Psychiatry Research 210 (2013) 62–68

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Cognitive empathy partially mediates the association between negative schizotypy traits and social functioning

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ARTICLE INFO

Article history:
Received 29 October 2012
Received in revised form
4 February 2013
Accepted 18 March 2013

Keywords:
Schizotypy
Empathy
Clusters
Mediation

ABSTRACT

The present study aimed to examine empathy in individuals with schizotypy and to explore whether empathy mediates the associations between schizotypy traits and social functioning in college students. 1083 (376 males, mean age 18.78 ± 0.86 years) Chinese university students completed questionnaires measuring empathy, social functioning, and schizotypy. Participants were categorized into four groups based on their scores on the Chapman Psychosis Proneness scales: mixed schizotypy, positive schizotypy, negative schizotypy, and healthy controls. Participants in the negative schizotypy group reported significantly poorer scores on both affective and cognitive empathy than those in the positive schizotypy and healthy control groups. The mixed schizotypy group showed lower affective empathy than the healthy control group. Scores on both cognitive and affective empathy in the positive schizotypy group were similar to those in the healthy control group. In addition, cognitive empathy was found to be a partial mediator of the association between negative schizotypy traits and social functioning. Results suggest that while individuals with negative schizotypy have deficits in empathy, individuals with positive schizotypy show empathy abilities comparable to that of healthy controls. Moreover, only cognitive empathy partially mediated the relationship between negative schizotypy and social functioning.

1. Introduction

Empathy is a complex, multi-dimensional construct that has been difficult for researchers to define. However, an increasing number of studies have recognized that empathy consists of at least two components, namely, cognitive and affective empathy (Deutsch and Madle, 1975; Shamay-Tsoory and Aharon-Peretz, 2007). While cognitive empathy refers to the ability to infer others' situation and take on others' perspectives, affective empathy refers to the ability to share others' emotional experiences (Shamay-Tsoory, 2011). The existence of these two components of empathy is supported by the results of neuroimaging studies (e.g., comic strips task conducted by Vollm et al., 2006) which show that empathy is not only associated with the activation of areas related to making references (e.g., medial prefrontal cortex, temporoparietal sulcus and temporal pole) but is also associated with some areas of emotion processing (e.g., paracingulate, anterior and posterior cingulate, and amygdala) (Vollm et al., 2006). During an NIMH workshop, Green et al. (2008) defined several domains of social cognition in studies of schizophrenia, including theory of mind, social perception, social knowledge, attributional bias and emotional processing. Green et al. (2008) also noted that empathy is a component of social cognition, although research on empathy in schizophrenia is still in its early stages. Further, cognitive empathy, typically conceptualized as perspective taking, is regarded as conceptually similar to the affective Theory of Mind because each requires processing of others' affective states and involve the activation of an overlapping neural network (Baron-Cohen and Wheelwright, 2004; Lee et al., 2006; Lough et al., 2006).

The cognitive and affective components of empathy may differ across clinical and non-clinical subgroups in the population. For example, older healthy adults show poorer cognitive empathy but not affective empathy than younger healthy adults (Bailey et al., 2008). Women also show better affective empathy than men (Quince et al., 2011). In clinical populations, empathy deficits have been shown in adults with high-functioning autism (Baron-Cohen and Wheelwright, 2004) and in patients with psychotic disorders (Blair, 2005; Lawrence et al., 2007; Shamay-Tsoory and Aharon-Peretz, 2007). In particular, schizophrenia patients have shown

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http://dx.doi.org/10.1016/j.psychres.2013.03.015

deficits only in cognitive empathy when compared to healthy controls, suggesting that there is dissociable performance on both cognitive and affective empathy components in this population (Achim et al., 2010; Montag et al., 2007).

However, the mechanisms underlying the relationship between the psychopathology of schizophrenia and empathy are not fully understood. Preliminary and limited studies have yielded inconsistent results regarding the relationship between self-reported empathy scores and clinical symptoms of schizophrenia (Achim et al., 2010; Haker and Rössler, 2009; Smith et al., 2012). Some of these studies have suggested that there are no significant associations between self-reported empathy scores and clinical symptoms (Achim et al., 2010). However, in other studies, some psychotic symptoms, such as negative symptoms or disorganized symptoms were found to be correlated to self-report empathy scores (Haker and Rössler, 2009; Smith et al., 2012). These inconsistent findings may be due to differences across the studies in the methods used to recruit patients and their resulting clinical characteristics. For example, patients with schizophrenia that are recruited at different stages of the illness may experience different degrees of empathy impairment. In addition, results obtained from patients with chronic schizophrenia may be confounded by the dosage of their antipsychotic medications and the duration of their illness (Achim et al., 2010; Montag et al., 2007).

To advance our understanding of social cognitive processes in schizophrenia, researchers have examined first-onset patients with schizophrenia and at-risk individuals prone for psychosis. The advantage of recruiting these individuals is that it minimizes the potential impact of medication status and illness duration on social cognitive functioning. Individuals with schizotypy are characterized by a set of behavioral and personality features similar to, although milder than, the clinical symptoms found in patients with schizophrenia. These behavioral manifestations are considered to be a vulnerability personality trait (Meehl, 1962). A recent review has suggested that the estimated median prevalence and 1-year incidence of psychotic symptoms in general population was around 5% and 3%, respectively (Van Os et al., 2010). For trait anhedonia, it was also found that individuals with schizotypy features reported significantly more physical and social anhedonia than those without schizotypy features (Chan et al., 2012b). Similar to schizophrenia, schizotypy can be decomposed into subtypes (Vollema and van den Bosch, 1995). Four clusters of schizotypy traits have been identified in non-clinical samples, namely, negative schizotypy, positive schizotypy, mixed schizotypy, and low schizotypy/healthy control in western samples (Barrantes-Vidal et al., 2010). In our prior study, the similar clusters of schizotypy were found in a Chinese sample (Wang et al., 2012). Individuals categorized as mixed schizotypy reported high scores on both anhedonia and positive traits (including perceptual aberration and magical ideation); individuals in the positive schizotypy group showed only high level on positive dimension, and the negative schizotypy group presented relatively high level on trait anhedonia; and low schizotypy individuals reported low scores on both negative and positive dimensions.

