



## Social functioning impairments in schizotypy when social cognition and neurocognition are not impaired

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### ABSTRACT

The present study examined the social, cognitive, and emotional functioning of persons with schizotypy. Over 2000 undergraduate students were screened for schizotypy with the Schizotypal Personality Questionnaire – Brief over two consecutive semesters. Ninety-two persons with high schizotypy and 22 persons with low schizotypy completed measures of social functioning (Social Adjustment Scale, Social Functioning Scale, MOS Social Support Survey), working memory (Paced Auditory Serial Addition Test, Digit Span, Letter-Number Sequencing, Corsi Block Tapping Test) and empathy (Interpersonal Reactivity Index, Empathy Quotient). Persons with high schizotypy, when compared to their counterparts with low schizotypy, displayed deficits on many indices of social functioning even though differences in working memory and empathy were not observed. The social functioning deficits of persons with high schizotypy included impairments in friendship relations, family relations, interpersonal engagement, and recreational activities. These findings indicate that persons with high schizotypy experience broad deficits in social functioning even when their cognitive and emotional skills are unaffected.

### 1. Introduction

Some persons with schizophrenia experience hallucinations, other persons with schizophrenia experience delusions; but all persons with schizophrenia experience severe social dysfunction (American Psychiatric Association, 2013). Thus, we may consider that social dysfunction is a core feature of schizophrenia, and not a byproduct of psychiatric symptoms and neurocognitive impairments.

Schizotypy is conceptualized as a non-clinical manifestation of the same underlying biological factors that give rise to schizophrenia and other schizophrenia-spectrum disorders (Claridge, 1994; Claridge and Beech, 1995). Investigators interested in identifying the core features of schizophrenia value studies of persons with schizotypy (psychometric schizotypes or persons diagnosed with schizotypal personality disorder) as performance impairments in these persons cannot be explained by confounds often present in research with schizophrenia patients such as antipsychotic medication usage, social isolation, and recurrent hospitalization.

Persons with schizophrenia experience severe deficits in social functioning and these deficits appear to be present prior to and predictive of psychosis onset (Dragt et al., 2011; Velthorst et al., 2016). Persons with high schizotypy display deficits in social functioning similar to but less severe than the severe social dysfunction of persons

with schizophrenia (Cohen et al., 2015). The presence of both positive and negative schizotypal traits have been linked to fewer self-reported social outings or activities, as well as struggles with work, recreation, and academics (Cohen et al., 2015). Persons with high schizotypy display deficits in both the frequency and intensity of their social interactions (Cohen et al., 2015). The social support and positive emotional feedback that is associated with high quality friendships and family relationships may be especially critical for persons with schizotypy who need friends and family to help them monitor and cope with their psychosis-like perceptual experiences, suspicious thoughts and social apprehension (Kwapil, 1998). Such disturbances in social functioning relate to high rates of social anhedonia, depression, and suicide attempts in persons with schizophrenia and persons with schizotypy (Mulholland and Cooper, 2000).

Social cognition, the ability to construct mental representations about others, oneself, and relations between others and oneself (Adolphs, 2001), is impaired in persons with schizophrenia (Green, 2005; Pinkham, 2014; Green et al., 2015; Green, 2016). Persons with schizophrenia, relative to healthy persons, display impairments in social cognitive domains such as emotion perception including facial affect recognition (Edwards et al., 2002; Weiss et al., 2006), social perception (Sergi and Green, 2003; Toomey et al., 2002), relationship perception (Sergi et al., 2009), theory of mind (Greig et al., 2004;

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Roncone et al., 2002), and emotional intelligence (Kee et al., 2009). Correlational and structural equation modeling analyses suggest that social cognition mediates relations between neurocognition and social functioning in schizophrenia (Addington et al., 2006; Brekke et al., 2005; Sergi et al., 2006; Vauth et al., 2004). Some studies of persons with high schizotypy suggest that they are impaired in social cognition (Pickup, 2006; Meyer and Shean, 2006; Henry et al., 2008), while other studies suggest that persons high and low in schizotypy do not differ in social cognition (Jahshan and Sergi, 2007; McCleery et al., 2012). As the methods and measures used to assess social cognition in schizotypy are most often the same as those employed to assess social cognition in schizophrenia, it appears that the mixed findings of social cognition deficits in schizotypy reflect lesser deficits in social cognition in schizotypy. Moreover, the lesser social cognition deficits in schizotypy are consistent with the less severe symptoms and social dysfunction of schizotypy compared to those of schizophrenia.

