reactive schizotypy” groups may warrant clinical attention.

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The funding agents had no further role in the study design; in the collection, analysis and interpretation of the data; in the writing of the manuscript; and in the decision to submit the paper for publication.

Contributors

YW, SHS, and WHL collected and analyzed the data, and wrote up the first draft of the manuscript. CY and FL collected the data, and analyzed and interpreted the data. SHWS, CDC, PWLL, EFCC, and DC commented critically to the manuscript. RCK designed the study, interpreted the data, and commented critically to the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest

None.

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Supplementary Data Analyses

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.schres.2017.07.038>.

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