Individuals with schizotypy traits have been found to differ from individuals without schizotypy traits on a range of neurocognitive tests. Barrantes-Vidal et al. (2010) found that mixed schizotypy individuals performed more poorly overall on neurocognitive tasks and exhibited more behavioral problems than healthy controls (Barrantes-Vidal et al., 2010). Our prior study also showed that mixed, positive, and negative schizotypy individuals reported poorer executive functioning than low schizotypy individuals (Wang et al., 2012). Negative schizotypy and positive schizotypy individuals were found to display different patterns of cognitive functioning, with negative schizotypy showing poorer cognitive functioning compared to positive schizotypy and healthy controls (Dinn et al., 2002; Shrira and Tsakanikos, 2009). However, very little is known about the relationship between schizotypy subtypes and either cognitive or affective empathy.

Within the current literature, only two studies have specifically examined empathy in individuals with schizotypy traits. Both showed that positive schizotypy was associated with poor cognitive empathy, whereas negative schizotypy was negatively associated with both cognitive and affect empathy (Henry et al., 2008; Thakkar and Park, 2010). Thakkar and Park (2010) also showed that there were significant inverse associations between the disorganized subscale of the Schizotypal Personality Questionnaire (SPQ) (Raine, 1991) and cognitive empathy, and between the interpersonal subscale of the SPQ and both cognitive and affective empathy (Thakkar and Park, 2010). However, the authors did not find any association between cognitive perceptual subscale scores of the SPQ, which was considered as a positive schizotypy trait, and empathy. In another study, Henry et al. (2008) found that higher schizotypy features were associated with poorer empathy. Moreover, they found that positive schizotypy was positively correlated with cognitive empathy while negative schizotypy was inversely associated with affective empathy (Henry et al., 2008).

The relationship between schizotypy traits and overall social functioning may be mediated by social cognitive traits such as empathy. Preliminary findings have suggested that social cognition, as reflected in emotional perception and Theory of Mind (ToM), mediates the relationship between neurocognition and functional outcomes. For example, Schmidt et al. (2011) recently reviewed 15 studies that examined the mediation of social cognition between neurocognition and functional outcomes in schizophrenia or schizoaffective patients. The results showed that the mean standardized indirect effect of social cognition for the nine studies out of 15 was 0.20 (Schmidt et al., 2011). Similarly, Henry et al. (2008) suggested that affective empathy might be considered to be a partial mediator in the relationship between negative schizotypy and social functioning in non-clinical samples.

Taken together, findings from the literature suggest that individuals who display schizotypy traits demonstrate deficits of multiple domains, including social cognition and functional outcomes. Empathy, as an important part of social cognition, might be a mediator on the relation between schizotypy traits and social functioning. The current study aimed to recruit a large non-clinical sample to examine whether individuals with subtypes of schizotypy traits show differential deficits in empathy when compared to healthy controls. More importantly, this study also aimed to examine the potential mediating effect of empathy in the relationship between schizotypy traits and social functioning. Given the findings of previous studies, it was hypothesized that individuals with schizotypy would report poorer empathy than healthy controls. In particular, individuals with negative schizotypy would show less empathy compared to other subtypes. It was also hypothesized that empathy would mediate the relationship between schizotypy traits and social functioning.

2. Method

2.1. Participants

One thousand two hundred and sixteen students were recruited from three universities in Beijing, Shanghai, and Guangzhou of China to complete a set of questionnaires measuring empathy, social functioning, and schizotypy traits. One thousand and eighty-three participants (376 males, mean age 18.78 ± 0.86 years) returned a completed set of questionnaires. Table 1 summarizes the demographic information of the final sample. The questionnaires were administered in a group format. Written informed consent was obtained before the study began. The study was approved by the ethics committee of the Institute of Psychology, Chinese Academy of Sciences.

Table 1
Descriptive statistics and gender differences.

	Male ($n=376$)		Female ($n=707$)		t	p
	Mean	S.D.	Mean	S.D.		
Age (years)	18.88	0.96	18.72	0.80	2.98	0.003
IRI						
Personal distress	2.74	0.71	3.02	0.68	−6.47	0.000
Perspective taking	3.58	0.59	3.57	0.59	0.17	0.867
Fantasy	3.50	0.66	3.82	0.60	−7.94	0.000
Empathic concern	3.64	0.56	3.79	0.52	−4.28	0.000
SF						
Social interaction	2.77	0.42	2.70	0.36	2.78	0.006
Family and friends	3.15	0.40	3.22	0.38	−2.91	0.004
School	3.09	0.36	3.05	0.34	1.53	0.127
Living skills	3.02	0.41	3.02	0.40	0.08	0.935
Intimacy	3.11	0.47	2.93	0.44	6.44	0.000
Balance	2.86	0.46	2.78	0.43	2.87	0.004
Psychosis proneness						
CPAS_total	16.17	8.01	14.95	6.77	2.51	0.012
CRSAS_total	8.47	5.77	7.92	5.41	1.53	0.126
PAS_total	6.95	6.31	6.35	5.20	1.60	0.111
MIS_total	11.64	4.69	11.71	4.83	−0.24	0.814

IRI: Interpersonal Reactivity Index; SF: Social Function Scale; CPAS: Chinese version of Physical Anhedonia Scale; CRSAS: Chinese version of Revised Social Anhedonia Scale; MIS: Chinese version of Magical Ideation Scale; PAS: Chinese version of Perceptual Abberation Scale; SF: Social Functioning Scale.