Empathy, a widely studied aspect of social cognition, refers to the ability to perceive emotions and to respond with the proper affective responsiveness (Davis, 1983). Empathy involves a cognitive component and an affective component. The cognitive component concerns the individual's cognitive understanding of the mental state of another individual, while the emotional component focuses on the individual's "heart-felt" emotional response to the mental state of another individual (Henry et al., 2008). Socially acceptable interactions rely on the presence of both cognitive and affective empathy, which in turn results in successful social functioning. Persons with high schizotypy display reduced empathy and increased negative affect compared to healthy controls (Henry et al., 2008; Kiang and Kutas, 2006). Individuals with schizotypal traits are both slower and less accurate at identifying the facial expressions of others (Dickey et al., 2011). Suggestive of a relationship between empathy and social functioning in schizotypy, Henry et al. (2008) found an association between these two constructs in individuals with high schizotypy.

Persons with schizophrenia experience deficits in many domains of neurocognition (Bowie and Harvey, 2006; Lesh et al., 2011; Fioravanti et al., 2012). Persons with high schizotypy evidence neurocognitive impairments, but the frequency and severity of these impairments are less than those experienced by persons with schizophrenia (Ettinger et al., 2015). Working memory is an aspect of neurocognition conceptualized as immediate memory in which information is actively held and manipulated (Baddeley and Hitch, 1974). Working memory is considered essential to a person's ability to understand and complete complex cognitive tasks, as well as being necessary for learning and reasoning (Baddeley, 1992). Studies of persons with schizophrenia indicate that their deficits in visual working memory relate to negative symptoms such as anhedonia and avolition as well as positive symptoms such as auditory hallucinations (Gooding and Tallent, 2002; Bruder et al., 2011). Studies of working memory in schizotypy suggest significant deficits in verbal working memory in individuals with high schizotypy (Cannon et al., 1994). Contrary to this, a study conducted by Lenzenweger and Gold (2000) found that noteworthy deficits in verbal memory were not present in a group of schizotypal individuals. These mixed results are likely due to the use of a range of different working memory tasks, in addition to the lack of control for the influence of other schizotypy dimensions (Schmidt-Hansen and Honey, 2009).

Toward identifying social dysfunction as a core feature of schizophrenia, the present study compares the social functioning of persons with high schizotypy and persons with low schizotypy. If persons with high schizotypy experience significant social dysfunction even though their neurocognition and social cognition are near normal – and they have not been impacted by antipsychotic medication usage, social alienation, and recurrent hospitalization – then it is reasonable to suggest that social dysfunction is a core feature of schizophrenia. Given the severity of the social dysfunction experienced by persons with schizophrenia, it was hypothesized that persons with high schizotypy would display impaired social functioning when compared to their low

**Table 1**  
Demographic data ( $N = 114$ ).

	Low schizotypy ( $n = 22$ )	High schizotypy ( $n = 92$ )
Gender (% female)	13 (59.1%)	72 (78.3%)
Mean age: years (S.D.)	20.73 (3.44)	19.96 (2.40)
Ethnicity: frequency (%)		
Caucasian	4 (18.2%)	13 (14.1%)
African-American	1 (4.5%)	7 (7.6%)
Hispanic	14 (63.6%)	48 (52.2%)
Asian American	2 (9.1%)	17 (18.5%)
Multiethnic	1 (4.5%)	7 (7.6%)

schizotypy counterparts. The current study also compares the empathy skills and working memory skills of persons with high schizotypy and persons with low schizotypy. As past research strongly supports impairments in social cognition and neurocognition in schizophrenia and, to a lesser extent, supports impairments in social cognition and neurocognition in schizotypy, it was hypothesized that persons with high schizotypy would be impaired in their empathy skills and working memory skills compared to persons with low schizotypy.

## 2. Method

### 2.1. Participants

Over 2000 undergraduates enrolled in lower division psychology courses at the California State University Northridge were screened for schizotypy using the Schizotypal Personality Questionnaire - Brief Version (SPQ-B; Raine and Benishay, 1995) for two consecutive semesters. Ninety-two participants with high schizotypy (scores from 15 to 22) and 22 participants with low schizotypy (scores from 0 to 3) participated in the study. All participants had to be at least 18 years old.

