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Empathic accuracy and cognition in schizotypal personality disorder

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ABSTRACT

Interpersonal dysfunction contributes to significant disability in the schizophrenia spectrum. Schizotypal Personality Disorder (SPD) is a schizophrenia-related personality demonstrating social cognitive impairment in the absence of frank psychosis. Past research indicates that cognitive dysfunction or schizotypy may account for social cognitive dysfunction in this population. We tested SPD subjects and healthy controls on the Empathic Accuracy (EA) paradigm and the Reading of the Mind in the Eyes Test (RMET), assessing the impact of EA on social support. We also explored whether EA differences could be explained by intelligence, working memory, trait empathy, or attachment avoidance. SPD subjects did not differ from controls in RMET, but demonstrated lower EA during negative valence videos, associated with lower social support. Dynamic, multimodal EA paradigms may be more effective at capturing interpersonal dysfunction than static image tasks such as RMET. Schizotypal severity, trait empathy, and cognitive dysfunction did not account for empathic dysfunction in SPD, although attachment avoidance is related to empathic differences. Empathic dysfunction for negative affect contributes to decreased social support in the schizophrenia spectrum. Future research may shed further light on potential links between attachment avoidance, empathic dysfunction, and social support.

1. Introduction

Empathy, the capacity to share and understand others' mental states, is crucial for maintaining social relationships (Eisenberg and Miller, 1987; Decety, 2011; Zaki and Ochsner, 2012). Thus far, psychiatric research on affective empathy is often limited to semantic mental state recognition paradigms that index an individual's capacity for recognition of affect in *static* images, but may not capture subtle syntactic understanding of mental states *in real time*, as in real-world empathic processing (Neisser, 1980; Zaki and Ochsner, 2009; 2012). Schizophrenia is associated with social cognitive dysfunction (Penn et al., 1997; Pinkham et al., 2003; Brune, 2005; Irani et al., 2006; Montag et al., 2007; Shamay-Tsoory et al., 2007; Derntl et al., 2009; Lee et al., 2010; Sparks et al., 2010), including abnormal neural activity during mental state attribution (Benedetti et al., 2009; Lee et al., 2010). Misattribution of mental states in schizophrenia may result from psychosis, cognitive impairment, or adverse effects of medication, or it may be independent of these factors. Thus, schizotypal personality disorder (SPD), a milder, non-psychotic disorder within the schizophrenia spectrum, provides a unique opportunity for the study of empathy.

Empathic processing can concern itself with understanding affects, thoughts, or intentions of others. Specifically, empathy for affective mental states consists in several simpler psychological processes: implicit, automatic sharing of affective experience, distinction between self and other via perspective-taking and explicit attribution of others' affect, and deliberation about future behavior with greater or lesser empathic concern (Leiberg and Anders, 2006; Zaki and Ochsner, 2012). Careful and accurate coordination of the first three processes (termed experience-sharing, perspective-taking, and mental state attribution) contribute to the latter process with greater empathic concern, considered crucial to prosocial behavior and maintaining important relationships.

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A related construct, theory of mind, is the basic capacity to understand that others are capable of having intentions, thoughts, or feelings separate from one's own (Premack and Woodruff, 1978; Dennett, 1978; Baron-Cohen et al., 1985). By definition, Theory of Mind is related to empathy in that it involves perspective-taking and explicit mental state attribution for further social cognitive deliberation. Within various components of empathic processing, Theory of Mind involves assuming a specific perspective to distinguish between mental states in self and other. This perspectival aspect of Theory of Mind contrasts with automatic sharing of affective experience, and each are subserved by distinct neural networks (Zaki and Ochsner, 2009, 2012). One paradigm that tests Theory of Mind is the Reading of the Mind in the Eyes Test (Baron-Cohen et al., 2001), which requires subjects to perform semantic mental state attributions to recognize complex mental states, based only upon seeing static images of eye regions of others. Individuals with high-functioning autism are impaired in the Reading of the Mind in the Eyes Test (Baron-Cohen et al., 2001).

Impairments in explicit mental state attribution and Theory of Mind are associated with social dysfunction in schizophrenia (Roncone et al., 2002; Brune et al., 2007). This impairment may result from cognitive deficits, psychosis, or antipsychotic medications. Past research has demonstrated that Theory of Mind deficits in the schizophrenia spectrum are not explained by intelligence differences (Doody et al., 1998; Garety and Freeman, 1999; Mitchley et al., 1998; Pickup and Frith, 2001; Greig et al., 2004) but contribute to greater disability than psychosis (Doop and Park, 2009; Hooker and Park, 2002; Malaspina and Coleman, 2003; Perlick et al., 1992). Schizophrenic patients' unaffected relatives also demonstrate subtle social cognitive deficits, indicating a familial basis for this dysfunction (Pinkham et al., 2003; Kee et al., 2004; Brune, 2005; Irani et al., 2006; Bediou et al., 2007; Penn et al., 2008;de Achaval et al., 2010), independent of cognitive dysfunction (Alfimova et al., 2009).