2.2. Measures

The Chapman Psychosis Proneness Scales, which include the Physical Anhedonia scale, Revised Social Anhedonia scale, Magical Ideation scale, and Perceptual Aberration scale, were used. The Chinese version of The Physical Anhedonia Scale (CPAS) (Chan et al., 2012b; Chapman and Chapman, 1978) was used to assess the inability to experience pleasure from typically pleasurable physical stimuli. The Chinese version of The Revised Social Anhedonia Scale (CRSAS) (Chan et al., 2012b; Eckblad et al., 1982) assessed the inability to experience pleasure from non-physical stimuli such as other people, talking, or exchanging expressions of feelings. Both the CPAS and CRSAS were found to have good validity and reliability in our prior study (Chan et al., 2012b). In the current sample, the Cronbach's alpha coefficients were 0.83 for physical anhedonia and 0.81 for social anhedonia scale. The Magical Ideation Scale (MIS) and the Perceptual Aberration Scale (PAS) were both considered to assess positive schizotypy personality (Chapman et al., 1982). The Chinese versions of the MIS and PAS were used after they underwent a series of standard validation procedures. The Cronbach's alpha coefficients were 0.76 for MIS Chinese version, 0.88 for PAS Chinese version, respectively, in the current study.

The First Episode Social Function Scale, *FESFS* (Lecomte et al., 2005) is a comprehensive rating scale designed to assess the social functioning of individuals with early psychosis. Based on this scale, 32 items were kept and used to assess the perceived ability of the individual's own social functioning (e.g., I find it easy to interact with authority figures). Each question was evaluated on a four-point Likert scale (from totally disagree to totally agree). A higher score indicates that participants reported better social functioning. The Chinese self-report version was also revised by a series of validation procedures, including item evaluation, translation and back-translation, and pretesting. Results of exploratory and confirmatory factor analyses suggested six domains of social functioning in university students, namely: "living skills", "social interaction", "intimacy", "friends and family", "school" and "balance". The factor model was testified by structural equation model with RMSEA=0.058, CFI=0.93 (Wang et al., submitted for publication). The internal consistency Cronbach's alpha coefficient was 0.88 in the present study.

The Depression Anxiety Stress Scale, *DASS* (Lovibond and Lovibond, 1995) is a self-report instrument designed to measure the negative emotional states of depression, anxiety, and stress. The 21-item version of the DASS was used in this study to measure the presence and severity of symptoms common to anxiety and depression and the prevalence of co-morbid depression and anxiety. Participants were asked to use a 4-point severity/frequency scale to rate the extent to which they had experienced each symptom over the past week from 'never' to 'most of the time'. The Chinese version has been previously shown to have good internal consistency and validity (Chan et al., 2012a; Taouk et al., 2001). The internal consistency Cronbach's alpha was 0.92 in the current study.

The Interpersonal Reactivity Index, *IRI* (Davis, 1983), is a 28-item self-report scale measuring empathy and consists of four subscales: perspective taking, fantasy, personal distress, and empathic concern. While the first two subscales index cognitive empathy, the last two subscales index affective empathy. In the Chinese version of the IRI, 6 items were deleted and 22 items remained (Chan, 1986) and it has been reported to have good reliability and validity in both normal and schizophrenic populations. The Cronbach's alpha coefficient for the whole scale was 0.75 in the present study.

2.3. Statistical analysis

First, basic demographic variables were described and gender differences on the scales administered were examined using independent sample t-tests by SPSS. Participants were next clustered into one of four groups: positive, negative, mixed schizotypy, and healthy controls based on their scores on the Chapman Psychosis Proneness Scales using the method described in our prior study (Wang et al., 2012). Principal component analysis of these scales using promax rotation found that two factors (positive and negative schizotypy) accounted for 79.36% of the total variance. The number of participants in the positive schizotypy, negative schizotypy, mixed schizotypy, and low schizotypy groups were 283 (90 males), 266 (89 males), 200 (85 males), and 334 (112 males), respectively. We used MANCOVAs to compare the differences among the four groups on IRI and social functioning scores by SPSS with gender as covariate.

To test the possible mediation effect of empathy, structural equation modeling (SEM) was conducted by the AMOS 16.0 package and followed by partial correlation analysis, controlling for negative affect and gender. SEM has its own advantages on measure errors, multicollinearity, and testing the whole structural links, compared to multiple regression (Iacobucci et al., 2007). All related variables were transformed into standard Z scores. According to the suggestions of Baron and Kenny (Baron and Kenny, 1986), two models were tested: a basic model postulating the direct relation between schizotypy traits and social functioning total score (Basic Model); and a mediation model that added empathy as a mediator to test the link between schizotypy traits and social functioning, as well as the indirect effect of empathy on social functioning (Mediation Model). To test the significance of the indirect effect, we adopted a bootstrapping approach with 2000 iterations and generated a confidence interval. Only if zero is not between the confidence interval was it concluded that the indirect effect is different from zero and mediation exists. The chi-square test, comparative fit index (CFI) and root mean-squared error of approximation (RMSEA) indices were also used to assess the model fit. Non-significant χ^2, higher than 0.9 for CFI and lower than 0.08 for RMSEA indicate a good model fit.

3. Results

3.1. Descriptive statistics and gender effect

We had 1083 participants in total in the current study, 376 of them were males. The mean age for male participants was 18.88 years (S.D.=0.96) and it was 18.72 years (S.D.=0.80) for female participants. As Table 1 shows, independent sample t-tests showed that males reported lower scores on three of the four IRI subscales' scores: personal distress ($t=-6.47$, $p<0.001$), fantasy ($t=-7.94$, $p<0.001$) and empathic concern ($t=-4.28$, $p<0.001$) than females. Males and females reported similar scores on perspective taking ($t=0.17$). On the Chapman Psychosis Proneness Scales, males and females showed significant differences only on the physical anhedonia scale, with males reporting higher scores than females ($t=2.51$, $p<0.05$). Finally, males demonstrated a higher level of social functioning than females on "interpersonal" ($t=2.78$, $p<0.01$), "intimacy" ($t=6.44$, $p<0.001$) and "balance" ($t=2.87$, $p<0.01$) subscales of the SFS but they showed poorer scores on "family and friends" subscale ($t=-2.91$, $p<0.01$) than females.