The gender, age, and ethnicity of the two groups are detailed in Table 1. The study was approved by the Institutional Review Board at the California State University Northridge.

### 2.2. Measures

#### 2.2.1. Schizotypy

The Schizotypal Personality Questionnaire - Brief Version (SPQ-B) is a commonly used measure of schizotypy that consists of 22 true/false items that are used to assess the cognitive-perceptual, interpersonal, and disorganized aspects of schizotypy (Raine and Benishay, 1995). The KR-20 internal consistency reliability coefficient for the SPQ-Brief is 0.83; and correlations between the three subscales range between 0.63 and 0.74 (Compton et al., 2007).

#### 2.2.2. Social functioning

The Social Adjustment Scale – Self Report (SAS-SR; Weissman and Bothwell, 1976) is a 54 item self-report scale with questions measuring instrumental and expressive role performance over the past two weeks in 6 major areas of functioning. As most undergraduates are not involved in all the major roles assessed by this scale (e.g., marital and parental roles), only three areas of functioning were assessed. The "Student" section assesses academic functioning with six questions about issues such as class attendance and scholastic performance. The "Social and Leisure" section assesses friendship relationships with nine questions about issues such as frequency of social contacts and satisfaction with social life. The "Family" section assesses family relationships with eight questions about issues such as contacts and satisfaction with one's family of origin. Each item is scored on a five-point scale with higher scores indicating poorer functioning. The SAS-SR has good internal consistency with Cronbach's  $\alpha$  ranging from 0.70 to 0.94 (Mundt et al., 2002). This measure was selected because it targets many of the domains relevant to the lives of adolescent university students,

regardless of their schizotypy status. It has also been used in schizotypy research in the past (Jahshan and Sergi, 2007; McCleery et al., 2012). The Social Functioning Scale is a 79 item questionnaire that covers various topics such as interpersonal communication, social engagement, and social activity (SFS; Birchwood et al., 1990). The seven subscales of the SFS are social engagement/withdrawal, interpersonal behavior, pro-social activities, recreation, independence-competence, independence-performance, and employment/occupation (Birchwood et al., 1990). The employment/occupation subscale was not used as most of the participants were not working. The SFS was designed to provide clinicians with a detailed assessment of the individual's relative strengths and weaknesses and guide them in tailoring individualized interventions (Birchwood et al., 1990). The SFS has good internal consistency with Cronbach's  $\alpha = 0.80$  (Birchwood et al., 1990) and has been used in various studies assessing individuals diagnosed with schizophrenia (Birchwood et al., 1990; Dickerson et al., 1997; Grant et al., 2001; Górná et al., 2014). The MOS Social Support Survey is a 20 item measure of perceived social support (MOS-SS; Sherbourne and Stewart, 1991). The MOS-SS displays good internal constancy; Cronbach's  $\alpha = 0.91$  (Sherbourne and Stewart, 1991). Although this measure has not generally been used in schizophrenia and schizotypy studies, it is often used to assess patients with chronic conditions.

### 2.2.3. Empathy

The Empathy Quotient is a 60 item questionnaire of empathy in adults (EQ; Baron-Cohen and Wheelwright, 2004). The EQ has been used in studies of autism and schizotypy (Thakkar and Park, 2010; Henry et al., 2008). The internal consistency of the EQ is strong; Cronbach's  $\alpha = 0.92$  (Baron-Cohen and Wheelwright, 2004). The Interpersonal Reactivity Index is a 28 item multidimensional measure of empathy that involves four subscales: perspective taking, fantasy, personal distress, and empathic concern (IRI; Davis, 1983). This measure has been used in schizophrenia and schizotypy research (Aaron et al., 2015). The IRI displays good internal constancy; Cronbach's  $\alpha = 0.85$  (Davis, 1983).