Reduced social support predates onset of overt psychosis in schizophrenic patients (GayerAnderson and Morgan (2013)), and greater social support reduces impairment from schizophrenia (Buchanan, 1995). Within the schizophrenia spectrum, greater social support is associated with positive medical and psychiatric outcomes, greater quality of life (Salokangas, 1997; Eklund and Hansson, 2007), greater time between psychotic decompensation (Hultman et al., 1997), shorter hospitalizations (Ossman and Mahmoud, 2012), and lesser medication side-effects owing to increased striatal dopamine transporter availability (Yeh et al., 2009). Poor social support correlates with longer durations of untreated psychosis and more severe negative symptoms (Thorup et al., 2006). Although it remains unclear whether social support changes clinical outcome or whether more severe psychopathology causes both limited support and worse overall outcome, social support nevertheless remains an important clinical correlate.

SPD is a personality disorder defined by attenuated versions of schizophrenic symptomatology and subtler impairments in working memory (Trestman et al., 1995; Gold et al., 1997; Goldman-Rakic, 1999; Diforio et al., 2000; Farmer et al., 2000; Braff and Light, 2005; Voglmaier et al., 2005; Matsui et al., 2007). SPD provides an opportunity for empathy research without confounds of psychosis or psychiatric medication (Siever and Davis, 2004; Fossati et al., 2005). In nonclinical samples, schizotypal severity correlates with social cognitive deficits, independent of cognitive dysfunction (Poreh et al., 1994; Langdon and Coltheart, 1999; Pickup, 2006; Brown and Cohen, 2010; Barragan et al., 2011; Germine and Hooker, 2011). Another non-clinical study correlates visuospatial cognitive impairment, schizotypy, and empathic ability (Thakkar and Park, 2010). However, others do not find associations between psychometric schizotypy and social cognitive impairment (Jahshan and Sergi, 2007; Versmissen et al., 2008). More specifically, psychometric schizotypes perform normally on the Reading of the Mind in the Eyes Test, but show deficits in another Theory of Mind paradigm that requires greater cognitive demand than semantic matching of visual stimuli (Gooding and Pflum, 2011). Research is lacking on social cognition in patients meeting full clinical criteria for SPD. Moreover, prior studies in SPD mainly utilized static, affect-recognition paradigms (Mikhailova et al., 1996; Waldeck and Miller, 2000), rather than studying multimodal empathic processing of affect in real-time.

The measurement of multimodal empathic processing of affect in real-time is needed for greater ecologic validity and greater sensitivity to real-world empathic dysfunction. Paradigms using *static* image stimuli may not capture real-life empathic processing, missing subtler, dynamic and contextual aspects (Zaki and Ochsner, 2012; Zaki, in press). Deficits in these aspects of empathy could nevertheless contribute to clinically-relevant social dysfunction or diminished social support. The Empathic Accuracy task utilizes *video* stimuli, requiring perceivers to continuously evaluate social affective cues produced by targets differing in emotional expressivity (Zaki et al., 2008, 2009). The stimuli used in the Empathic Accuracy task are multimodal, requiring attention to visual, verbal, and nonverbal auditory modalities in real time.

The primary outcome, Empathic Accuracy, is the degree of real-time correlation between the perceiver's judgment of targets' affect, and the target's judgments of his/her own affect while discussing *autobiographical* experiences (Levenson and Ruef, 1992; Ickes, 1997; Zaki and Ochsner, 2011; 2012). Judging accuracy by real-time correlation of perceivers' ratings to targets' own ratings of themselves contrasts with conventional scoring of other social cognitive paradigms (via correct answers agreed upon by extrinsic consensus). The Empathic Accuracy task recruits neural networks associated with automatic sharing of emotional experience, as well as brain regions associated with perspective-taking and explicit mental state attribution (Zaki et al., 2009; Harvey et al., 2012). Although other social cognitive paradigms *isolate* specific neurobiological processes, they may not capture the capacity for *integration* of these processes necessary for real-life empathy as effectively as the Empathic Accuracy paradigm (Zaki and Ochsner, 2011; 2012; Zaki, in press). Greater Empathic Accuracy is associated with social adjustment and relationship satisfaction through adolescence (Gleason et al., 2009; Haugen et al., 2008) and adulthood (Cohen et al., 2012).

In addition to effects of psychopathology, empathic dysfunction may be affected by internal working models of earlier relationships and their impact on development. Individuals develop working models of self and other early in development, influencing the way they understand mental states and how they think, feel, and behave in relationships (Bowlby, 1969; 1973; 1980), leading to reliably-measured, overall attachment style. Attachment style consists in relational patterns across relationships, characterized dimensionally on two orthogonal axes: attachment anxiety and attachment avoidance. Individuals low in both dimensions tend to experience secure and satisfying relationships. Attachment anxiety is defined by fears of rejection or abandonment, while attachment avoidance involves discomfort with closeness or intimacy (Brennan et al., 1998). In order to regulate affective arousal, attachment style affects the extent to which others' behavior is ignored, how behavior is understood, and whether specific actions are later remembered (Collins et al., 2004). High attachment avoidance is associated with recalling less details when listening to others describing loss (Fraley et al., 2000a). In Empathic Accuracy paradigms with non-clinical subjects rating significant others, higher attachment avoidance predicted lower accuracy during relationship-threatening discussions (Simpson et al., 2011).