3.2. Comparison of IRI and social functioning among the subtypes of schizotypy

The self-reported scores on the IRI were compared across the four schizotypy subtypes using a MANCOVA, with gender as a covariate. Result showed a significant multivariate effect of group ($F=18.52$, $p<0.001$, Wilk's Lambda=0.82, partial eta squared=0.064). As Table 2 shows, there were significant differences between the subtypes on all four subscales of the IRI (personal distress: $F=27.98$, $p<0.001$; perspective taking: $F=18.47$, $p<0.001$; fantasy: $F=21.85$, $p<0.001$; and empathic concern: $F=21.59$, $p<0.001$). Multiple

Table 2
Comparisons among four clusters on empathy and social function.

	Healthy controls (n=334)		Negative schizotypy (n=266)		Positive schizotypy (n=283)		Mixed schizotypy (n=200)		F/χ^2	Partial eta squared	post hoc
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.			
Gender(m:f)	112:222		89:177		90:193		85:115		6.80,n.s.		
Age	18.70	0.88	18.81	0.79	18.81	0.95	18.81	0.77	1.16,n.s.		
Years of education	12.28	0.66	12.26	0.57	12.39	0.76	12.40	0.66	3.26*		
Empathy-IRI											
Personal distress	2.70	0.66	2.99	0.70	2.93	0.63	3.21	0.75	27.98**	0.07	MS > PS, NS > HC
Perspective taking	3.66	0.52	3.36	0.60	3.68	0.56	3.56	0.63	18.47**	0.05	MS, PS, HC > NS
Fantasy	3.75	0.56	3.49	0.66	3.90	0.57	3.66	0.73	21.85**	0.06	HC, PS, MS > NS; PS > MS
Empathic concern	3.86	0.50	3.59	0.57	3.84	0.50	3.59	0.53	21.59**	0.06	PS,HC > NS,MS
Social functioning											
Social Interaction	2.85	0.35	2.53	0.36	2.83	0.34	2.65	0.41	51.40**	0.13	HC, PS > MS > NS
Family and friends	3.26	0.39	3.08	0.39	3.27	0.37	3.15	0.39	15.12**	0.04	HC, PS > NS
School	3.13	0.33	2.98	0.33	3.12	0.35	2.98	0.38	17.57**	0.05	HC, PS > MS, NS
Living skills	3.10	0.41	2.90	0.34	3.08	0.40	2.93	0.42	19.07**	0.05	HC, PS > MS, NS
Intimacy	3.04	0.41	2.88	0.46	3.05	0.45	3.00	0.51	8.69**	0.02	HC, PS > NS
Balance	2.92	0.41	2.71	0.42	2.85	0.42	2.71	0.49	16.76**	0.05	HC, PS > MS, NS

GLM multivariate analyses were conducted for empathy and social function, respectively, with gender as covariate. To control for Type 1 error, alpha level was set at 0.008 (0.05/6). Bonferroni correction was adopted for multiple comparisons.

* $p < 0.05$.
** $p < 0.001$.

Table 3
Partial correlations between schizotypy, empathy and social functioning with gender and depression controlled.

	Positive schizotypy traits	Negative schizotypy traits	Personal distress	Perspective taking	Fantasy	Empathic concern	Social functioning
Positive schizotypy traits	–						
Negative schizotypy traits	0.13***	–					
Personal distress	0.18***	0.07*	–				
Perspective taking	0.08**	−0.27***	−0.07*	–			
Fantasy	0.13***	−0.28***	0.11***	0.24***	–		
Empathic concern	−0.04	−0.31***	0.08*	0.32***	0.39***	–	
Social functioning	−0.02	−0.37***	−0.18***	0.31***	0.25***	0.20***	–

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

comparisons with Bonferroni correction showed that on perspective taking, the negative schizotypy group was poorer than the other three groups; on empathic concern, the negative and mixed schizotypy groups were poorer than the positive and healthy control groups.

A MANCOVA was also used to compare the four schizotypy subtypes on social functioning subscale scores. Significant multivariate effect of group was found (F=9.87, $p < 0.001$, Wilk's Lambda=0.85, partial eta squared=0.052). As shown in Table 2, the schizotypy subtypes reported significantly different scores on all domains of the social functioning scale, including "Social interaction" (F=51.40, $p < 0.001$), "Family and Friends" (F=15.12, $p < 0.001$), "School" (F=17.57, $p < 0.001$), "Living Skills" (F=19.07, $p < 0.001$), "Intimacy" (F=8.69, $p < 0.001$) and "Balance" (F=16.76, $p < 0.001$). Multiple comparisons showed that the mixed and negative schizotypy groups reported similar social functioning levels for "School", "Living Skills" and "Balance", but that they both demonstrated poorer outcomes than the positive schizotypy group and healthy controls. For "Family and Friends", "Intimacy" and "Social Interaction" subscales, the negative schizotypy group reported worst scores in all four subtypes.

3.3. Relationship between schizotypy traits, empathy and social functioning

Before the mediation effect testing, we calculated partial correlations for the relevant variables: positive/negative schizotypy traits, empathy subscale scores, and social functioning total scores. As shown in Table 3, after controlling for gender and negative affect (as assessed by the DASS-Depression scale), partial correlations revealed that both positive schizotypy and negative schizotypy were significantly correlated with personal distress, perspective taking, and fantasy subscale scores. However, only negative schizotypy was significantly correlated with empathic concern (r=−0.31, $p < 0.001$) and social functioning (r=−0.37, $p < 0.001$) scores. The results thus indicate that negative schizotypy, but not positive schizotypy, presented stronger and more extensive associations with empathy and social functioning.