### 2.2.4. Working memory

The Paced Auditory Serial Addition Test (PASAT; Gronwall, 1977) involves a verbal presentation of a sequence of single numbers 1–9 at a constant speed. Participants must mentally sum the last 2 digits, NOT a running total. There are 3 possible speed levels, moving from slowest to fastest. Each level consists of 60 trials. The run time for this measure is approximately 5 min. The Digit Span Task asks participants to hear a series of number sequences and recall them in either a forward or backward manner. Depending on performance, participants move up or down a level. The assessment is complete after 14 trials. The run time for this measure is between 4 and 6 min. The Letter Number Sequencing Task gives participants a growing series of letters and digits. They are asked to recall them in order, and later asked to recall them from smallest to largest in numerical and alphabetic order. The measure has 21 items, each consisting of 3 trials. In order to discontinue, the participant must fail to recall all three trials within an item. The run time for this measure is between 5 and 7 min. The Corsi Block Tapping Test developed by Corsi (1972) presents participants with a screen of small, square boxes, as they light up in a pre-fixed sequence. Participants are then asked to click on boxes in the same order they were lit. The measure has 8 items, each consisting of 2 trials. In order to discontinue, participants must fail to recall 2 sequences of equal length within a single item. The run time for this measure is between 4 and 7 min.

## 2.3. Procedure and analyses

Participants were told that this study examined social functioning, empathy and working memory in college students. They were not informed that the construct of schizotypy was measured through the use of the SPQ–B. Participants in this online cross-sectional study were

individually administered measures of social functioning and empathy through the use of the Qualtrics online software. In addition, the tests of working memory were embedded within the Qualtrics software through the Inquisit Millisecond Online Testing Library.

To examine group differences on measures of social functioning, empathy and working memory, independent samples *t*-tests were performed on normally distributed variables. For variables that were not normally distributed, Mann-Whitney *U* tests were performed. To examine whether ethnicity and gender systematically impacted the data, a series of one-way analyses of variance (ANOVAS) were conducted. Ethnicity showed limited and inconsequential relations with the independent variables as ANOVAS found significance for 0 of 5 empathy variables, 0 of 5 working memory variables, and 2 of 10 social functioning variables. Gender showed limited and inconsequential relations with the working memory and social functioning variables and a pattern of relations for the empathy variables as ANOVAS found significance for 4 of 5 empathy variables, 1 of 5 working memory variables, and 0 of 10 social functioning variables. As the main statistical analyses show that schizotypy status does not systematically impact empathy, gender's impact on this null finding was not pursued further. A series of Pearson's correlations were performed to examine correlations between measures of social functioning, empathy and working memory in the high schizotypy group. For variables that were not normally distributed, Spearman's correlations were performed.

## 3. Results

### 3.1. Descriptive statistics

Descriptive data for the sample is presented in Table 1 for all participants included in the study. Statistical analyses were conducted using SPSS Version 22. For variables within the acceptable range of  $\pm 3.29$  for skewness and kurtosis (Tabachnik and Fidell, 1996), independent samples *t*-tests were used for between-group comparisons. For variables that were not normally distributed, Mann-Whitney *U* non-parametric tests were used as log-transformation did not normalize the data sufficiently. Independent samples *t*-tests were conducted to compare persons with high ( $N = 92$ ) and low ( $N = 22$ ) schizotypy on measures of social functioning, empathy, and working memory (Table 2).

### 3.2. Schizotypy group and measures of working memory and empathy

Persons with high and low schizotypy did not differ in their performance on all measures of working memory (Table 2). Persons with high schizotypy demonstrated impairment on only one of the five indices assessing empathy (Table 2). Persons with high schizotypy were impaired relative to their counterparts on the Fantasy Taking subscale of the IRI  $t(107) = -2.51, p = 0.01$ , which assesses the ability to imaginatively feel the emotions of fictitious characters in books, films, and television series.

### 3.3. Schizotypy group and measures of social functioning

Significant group differences reflective of impaired social functioning in persons with high schizotypy were found in two of the three subscales of the Social Adjustment Scale (SAS) (Table 2). Persons with high schizotypy performed less well than persons with low schizotypy on the Family subscale (Family Relations) of the SAS (low schizotypy:  $M = 11.14, S.D. = 5.26$ ; high schizotypy:  $M = 16.20, S.D. = 6.25$ ;  $t(107) = -3.43, p \leq 0.01$ ) and on the Social/Leisure subscale (Friendship Relations) of the SAS (low schizotypy:  $M = 18.14, S.D. = 5.68$ ; high schizotypy:  $M = 28.38, S.D. = 8.19$ ;  $t(107) = -5.41, p \leq 0.01$ ).