High attachment avoidance is associated with schizotypy in non-clinical samples (Wilson and Costanzo, 1996; Berry et al., 2006; 2007; Meins et al., 2008; Tiliopoulos and Goodall, 2009). Empirical research on attachment style in clinical SPD is lacking. Schizophrenia has been characterized by ambivalent indifference toward relationships and intimacy (Bleuler, 1913), suggestive of attachment avoidance. Attachment avoidance is associated with greater positive and negative symptoms and poorer interpersonal functioning in schizophrenic patients (Ponizovsky et al., 2007; Kyrgic et al., 2012). Although attachment anxiety correlates with reported distress from hallucinations, high attachment avoidance correlates with hallucinations whose content is thematically associated with interpersonal threat (Berry et al., 2012). Attachment anxiety is associated with greater treatment adherence and depressive symptoms in patients with schizophrenia spectrum disorders (Kyrgic et al., 2012). Attachment insecurity of either type is associated with negative interpersonal experiences in psychometric schizotypy (Berry et al., 2007), and earlier illness onset and longer hospitalizations in schizophrenic patients (Ponizovsky et al., 2007).

Schizophrenic patients show lower Empathic Accuracy, unrelated to psychosis severity (Lee et al., 2011), and reduced neural sensitivity to empathic targets' emotional expressivity (Harvey et al., 2012). Therefore, we compared healthy subjects to non-psychotic, unmedicated SPD patients, expecting patients to demonstrate lower Empathic Accuracy. In order to distinguish impairments in Empathic Accuracy during *video* stimuli from impairment in semantic processing of *static* images, we also included the Reading of the Mind in the Eyes Test (Baron-Cohen et al., 2001).

Because SPD involves subtler symptoms and neurobiological dysfunction compared to schizophrenia, we expected no differences to emerge in Reading of the Mind in the Eyes Test performance. Because of conflicting evidence about links between social cognitive impairment on the one hand, and cognitive impairment or schizotypal severity on the other, we explored potential correlations in our sample between Empathic Accuracy, schizotypy, intelligence, and working memory. Given potential association between schizotypy and attachment avoidance, and the effect of the latter on Empathic Accuracy in non-clinical groups, we explored whether attachment avoidance might account for differences between groups in Empathic Accuracy. In order to establish the clinical significance of empathic dysfunction, we also tested for correlations between Empathic Accuracy and well-validated measures of social support.

2. Methods

2.1. Subjects

Our sample consisted of 19 subjects with SPD and 19 healthy controls (HCs), all 18—60 years of age. Subjects were recruited through advertisement in local newspapers and internet postings, or via referral from outpatient mental health clinics at the James J. Peters VA Medical Center.

Patients met full DSM-IV criteria for SPD. HCs had no Axis I or II disorders. Exclusion criteria included: history of head trauma, neurological disease, organic mental syndrome, mental retardation, medical illness, substance dependence, substance use in prior 6 months, use of any psychoactive medications in prior 2 weeks, or positive urine toxicology. SPD subjects were excluded if they met criteria for psychotic disorder or comorbid bipolar I disorder, active major depressive disorder, or borderline personality disorder. SPD patients were not taking medication and denied history of psychiatric hospitalization. All participants provided written informed consent. The study was approved by the Mount Sinai School of Medicine Institutional Review Board.

2.2. Structured diagnostic interviews

For each subject, diagnosis was established by doctoral-level psychologists with expertise in evaluation of Axis II disorders, using Structured Clinical Interview for DSM-IV Axis I disorders (SCID-I; (First et al., 2001)) and Structured Interview for DSM-IV Personality Disorders (SIDP-IV; (Pfohl et al., 1997)). Physicians screened participants for medical and neurological illness via history, physical examination, and routine blood and urine laboratory testing, just prior to participation.

2.3. Questionnaires assessing social support

Refer to Table 1 for details on measures and references for validity and reliability. Subjects completed a battery of self-report measures, including the Interpersonal Support Evaluation List (ISEL, (Cohen and Hoberman, 1983; Cohen and Wills, 1985)) and Social Network Index (SNI, (Cohen et al., 1997)). These were used as self-report measures of subjective and objective aspects of social support, respectively. The ISEL contains subscales measuring an individual's subjective sense of the perceived availability of tangible, material support (tangible subscale), the perceived availability of someone to talk with about one's problems (appraisal subscale), sense of identification and belonging in one's support group (belonging subscale), and the sense of positive self-esteem when comparing oneself to others (self-esteem subscale). The SNI involves a subscale that measures overall quantity of social support, and another that indexes diversity of different types of supportive relationships.