3.4. Mediation effect of empathy

Based on the significant correlations among negative schizotypy traits, cognitive empathy (perspective taking and fantasy subscales) and social functioning, we postulated the direct model (Basic model) and indirect model (Mediation Model with cognitive empathy), as depicted in Fig. 1. For the direct model (Basic Model), the prediction effect of negative schizotypy traits (anhedonia) to social functioning was tested. Result shows that the direct relation between negative schizotypy (anhedonia) and social functioning was significant (standardized coefficient β=−0.62, $p < 0.001$). The model fit for the observed data: χ^2=124.06, d.f.=19, $p < 0.001$, RMSEA=0.071, CFI=0.94, and GFI=0.97.

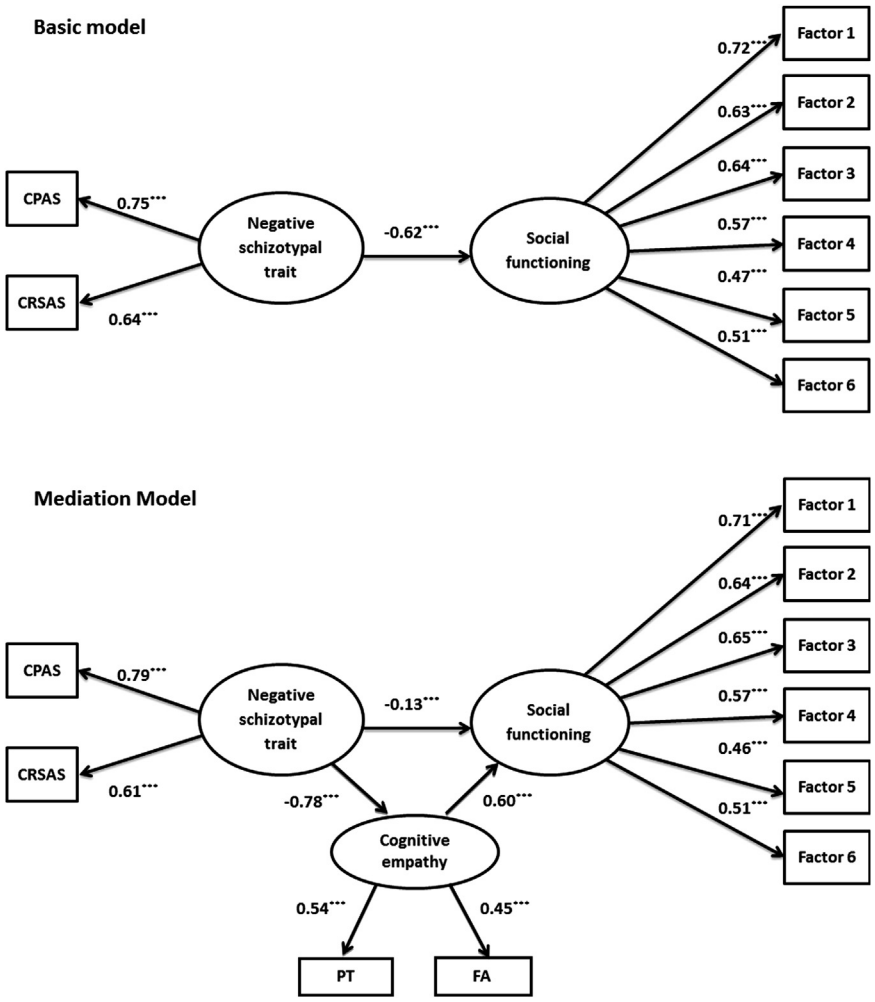

Fig. 1. Basic model and mediation model. The direct relation between negative schizotypy and social functioning was significant (standardized coefficient $\beta = -0.62$, $p < 0.001$). The model fit for the observed data: $\chi^2 = 124.06$, d.f. = 19, $p < 0.001$, RMSEA = 0.071, CFI = 0.94, and GFI = 0.97. After controlling for the direct effect of negative schizotypy on social functioning, mediation model evaluated the strength of the indirect relationship. The direct effect was still significant, but with a smaller standardized coefficient ($\beta = -0.13$, $p < 0.001$). The model fit indices are as follow: $\chi^2 = 208.48$, d.f. = 32, $p < 0.001$, RMSEA = 0.071, CFI = 0.92, and GFI = 0.96. The bootstrapping estimate revealed a significant indirect effect ($\beta = -0.47$, 90% CI = −0.29 to −0.93, $p < 0.001$). The results showed a partial mediation effect through cognitive empathy. CPAS: Chinese version of Physical Anhedonia Scale; CRSAS: Chinese version of Revised Social Anhedonia Scale; social functioning scale: Factor 1: interpersonal; Factor 2: Family and Friends; Factor 3: School; Factor 4: Living skills; Factor 5: Intimacy; Factor 6: Balance. Cognitive empathy: PT: perspective taking; FA: fantasy. ***: $p < 0.001$.

For the indirect model (Mediation Model), after controlling for the direct effect of negative schizotypy on social functioning, the strength of the indirect relationship of cognitive empathy (perspective taking and fantasy) was tested. The direct effect was still significant, but produced a smaller standardized coefficient ($\beta = -0.13$, $p < 0.001$). The bootstrapping estimate revealed a significant indirect effect ($\beta = -0.47$, 90% CI = −0.29 to −0.93, $p < 0.001$). The model fit indices also indicated good fit: $\chi^2 = 208.48$, d.f. = 32, $p < 0.001$, RMSEA = 0.071, CFI = 0.92, and GFI = 0.96. The results showed a partial mediation effect through cognitive empathy. In addition, we tested the mediation effect of affective empathy by another mediation model with empathic concern as the potential mediator. The direct effect in the mediation model was the same as Basic model ($\beta = -0.62$, $p < 0.001$). In addition, the bootstrapping estimate revealed a non-significant indirect effect ($\beta = -0.003$, n.s.).