Significant group differences reflective of impaired social functioning in persons with high schizotypy were also found in four of the six subscales of the Social Functioning Scale (SFS). Persons with high

**Table 2**  
Measures of social functioning, empathy, and working memory by schizotypy group.

	Low schizotypy (n = 22)		High schizotypy (n = 92)		Statistic	p
	M	SD	M	SD		
PASAT	39.18	37.78	34.45	26.51	15.25	0.58
Letter-number sequencing	15.91	8.39	18.88	7.93	0.42	0.12
Corsi block tapping	55.45	28.59	60.12	28.67	0.25	0.50
EQ total score	39.82	13.81	35.93	10.86	1.33	0.16
Fantasy taking-IRI	16.62	5.92	20.24	5.93	0.09	0.01*
Perspective taking-IRI	21.24	6.53	18.98	4.76	3.92	0.15
Empathic concern-IRI	21.19	5.16	20.30	5.39	0.32	0.49
Personal distress-IRI	14.76	5.40	17.25	5.65	0.10	0.07
Social/leisure score-SAS	18.14	5.68	28.38	8.19	1.99	< 0.01**
Family score-SAS	11.14	5.26	16.20	6.25	1.33	< 0.01**
Social withdrawal-SFS	13.18	2.97	11.30	2.51	0.45	< 0.01**
Interpersonal functioning-SFS	22.82	2.95	20.34	4.20	2.67	0.01*
	Mdn	IQR	Mdn	IQR	U	p
Digit span forward <sup>a</sup>	6.00	1.00	6.00	3.00	907.50	0.59
Digit span backward <sup>a</sup>	5.00	4.00	5.00	2.00	907.00	0.59
MOS index score <sup>a</sup>	4.39	1.26	3.76	1.30	615.00	< 0.01**
Student score-SAS <sup>a</sup>	11.00	7.00	12.00	4.00	715.50	0.11
Social activities-SFS <sup>a</sup>	27.50	14.00	17.00	11.00	491.50	< 0.01**
Recreational activities-SFS <sup>a</sup>	19.00	8.75	15.00	11.00	736.00	0.05*
Independence competence-SFS <sup>a</sup>	37.00	6.00	35.00	5.00	768.50	0.08
Independence performance-SFS <sup>a</sup>	29.50	12.75	29.00	9.75	955.50	0.68

<sup>a</sup> = Mann-Whitney *U* test was used due to non-normal distribution.

\* *p* < 0.05.

\*\* *p* < 0.01.

schizotypy performed less well than persons with low schizotypy on Social Withdrawal (low schizotypy: *M* = 13.18, *S.D.* = 2.97; high schizotypy: *M* = 11.30, *S.D.* = 2.51; *t*(112) = 3.04, *p* ≤ 0.01), on Interpersonal Functioning (low schizotypy: *M* = 22.82, *S.D.* = 2.95; high schizotypy: *M* = 20.34, *S.D.* = 4.20; *t*(112) = 2.62, *p* = 0.01), on Social Activities (low schizotypy: *Mdn* = 27.50; high schizotypy: *Mdn* = 17.00; *U* = 491.50, *p* ≤ 0.01), and on Recreational Activities (low schizotypy: *Mdn* = 19.00; high schizotypy: *Mdn* = 15.00; *U* = 736.00, *p* = 0.05). Significant group differences were also found between the low schizotypy group (*Mdn* = 4.39) and high schizotypy group (*Mdn* = 3.76) on the MOS-SSS, *U* = 615.00, *p* ≤ 0.01; indicating that persons with high schizotypy perceived less social support than persons with low schizotypy.

### 3.4. Relations between social functioning, empathy, and working memory

Table 3 displays correlations between measures of social functioning, empathy, and working memory for the high schizotypy group. Few correlations were observed between social functioning variables and working memory variables. Empathy, as represented by scores on the Emotion Quotient, correlated with 2 of 3 subscales of the Social Functioning Scale – Self Report and 2 of 6 subscales of the Social Functioning Scale.

## 4. Discussion

Individuals with high schizotypy evidenced impairments in social functioning but not in empathy and working memory when compared to individuals with low schizotypy. These findings indicate that social functioning is impaired in persons with schizotypy even when their emotional functioning and cognition are normative. The current finding of social functioning deficits in persons with schizotypy and prior findings that social dysfunction is predictive of psychosis onset in schizophrenia (Dragt et al., 2011; Velthorst et al., 2016) suggest that social dysfunction is a core feature of schizophrenia.