2.4. Questionnaires assessing personality factors

The Balanced Emotional Empathy Scale (BEES, (Mehrabian and Epstein, 1972)) was included as a self-report measure of trait empathy. The Schizotypal Personality Questionnaire (SPQ, (Raine, 1991)) provided a measure of the severity of schizotypy. We scored the SPQ according to three-factor models supported by confirmatory factor analyses, yielding cognitive—perceptual, interpersonal, and disorganization factors (Raine et al., 1994; Chen et al., 1997; Reynolds et al., 2000). The Experiences in Close Relationships Inventory (ECRI, (Brennan et al., 1998; Fraley et al., 2000b) provided a measure of relational patterns of attachment anxiety and avoidance. The Childhood Trauma Questionnaire (CTQ, (Bernstein et al., 1994; Bernstein and Fink, 1998)) provided an estimate of severity of childhood trauma. The CTQ was included due to potential developmental effects of childhood trauma on social cognition and personality.

2.5. Social cognitive tasks

All subjects completed two tasks on laptop computer in research offices. These were administered with Presentation software (Neurobehavioral Systems). Subjects were provided instructions before each task. All responses were recorded via keyboard. Order of tasks was randomized between subjects.

2.5.1. Reading the Mind in the Eyes Task

The Reading of the Mind in the Eyes Test (Baron-Cohen et al., 1997, 2001) includes 36 self-paced trials, each consisting of an image of an adult cropped to display only the eyes, alongside four words as answer choices describing possible internal states that the person in the image could be thinking or feeling. Without time constraint, subjects chose which word best described the target's mental state, requiring explicit recognition of complex mental states such as 'playful,' 'worried,' or 'suspicious' (i.e. Theory of Mind). In addition to the total score, we report scores for positive, negative, and neutral valence Reading of the Mind in the Eyes Test items, according to the method used by Fertuck et al. (2009) and Harkness et al. (2005). Although the Reading of the Mind in the Eyes Test is generally considered a Theory of Mind task, this well-validated subdivision of items into affective subscores emphasizes the conceptual overlap between Theory of Mind and affect recognition. Order of images in this task was randomized.

2.5.2. Empathic Accuracy Task

The Empathic Accuracy Task was adapted from (Zaki et al., 2008; 2009). Subjects viewed a random assortment of 10 of 20 video clips, each lasting for 1—3 min, in which a healthy target is seen discussing an emotional, autobiographical experience. Half of the viewed videos were of primarily negative valence, and half positive. Each target was previously filmed and provided continuous valence ratings for each of his/her videos. Targets previously completed the Berkeley Expressivity Questionnaire (BEQ; (Gross and John, 1995; Gross, 2000), assessing the tendency to overtly express emotion. Half of target videos were of females and half of males.

A central fixation was presented at the start of each video. Then, the target video played, with a nine-point rating scale presented below (1: very negative; 5: neutral; 9: very positive). Subjects in the present study continuously rated how positively or negatively the target was feeling during the video, using left or right arrow keys to adjust the indicated rating number. The selected rating remained highlighted, so participants could monitor their continuous ratings. Empathic Accuracy, the primary outcome variable, is the degree of real-time correlation between subjects' affective ratings and targets' ratings of their own affect in each video (see Fig. 1). Video order was randomized. As in the specific scoring

Table 1
Self-report questionnaires administered to subjects, along with brief descriptions of each of these measures and their relevant subscales.

Self-report questionnaire	Description of measure	Citation
Interpersonal Support Evaluation List (ISEL)	Subjective aspects of social support	Cohen and Hoberman (1983) and Cohen and Wills (1985)
Tangible	Perceived availability of material support	
Appraisal	Appraisal of presence of someone with whom to discuss issues of personal importance	
Belonging	Perceived availability of group with which one belongs and with which one can identify	
Self-esteem	Perceived sense of positive self-esteem relative to others with whom one favorably compares oneself	
Social Network Index (SNI)	Quantitative aspects of social support	Cohen et al. (1997)
Quantitative support	Number of people subject considers supportive	
Diversity of support	Diversity of types of relationships with supportive persons	
Revised Experiences in Close Relationships Inventory (ECRI)	Emotional reactions in close or significant relationships	Brennan et al. (1998) and Fraley et al. (2000b)
Attachment avoidance	Tendency to experience distress with increasing potential intimacy	
Attachment anxiety	Tendency to experience distress with increasing potential aloneness	
Balanced Emotional Empathy Scale (BEES)	Trait empathy and tendency to automatically share in emotional experiences	Mehrabian and Epstein (1972)
Schizotypal Personality Questionnaire (SPQ)	Severity of schizotypal psychopathology	Raine (1991)
Cognitive—perceptual factor	Positive-like symptoms, including referential/magical thinking, perceptual aberrations, suspicion	
Interpersonal factor	Negative-like symptoms, including social anxiety, lack of friends, blunted affect	
Disorganized factor	Odd speech, eccentric behavior	
Childhood Trauma Questionnaire	Childhood trauma (collapsed across different types: physical, sexual, emotional, neglect)	Bernstein et al. (1994) and Bernstein and Fink (1998)