4. Discussion

The current study has two main findings. First, among the subtypes of schizotypy, the negative schizotypy group reported poorer empathy than the positive schizotypy group and healthy controls. Significantly, the reduced empathy in the negative schizotypy group was found to span both the cognitive and affective components of empathy. Secondly, and more importantly, there was a partial mediation effect of cognitive empathy, but not affective empathy, on the association between negative schizotypy scores and social functioning.

For the association between empathy and schizotypy traits, negative correlations between negative schizotypy scores and empathy scores were found ($r = -0.27$ for perspective taking subscale, $p < 0.001$; $r = -0.28$ for fantasy subscale, $p < 0.001$ and $r = -0.31$ for empathic concern subscale, $p < 0.001$). On the contrary, positive correlations were found between empathy and positive schizotypy traits ($r = 0.18$ for personal distress, $p < 0.001$; $r = 0.08$, $p < 0.01$ for perspective taking and $r = 0.13$, $p < 0.001$ for fantasy subscale). Comparisons among the four subtypes also showed that the negative schizotypy group reported poorer empathy than the healthy controls. The positive schizotypy group reported similar levels to the healthy control group with no differences present for affective or cognitive empathy. These outcomes are consistent with prior studies (Henry et al., 2008; Thakkar and Park, 2010). For example, Henry et al. examined the relationship between empathy and schizotypy in adult

participants recruited from the community by using The Empathy Quotient (Baron-Cohen and Wheelwright, 2004) and Schizotypal Personality Questionnaire (SPQ) (Raine, 1991). The authors found that the negative subscale of the SPQ was negatively correlated with both cognitive and affective empathy ($r=-0.15$ and -0.23 respectively). It was also found that the positive subscale of the SPQ was positively related to cognitive empathy ($r=0.13$) (Henry et al., 2008). Thakkar and Park (2010) also found that the interpersonal subscale of the SPQ was negatively correlated with cognitive empathy ($r=-0.49$) and affective empathy ($r=-0.59$) with no significant correlations between positive schizotypy and empathy present. Unlike negative schizotypy, positive schizotypy does not appear to show negative correlations with empathy. This suggests that individuals with different schizotypy traits show different profiles of social cognitive abilities such as empathy. Therefore, it is necessary to differentiate the subtypes of schizotypy and by extension the symptom classifications of patients with schizophrenia, in order to understand the potential deficits that may exist in cognitive and affective empathy.

To examine the social functioning outcomes of schizotypy individuals further, a mediation effect of empathy was tested. Results showed that empathy, an important social cognitive ability, did serve as a partial mediator on the relationship between negative schizotypy scores and social functioning. Such findings are consistent with prior studies which propose that social cognition would be an important mediator in psychosis proneness or for symptoms in schizophrenic patients and their social functioning (Schmidt et al., 2011). Another study focused on social cognition and quality of life in schizophrenia and found that the interaction between psychotic symptoms assessed by the Positive and Negative Syndrome Scale (Kay et al., 1987) and performance on the hinting task (a ToM task) significantly predicted the quality of life of patients in schizophrenia (Maat et al., 2012).

In examining the mediation effect of empathy further, differences emerged between the affective and cognitive components of empathy. Using SEM to examine the mediation effect of empathy, a significant indirect effect was found only for cognitive empathy. No significant indirect effect was found for affective empathy in the relationship between negative schizotypy traits and social functioning. Smith et al. (2012) examined the influence of empathy on the correlations between neurocognitive, psychopathological variables, and outcomes in patients with schizophrenia. Their results showed that perspective taking, but not the empathic concern subscale of the IRI, presented significant incremental effects (Smith et al., 2012). Henry et al. examined the influence of empathy (assessed by EQ) on the relationship between schizotypy (assessed by SPQ interpersonal factor) and social functioning in a non-clinical sample by regressions and found that after controlling for affective empathy, the prediction of negative schizotypy to social functioning reduced from $\beta=-0.31$, $p<0.01$ to $\beta=-0.25$, $p<0.01$, suggesting that affective empathy is a partial mediator on this correlation. However, in their study, Henry and coworkers did not find a similar effect with cognitive empathy (Henry et al., 2008). The different results between the present study and that of Henry et al. may reflect the different scales that were used. Henry et al. assessed negative schizotypy by using the SPQ interpersonal factor, including five sub-factors: excessive social anxiety; no close friends; constricted affect; ideas of reference and suspiciousness. However in current study, negative schizotypy trait means anhedonia, including both physical and social anhedonia. Henry et al. also found that constricted affect was responsible for the significant correlation between cognitive empathy and negative schizotypy. Thus, we argue that the results of the current study indicated that cognitive empathy, assessed by perspective taking and fantasy subscale of IRI, partially mediated the associations between trait anhedonia and social functioning in college students.

There are some limitations in the current study. The measures used were self-reported questionnaires. Given that subjective and objective measures of cognitive functioning may give rise to different outcomes (Chan et al., 2008, 2011), further research incorporating objective measures of empathy should be conducted to confirm that whether social cognition, as measured in terms of empathy performance, will still produce similar results. This is a large scale investigation and we did not adopt any interview to verify the schizotypy and exclude other diagnosis. Finally, results of the current study may not be generalized to samples with more severe clinical problems as participants in the current study were considered to be "behaviorally" at-risk for psychosis (i.e., without any family history of psychosis). These participants may behave differently from "genetically" at-risk individuals (i.e., non-psychotic siblings of patients with schizophrenia). It is important to examine whether the current findings can be replicated and extended to those individuals that are "genetically" at-risk for schizotypy.