Multiple deficits in social functioning were identified in persons with high schizotypy. Deficits in familial and peer relationships were

observed in their responses to the Social Adjustment Scale. This finding indicates that persons with high schizotypy experience more conflictual relations with and isolation from friends and family. The absence of a deficit in academic functioning may have been influenced by their intact cognitive skills. Group differences on the Social Functioning Scale suggest that individuals with high schizotypy engage in fewer social outings, fewer independent social activities, and fewer recreational activities. Additionally, individuals high in schizotypy reported less perceived social support as evidenced by their responses to the MOS-SSS. Overall, the high schizotypy group reported difficulties in forming close emotional relationships, initiating social activities, and garnering support from family and friends.

Persons with high schizotypy were not impaired in their empathy. Persons with high schizotypy displayed significant impairments only on the Fantasy subscale of the Interpersonal Reactivity Index, which may be reflective of a deficit in their ability to understand the feelings and emotions of fictional characters. The lack of impairment in empathy observed in the present study contrasts with prior results suggestive of impaired emotion perception and empathy in persons with high schizotypy (Dickey et al., 2011; Lee et al., 2011).

No significant group differences were found in working memory. This is congruent with past studies that have reported mixed findings regarding impairments in working memory for persons high in schizotypy (Cannon et al., 1994; Lenzenweger and Gold, 2000). The lack of group difference in working memory may be attributed to the fact that all participants were university students. Future studies involving community samples may better examine cognitive deficits in persons with schizotypy.

These findings highlight the importance of continuing research on social cognition and social functioning in schizotypy. The current finding – persons high in schizotypy report significant impairments in their social functioning despite their unaffected neurocognitive and emotional functioning – may suggest that the social functioning deficits of persons with schizotypy are the most pervasive deficits in schizotypal individuals and, therefore, require the most intervention. By examining individuals who report subclinical symptoms of a pervasive, life-long disorder such as schizophrenia, early intervention may be employed to

**Table 3**  
Correlations in the high schizotypy group between measures of social functioning, empathy, and working memory.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. PASAT																				
2. LN sequencing	0.22*																			
3. Corsi block tapping	0.19	0.35**																		
4. Digit span forward <sup>a</sup>	0.19	0.57**	0.21*																	
5. Digit span backward <sup>a</sup>	0.08	0.54**	0.04	0.66**																
6. MOS-SFS <sup>b</sup>	-0.12	0.22*	0.01	0.18	0.16															
7. EQ	-0.10	0.24*	0.10	0.12	0.12	0.18														
8. Fantasy-IRI	-0.05	-0.08	-0.19	-0.07	-0.06	0.08	0.10													
9. Perspective taking-IRI	-0.02	-0.10	-0.16	0.08	0.02	0.04	0.21*	0.39**												
10. Empathic concern-IRI	0.07	0.02	-0.18	0.08	0.17	0.10	0.24*	0.56**	0.55**											
11. Personal distress-IRI	-0.02	-0.25*	-0.27*	-0.13	-0.04	-0.11	0.07	0.43**	0.52**	0.65**										
12. Student-SAS <sup>b</sup>	-0.11	-0.15	-0.02	-0.11	0.01	-0.23*	-0.33**	0.07	-0.11	-0.10	0.08									
13. Social/leisure-SAS	0.04	-0.04	0.23*	-0.11	-0.04	-0.39**	-0.21*	-0.04	0.07	-0.01	0.12	0.24*								
14. Family-SAS	-0.14	-0.07	-0.10	-0.15	-0.11	-0.13	0.18	0.06	-0.12	-0.10	0.00	0.15	-0.16							
15. Social withdrawal-SFS	-0.15	0.00	-0.25*	0.01	-0.01	0.08	-0.05	0.15	-0.07	0.05	0.04	0.12	-0.31**	0.03						
16. Interpersonal functioning-SFS	0.03	0.09	0.01	0.10	0.07	0.30**	0.26*	0.20	0.02	0.07	0.01	-0.25*	-0.55**	0.09	0.22*					
17. Social activities-SFS <sup>b</sup>	-0.24*	0.05	-0.13	-0.07	-0.05	0.09	0.09	0.00	-0.12	-0.15	-0.07	-0.03	-0.36**	0.33**	0.16	0.10				
18. Recreational activities-SFS	-0.15	0.13	-0.14	0.11	0.14	0.11	-0.01	0.12	-0.01	0.04	0.04	-0.06	-0.14	0.21	0.09	0.01	0.58**			
19. Independence competence-SFS <sup>b</sup>	-0.11	0.22*	0.19	0.34**	0.20	0.07	0.16	-0.04	0.06	0.00	-0.14	-0.09	-0.03	-0.05	0.10	0.09	-0.01	-0.11		
20. Independence performance-SFS <sup>a</sup>	-0.10	0.30**	-0.02	0.19	0.12	0.08	0.29**	0.25*	0.23*	0.12	0.00	-0.11	-0.13	-0.06	0.25*	0.22*	0.07	0.00	0.60**	