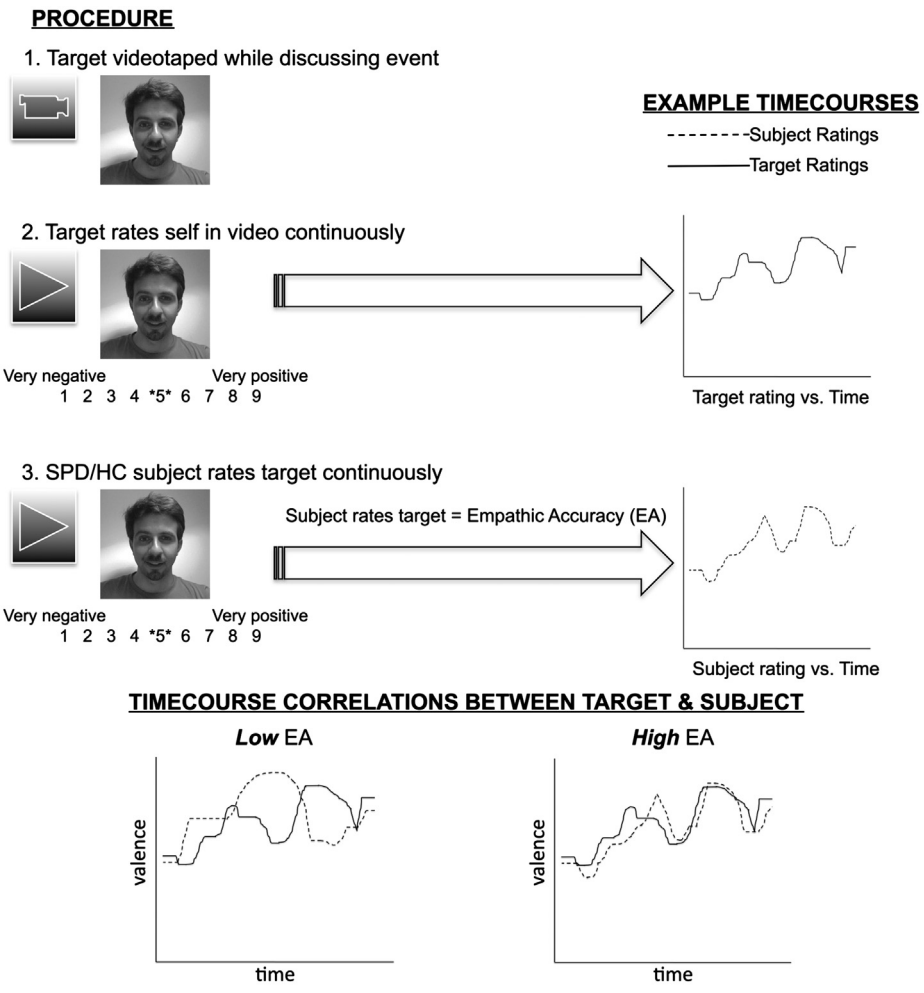

Fig. 1. Schematic of the Empathic Accuracy (EA) procedure and sample timecourses for target and subject ratings. Primary outcomes consisted in the time-series correlation between ratings produced by targets in videos, and ratings produced by SPD and healthy control subjects.

methodology used for the Reading of the Mind in the Eyes Test (see above), this paradigm focuses on affect recognition. However, in the Empathic Accuracy Task, subjects engage in explicit affect recognition in real-time, over the course of a video of a target engaging in spontaneous, autobiographical speech. The task involves multi-modal attention to visual, verbal, and other auditory social cues.

After each of the 10 videos, subjects answered questions presented on screen above a 9-point scale. Questions inquired how accurate subjects believed they performed (Perceived Accuracy), how likeable the subject considered the target (Likeability), how similar they believed they were to the target (Self-Similarity), and the Importance of the target in the preceding video. Questions required subjects to provide a single-number as overall rating of target Likeability, Self-Similarity, Importance, and Perceived Accuracy. One SPD subject had technical difficulties that inadvertently deleted all Empathic Accuracy data.

2.6. Cognitive testing

2.6.1. Wechsler Abbreviated Scale of Intelligence

Subjects completed the Wechsler Abbreviated Scale of Intelligence (WASI; (Wechsler, 1999)), and Full Scale IQ was extrapolated from two subtests (Vocabulary and Matrix Reasoning).

2.6.2. Dot Test

The Dot Test is a test of visuospatial working memory in which schizophrenic patients demonstrate impairments (Keefe et al., 1995, 1997). Subjects were shown each dot trial at a specific position on the paper and then asked to reproduce it at the same location on a separate paper after no delay, 10 s, or 30 s delay. Visuospatial working memory is calculated by the mean distance error after 30 s minus mean distance error at no delay.