In conclusion, the results of this study suggested that individuals with schizotypy, especially negative schizotypy, have deficits in both cognitive and affective empathy. There is also a mediation effect of cognitive empathy on the association between negative schizotypy traits and social functioning. These results highlight the important role that empathy plays in social interactions and social functioning outcomes in individuals with schizotypy traits and, by extension, to individuals with schizophrenia. Such findings have important implications for the evaluation, management, and treatment of individuals with schizophrenia, particularly those that exhibit negative symptomatology. The significance of the role of social cognition has also been highlighted in research pertaining to interventions for schizophrenic patients and high-risk samples that aim to improve functional outcomes (Chan et al., 2010; Penn et al., 2007; Roberts et al., 2010). Taken together, these findings highlight the importance of exploring the mediation effect of social cognition due to its potential application in intervention and training programs to prevent schizophrenia in early high-risk individuals.

Acknowledgments

This study was supported partially by the National Key Technologies R&D Program (Grant no. 2012BAI36B01), the National Science Fund China Young Investigator Award (Grant no. 81088001), the Knowledge Innovation Project of the Chinese Academy of Sciences (Grant no. KSCX2-EW-J-8), the CAS/SAFEA International Partnership Program for Creative Research Teams (Grant no. Y2CX131003), and the Key Laboratory of Mental Health, Institute of Psychology to Raymond Chan. DHKS and DN are supported by an Area of Strategic Investment Chronic Disease Prevention Innovation Grant (Grant no. 213507) from Griffith University. These funding agents had no role in the study design; collection, analysis, and interpretation of the data; writing of the manuscript; or decision to submit the paper for publication.

References

Achim, A.M., Ouellet, R., Roy, M.A., Jackson, P.L., 2010. Assessment of empathy in first-episode psychosis and meta-analytic comparison with previous studies in schizophrenia. Psychiatry Research 10.1016/j.psychres.2010.10.030.

Bailey, P.E., Henry, J.D., Von Hippel, W., 2008. Empathy and social functioning in late adulthood. Aging & Mental Health 12, 499–503.

Baron-Cohen, S., Wheelwright, S., 2004. The empathy quotient: an investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. Journal of Autism and Developmental Disorders 34, 163–175.

Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology 51, 1173.