\* Correlation is significant at the 0.05 level (2-tailed).

\*\* Correlation is significant at the 0.01 level (2-tailed).

<sup>a</sup> = Spearman's correlation was used.

provide individuals with the proper tools to overcome feelings of isolation, social anxiety, and impaired interpersonal perception. Liberman and Robertson (2005) found that high school students with schizotypal traits benefit from training in conversational skills, assertive skills, problem solving skills, and general knowledge about handling interpersonal situations and that skills training improved relationships with their friends and family. Similarly, another study demonstrated that an adult with schizotypal traits and obsessive compulsive disorder benefited from social skills training (McKay and Neziroglu, 1996). Currently, these studies are the only experiments that have focused on implementing skills training in order to remedy deficit areas in individuals with schizotypal traits. Employing similar skills training interventions for adolescents and young adults at risk for developing schizophrenia may develop their social skills and social functioning as well as reduce the probability that they would develop a severe mental illness such as schizophrenia.

The present study had various limitations that must be addressed in future research in this area. One potential limitation of the study concerns the unequal numbers of high and low schizotypes identified with the Schizotypal Personality Questionnaire – Brief (SPQ–B). While past studies commonly yielded equal numbers of persons high and low in schizotypy using the SPQ–B, a 4.5:1 yield was obtained over two consecutive semesters in the present study. This may reflect a unique difference in the undergraduate population sampled or, more interestingly, possibly a shift in the schizotypal thinking of college students such that low scores are less common. The groups also differed in gender composition, as well as ethnic background. Future studies should work to maintain a relatively even sample size and demographic variables for each schizotypy group. Additionally, the use of a convenience sample of university students likely contributed to the limited variability especially in cognition. Therefore, the generalizability of the results to a clinical population of schizotypal individuals is uncertain. Future research in this area should employ both empirically validated screening tools for schizotypal traits, as well as a structured diagnostic interview to establish a well-informed view of each individual participant's schizotypal traits and tendencies. Through a structured interview, it would also be possible to identify possible comorbid psychiatric diagnoses that may affect the presence of schizotypal traits in the study sample. Additionally, the study relied heavily on self-report measures of social functioning, empathy, and schizotypy. Individuals presenting with schizotypal traits may display a lack of insight about their own emotional and social state, which may lead to biased responding on self-reported measures of social interactions, social outings, and empathy skills. Another significant limitation is found in the generalizability of the findings in relation to measures of working memory. The Inquisit Testing Library does not employ the appropriate neuropsychological testing norms that are generally available for many cognitive measures, as it uses adapted versions of the original cognitive assessments. In the current study, high schizotypy subjects did not differ significantly from their low schizotypy counterparts in working memory. However, past research has identified significant deficits in working memory for individuals high in schizotypal traits. As previously mentioned, the current university sample may be characterized by individuals with relatively average working memory skills. A larger, more diverse community sample may be needed to demonstrate significant deficits in working memory in a high schizotypy sample. Additionally, future research may examine links between specific symptoms of schizotypy and measures of neurocognition, social cognition, and social functioning.

The present research suggests that schizotypal persons, although not impaired in working memory nor empathy, display deficits in social functioning. Further study of empathy (social cognition), working memory (cognition), and social functioning is indicated. Moreover, future studies should examine skills training for adolescents and young adults who are experiencing emotional and interpersonal problems due to their schizotypal traits.

## Author contributions

Maral Aghvinian and Dr. Mark Sergi designed the study. Ms. Aghvinian wrote the protocol, conducted the statistical analyses, and wrote the first draft of the manuscript. Dr. Sergi assisted with the editing and preparation of the final manuscript. All authors contributed to and have approved the final manuscript.

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## Conflict of interest

All authors report no potential conflicts of interest.

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