2.7. Statistical analysis

Statistical testing was performed with IBM SPSS 19. Primary outcomes were Empathic Accuracy and Reading of the Mind in the Eyes Test scores. We hypothesized that SPD subjects would demonstrate lower Empathic Accuracy and no differences in Reading of the Mind in the Eyes Test, compared to HCs. Self-report scores, Empathic Accuracy, Reading of the Mind in the Eyes Test scores, Full-Scale IQ, and Dot Test results were tested for normality across the sample, using Shapiro—Wilk testing. For normally distributed variables, one-way ANOVA was used to compare SPD and HC groups, whereas for non-normally distributed variables, Mann—Whitney *U* testing was used to compare groups. Spearman's correlations were used to test for correlations, due to non-normal distribution of relevant variables. Because SPD and HC groups differed in sex composition (see Table 2), we tested a general linear model for main effects of sex, diagnosis, and their interaction, on Empathic Accuracy and Reading of the Mind in the Eyes Test performance.

The only difference between groups in social cognitive measures was in negative-valence Empathic Accuracy (see below). Subsequent analyses focused on this, non-normally distributed variable. To understand the clinical significance of Empathic Accuracy differences between groups, we reported Spearman's correlations between negative-valence Empathic Accuracy on the one hand, and self-report or cognitive measures on the other. We also tested for main effects of diagnostic group, sex, and their interaction on negative-valence Empathic Accuracy, with Full Scale IQ, Dot Test scores, and self-reported trait empathy (BEES scores) entered as covariates. Mann—Whitney *U* tested for significant differences between groups in post-video questions. We also explored correlations between answers to questions and Empathic Accuracy.

3. Results

Groups did not differ in terms of age (mean [*M*]=38.6, standard deviation [S.D.]=10.4; and *M*=33.7, S.D.=9.1 years respectively, p=n.s.). A significant difference between groups emerged in terms of sex (six (32%) HC males and 13 (68%) HC females vs. 13 (68%) SPD males and six (32%) SPD females, $p<0.03$). We factored sex into subsequent analyses via general linear model.

3.1. Questionnaires

SPQ and CTQ results, attachment avoidance, and SNI quantitative support were non-normally distributed in the total sample. For normally-distributed variables, ANOVA demonstrated differences between SPD and HC groups, with SPD subjects reporting lower BEES scores (F=10.0, d.f.=1, 36, p=0.003) and greater attachment anxiety (F=6.3, d.f.=1, 29, $p<0.02$) (see Table 3). For non-normally distributed self-report measures, expected differences emerged between groups in total SPQ (U=3.0, d.f.=1, 33, $p<0.001$), cognitive—perceptual (U=6.5, d.f.=1, 33, $p<0.001$), interpersonal (U=7.5, d.f.=1, 33, $p<0.001$), and disorganization (U=26.5, d.f.=1, 33, $p<0.001$) factor scores, all higher in the SPD group. SPD subjects had lower scores on SNI quantitative support (U=65.5, d.f.=1, 31, $p<0.03$) and the belonging (F=51.6, d.f.=1, 29, $p<0.001$), tangible (F=35.6, d.f.=1, 29, $p<0.001$), self-esteem (F=9.2, d.f.=1, 29, p=0.003), and appraisal (F=26.8, d.f.=1, 29, $p<0.001$) subscales of the ISEL, and higher CTQ scores (U=58.5, d.f.=1, 32, p=0.005) and attachment avoidance (U=52.0, d.f.=1, 29, $p<0.02$) (see Table 4.

3.2. Social Cognition Tasks

3.2.1. Reading of the Mind in the Eyes Test performance

Total Reading of the Mind in the Eyes Test score and positive, negative, and neutral item scores, were non-normally distributed.

Table 2
Age and sex composition of healthy control (HC, n=19) and schizotypal personality disorder (SPD, n=19) groups, as well as Axis I and II comorbidity rates for the SPD group. HC subjects did not meet criteria for any Axis I or II disorders, and no subjects met criteria for active major depressive disorder or substance abuse, or any history of substance dependence.

	HC	SPD	Statistic
Age in years (mean ± standard deviation)	33.7 ± 9.1	38.6 ± 10.4	p=0.5
Sex composition	13/19 female (68%)	6/19 female (32%)	$\chi^2<$ **0.03**
Axis I Comorbidity	n/a		
Past major depressive disorder		3 (16%)	
Dysthymic disorder		2 (11%)	
Social phobia		6 (32%)	
Specific phobia		2 (11%)	
Post-traumatic stress disorder		2 (11%)	
Intermittent explosive disorder		1 (5%)	
Past alcohol abuse		2 (11%)	
Past cannabis abuse		4 (21%)	
Past cocaine abuse		3 (16%)	
Axis II Comorbidity	n/a		
Paranoid personality disorder		4 (21%)	
Schizoid personality disorder		1 (5%)	
Narcissistic personality disorder		1 (5%)	
Antisocial personality disorder		1 (5%)	
Avoidant personality disorder		3 (16%)	
Obsessive-compulsive personality disorder	6 (32%)		

Table 3
Mean ± standard deviation, for each normally distributed self-report measure. Also included are results of ANOVA comparing the healthy control (HC) and schizotypal personality disorder (SPD) groups. Note significant differences between groups in trait empathy (BEES), attachment anxiety (ECRI), and subjective perception of social support (ISEL). BEES=Balanced Emotional Empathy Scale; ECRI=Experiences in Close Relationships Inventory; ISEL=Interpersonal Support Evaluation List; SNI=Social Network Index.