Barrantes-Vidal, N., Lewandowski, K.E., Kwapil, T.R., 2010. Psychopathology, social adjustment and personality correlates of schizotypy clusters in a large non-clinical sample. Schizophrenia Research 122, 219–225.
Blair, R., 2005. Responding to the emotions of others: dissociating forms of empathy through the study of typical and psychiatric populations. Consciousness and Cognition 14, 698–718.
Chan, C.-y., 1986. The relations between Age, Sex-role, Orientation of Human and Empathy. Department of Education, National Chengchi University, Taibei.
Chan, R.C.K., Gao, X., Li, X., Li, H., Cui, J., Deng, Y., Wang, Y., 2010. The Social Cognition and Interaction Training (SCIT): an extension to individuals with schizotypal personality features. Psychiatry Research 178, 208–210.
Chan, R.C.K., Xu, T., Huang, J., Wang, Y., Zhao, Q., Shum, D.H.K., O'Gorman, J., Potangaroa, R., 2012a. Extending the utility of the Depression Anxiety Stress scale by examining its psychometric properties in Chinese settings. Psychiatry Research 200, 879–883.
Chan, R.C.K., Wang, Y., Ma, Z., Hong, X.-h., Yuan, Y., Yu, X., Li, Z., Shum, D., Gong, Q.-y., 2008. Objective measures of prospective memory do not correlate with subjective complaints in schizophrenia. Schizophrenia Research 103, 229–239.
Chan, R.C.K., Wang, Y., Yan, C., Zhao, Q., McGrath, J., Hsi, X., Stone, W.S., 2012b. A study of trait anhedonia in non-clinical chinese samples: evidence from the chapman scales for physical and social anhedonia. PLoS One 7, e34275.
Chan, R.C.K., Yan, C., Qing, Y.-H., Wang, Y., Wang, Y.-N., Ma, Z., Hong, X.-H., Li, Z.-J., Gong, Q.-Y., Yu, X., 2011. Subjective awareness of everyday dysexecutive behavior precedes 'objective' executive problems in schizotypy: a replication and extension study. Psychiatry Research 185, 340–346.
Chapman, L., Chapman, J., Miller, E., 1982. Reliabilities and intercorrelations of eight measures of proneness to psychosis. Journal of Consulting and Clinical Psychology 50, 187–195.
Chapman, L.J., Chapman, J.P., 1978. The Revised Physical Anhedonia Scale, Unpublished test. University of Wisconsin, Madison.
Davis, M.H., 1983. Measuring individual differences in empathy: evidence for a multidimensional approach. Journal of Personality and Social Psychology 44, 113.
Deutsch, F., Madle, R.A., 1975. Empathy: Historic and current conceptualizations, measurement, and a cognitive theoretical perspective. Human Development 18, 267–287.
Dinn, W.M., Harris, C.L., Aycicegi, A., Greene, P., Andover, M.S., 2002. Positive and negative schizotypy in a student sample: neurocognitive and clinical correlates. Schizophrenia Research 56, 171–185.
Eckblad, M.L., Chapman, L.J., Chapman, J.P.M.M., 1982. The Revised Social Anhedonia Scale, Unpublished Test. University of Wisconsin, Madison.
Green, M.F., Penn, D.L., Bentall, R., Carpenter, W.T., Gaebel, W., Gur, R.C., Heinssen, R., 2008. Social cognition in schizophrenia: an NIMH workshop on definitions, assessment, and research opportunities. Schizophrenia Bulletin 34, 1211–1220.
Haker, H., Rössler, W., 2009. Empathy in schizophrenia: impaired resonance. European Archives of Psychiatry and Clinical Neuroscience 259, 352–361.
Henry, J.D., Bailey, P.E., Rendell, P.G., 2008. Empathy, social functioning and schizotypy. Psychiatry Research 160, 15–22.
Iacobucci, D., Saldanha, N., Deng, X., 2007. A meditation on mediation: evidence that structural equations models perform better than regressions. Journal of Consumer Psychology 17, 139–153.
Kay, S.R., Fiszbein, A., Opler, L.A., 1987. The Positive and Negative Syndrome Scale (PANSS) for Schizophrenia. Schizophrenia Bulletin 13, 261–276.
Lawrence, E.J., Shaw, P., Baker, D., Patel, M., Sierra-Siegert, M., Medford, N., David, A. S., 2007. Empathy and enduring depersonalization: the role of self-related processes. Social Neuroscience 2, 292–306.
Lecomte, T., Ehmann, T., Corbiere, C., 2005. The First Episode Social Functioning Scale (FESFS). University of British Columbia.
Lee, K.H., Brown, W.H., Egleston, P.N., Green, R.D., Farrow, T.F., Hunter, M.D., 2006. A functional magnetic resonance imaging study of social cognition in schizophrenia during an acute episode and after recovery. American Journal of Psychiatry 163 (11), 1926–1933.
Lough, S., Kipps, C.M., Treise, C., Watson, P., Blair, J.R., Hodges, J.R., 2006. Social reasoning, emotion and empathy in frontotemporal dementia. Neuropsychologia 44 (6), 950–958.
Lovibond, P.F., Lovibond, S.H., 1995. The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behaviour Research and Therapy 33, 335–343.
Maat, A., Fett, A.-K., Derks, E., 2012. Social cognition and quality of life in schizophrenia. Schizophrenia Research 137, 212–218.
Meehl, P.E., 1962. Schizotaxia, schizotypy, schizophrenia. American Psychologist 17, 827.
Montag, C., Heinz, A., Kunz, D., Gallinat, J., 2007. Self-reported empathic abilities in schizophrenia. Schizophrenia Research 92, 85–89.
Penn, D.L., Roberts, D.L., Combs, D., Sterne, A., 2007. The development of the social cognition and interaction training program for schizophrenia spectrum disorders. Psychiatric Services 58, 449–451.
Quince, T.A., Parker, R.A., Wood, D.F., Benson, J.A., 2011. Stability of empathy among undergraduate medical students: a longitudinal study at one UK medical school. BMC Medical Education 11, 90.
Raine, A., 1991. The SPQ: a Scale for the assessment of schizotypal personality based on Dsm-Iii-R criteria. Schizophrenia Bulletin 17, 555–564.
Roberts, D.L., Penn, D.L., Labate, D., Margolis, S.A., Sterne, A., 2010. Transportability and feasibility of Social Cognition And Interaction Training (SCIT) in community settings. Behavioural and Cognitive Psychotherapy 38, 35–47.
Schmidt, S.J., Mueller, D.R., Roder, V., 2011. Social cognition as a mediator variable between neurocognition and functional outcome in schizophrenia: empirical review and new results by structural equation modeling. Schizophrenia Bulletin 37 (Suppl. 2), S41–54.
Shamay-Tsoory, S.G., 2011. The neural bases for empathy. The Neuroscientist 17, 18.
Shamay-Tsoory, S.G., Aharon-Peretz, J., 2007. Dissociable prefrontal networks for cognitive and affective theory of mind: a lesion study. Neuropsychologia 45, 3054–3067.
Shrira, A., Tsakanikos, E., 2009. Latent inhibition as a function of positive and negative schizotypal symptoms: evidence for a bi-directional model. Personality and Individual Differences 47, 434–438.
Smith, M.J., Horan, W.P., Karpouzian, T.M., Abram, S.V., Cobia, D.J., Csernansky, J.G., 2012. Self-reported empathy deficits are uniquely associated with poor functioning in schizophrenia. Schizophrenia Research 137, 196–202.
Taouk, M., Lovibond, P., Laube, R., 2001. Psychometric properties of a Chinese version of the 21-item Depression Anxiety Stress Scales (DASS21). Report for New South Wales Transcultural Mental Health Centre, Cumberland Hospital, Sydney.
Thakkar, K.N., Park, S., 2010. Empathy, schizotypy, and visuospatial transformations. Cognitive Neuropsychiatry 15, 477–500.
Van Os, J., Linscott, R., Myin-Germeys, I., Delespaul, P., Krabbendam, L., 2010. A systematic review and meta-analysis of the psychosis continuum: evidence for a psychosis proneness–persistence–impairment model of psychotic disorder. Psychological Medicine 39, 179.
Vollema, M.G., van den Bosch, R.J., 1995. The multidimensionality of schizotypy. Schizophrenia Bulletin 21, 19–31.
Vollm, B.A., Taylor, A.N.W., Richardson, P., Corcoran, R., Stirling, J., McKie, S., Deakin, J.F.W., Elliott, R., 2006. Neuronal correlates of theory of mind and empathy: a functional magnetic resonance imaging study in a nonverbal task. NeuroImage 29, 90–98.
Wang, Y., Neumann, D., Shum, D.H., Chan, R.C., 2012. A cross-validation study of clustering of schizotypy using a non-clinical Chinese sample. Psychiatry Research 10.1016/j.psychres.2012.03.026.
Wang, Y., Yeh, Y.-h., Tsang, S.-m., Liu, W.-h., Shi, H.-s., Li, Z., Shi, Y.–f., Wang, Y., Wang, Y.-n, Lui, S., Neumann, D., Shum, D.H., Chan,R.C., (submitted for publication). Social functioning in Chinese college students with and without schizotypal personality traits: an exploratory study of the Chinese version of the First Episode Social Functioning Scale.