Self-report measure	SPD	HC	*F*	d.f.	Sig.
BEES total	21.7 ± 27.5 (n=19)	50.8 ± 28.4 (n=18)	10.04	1, 36	p=**0.003**
ECRI attachment anxiety	64.9 ± 24.6 (n=14)	46.1 ± 16.0 (n=16)	6.3	1, 29	p<**0.02**
ISEL tangible	15.4 ± 6.3 (n=13)	26.2 ± 3.6 (n=17)	35.6	1, 29	p<**0.001**
ISEL appraisal	15.1 ± 6.9 (n=13)	25.8 ± 4.4 (n=17)	26.8	1, 29	p<**0.001**
ISEL belonging	14.4 ± 6.0 (n=13)	26.4 ± 2.9 (n=17)	51.6	1, 29	p<**0.001**
ISEL self-esteem	18.2 ± 4.6 (n=13)	22.7 ± 3.6 (n=17)	9.2	1, 29	p=**0.005**
SNI diversity of support (DIV)	3.4 ± 2.1 (n=14)	4.4 ± 1.9 (n=18)	2.2	1, 30	p=0.2

Table 4
Median (interquartile range), for all non-normally distributed self-report measures. Also presented is Mann—Whitney *U* testing comparing healthy control (HC) and schizotypal personality disorder (SPD) groups. Note the expected significant differences between groups in severity of schizotypy and its component factors (SPQ), as well as significantly increased rates of childhood trauma (CTQ) and attachment avoidance (ECRI), and lower quantity of social support (SNI) in the SPD group. SPQ=Schizotypal Personality Questionnaire; CTQ=Childhood Trauma Questionnaire; ECRI=Experiences in Close Relationships Inventory; SNI=Social Network Index.

Self-report measure	SPD	HC	Statistic
SPQ total	36.5 (13.3); n=16	4.0 (6.3); n=18	p<**0.001**
SPQ cognitive-perceptual factor	14 (5.8); n=16	0.8 (2.0); n=18	p<**0.001**
SPQ disorganization factor	6.5 (8.0); n=16	0.5 (1.2); n=18	p<**0.001**
SPQ interpersonal factor	23.0 (11.0); n=16	2.2 (3.6); n=18	p<**0.001**
CTQ total	60.5 (31.6); n=16	41.4 (9.5); n=17	p=**0.005**
ECRI attachment avoidance	81 (48.0); n=14	38.0 (29.5); n=16	p=**0.01**
SNI quantity of support (PPL)	5.5 (10.0); n=14	14.7 (17); n=18	p=**0.02**

There were no significant differences between groups in total Reading of the Mind in the Eyes Test score (U=148.5, d.f.=1, 37, p=n.s.), positive-valence items (U=161.0, d.f.=1, 37, p=n.s.), negative-valence items (U=157.5, d.f.=1, 37, p=n.s.), nor neutral-valence items (U=141.0, d.f.=1, 37, p=n.s.).

3.2.2. *Empathic Accuracy performance*

Empathic Accuracy was non-normally distributed. SPD subjects demonstrated lower Empathic Accuracy for negative videos, compared with HC subjects (U=83.0, d.f.=1, 36, p=0.007), but there were no significant differences between groups in positive videos (U=164.0, d.f.=1, 36, p=n.s.). There were no significant effects of sex and no significant sex by diagnosis effects on positive- or negative-valence Empathic Accuracy (see Figs. 2 and 3).

3.2.3. *Empathic Accuracy correlations*

In the total sample, total BEES scores (rho=0.4, p<0.03), and ISEL subscales of appraisal (rho=0.4, p=0.02), tangibility (rho=0.4, p<0.03), and belonging (rho=0.5, p<0.01), and SNI quantitative support scores (rho=0.5, p=0.005) were correlated with negative-valence Empathic Accuracy. There were no significant correlations between negative-valence Empathic Accuracy and SPQ, CTQ, or attachment variables in the total sample. When examining correlations separately in each diagnostic group, only the SNI quantitative support and diversity subscales (rho=0.7, p<0.01 for both) were significantly correlated with negative-valence Empathic Accuracy in the SPD group, with no significant correlations with negative-valence Empathic Accuracy in the HC group (see Table 5.

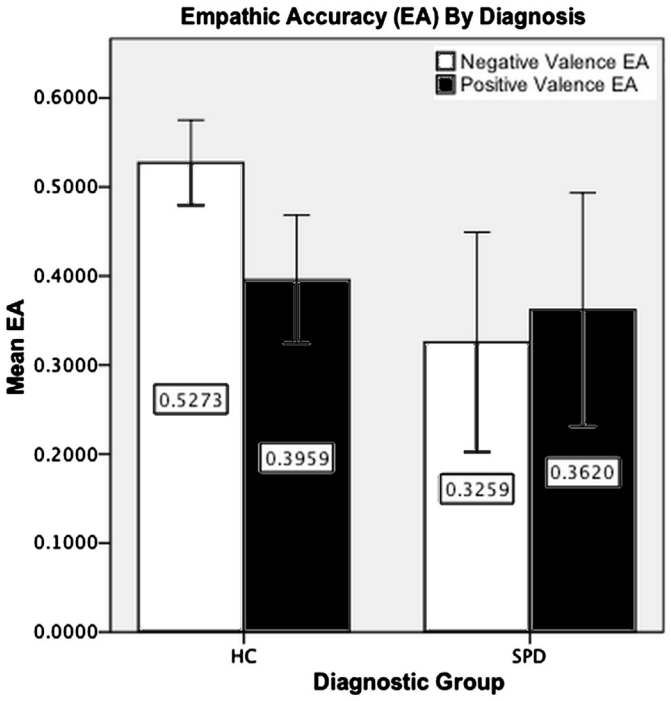

Fig. 2. Mean Empathic Accuracy (EA) in healthy control (HC) and schizotypal personality disorder (SPD) groups, separately by overall valence of the video clip (negative or positive). Note significant differences between groups in negative-valence clips, but no significant differences in those of positive valence.

3.2.4. *Post-video questions*

Responses to post-video questions were all non-normally distributed. There were no significant differences between groups in answers to these questions. We found that in the HC group, there were significant correlations between subjects' Perceived Accuracy and Empathic Accuracy (rho=0.16, n=181 video trials, p<0.03) and Target Expressivity (BEQ) and Empathic Accuracy (rho=0.41, n=181 video trials, p<0.001). In the SPD group, there was no significant correlation between Empathic Accuracy and Perceived Accuracy, though there was between target Expressivity and Empathic Accuracy (rho=0.18, n=169, p<0.03).

3.3. Cognition

Full Scale IQ was non-normally distributed in our sample, but Dot Test scores were normally-distributed. For the HC group, median Full Scale IQ (interquartile range)=110(11), and for the SPD group, median(interquartile range)=95(29). For Dot Test scores, M(S.D.)=0.76(0.67), and 1.05(1.86) for the HC and SPD groups, respectively. There were no significant differences between groups in Full Scale IQ (U=49.5, d.f.=1, 25, p=0.07), nor in Dot Test results (F=0.31, d.f.=1, 27, p=0.6). There were no statistically significant correlations between Full Scale IQ, Dot Test results, and negative valence Empathic Accuracy.

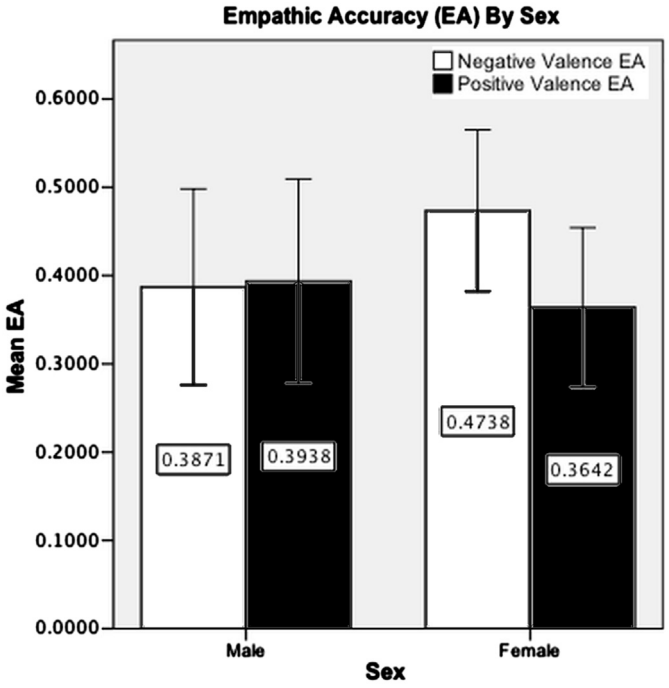

Fig. 3. Mean Empathic Accuracy (EA) in males and females, separately by overall valence of the video clip (negative or positive). Note there are no significant differences between sexes in EA for clips of positive or negative valence. Moreover, there were no significant diagnosis × sex effects on EA for clips of positive or negative valence.

3.4. General linear modeling

We tested a general linear model, with negative-valence Empathic Accuracy as dependent variable, sex and diagnosis as fixed factors, and BEES score as covariate, and there remained a significant difference by diagnosis (F=4.7, d.f.=1, 35, $p<0.04$). Similarly, a general linear model with negative valence Empathic Accuracy as the dependent variable, sex and diagnosis as fixed factors, and Full Scale IQ or Dot Test results as covariates, demonstrated continued, significant diagnosis effects on negative-valence Empathic Accuracy in each instance (F=7.6, d.f.=1, 24, p=0.01 for Full Scale IQ; F=6.2, d.f.=1, 26, p=0.02, for Dot Test).

4. Discussion

Our study demonstrated that SPD patients have difficulty understanding others' negative affect, which was associated with lower indices of social support. SPD subjects did not differ from controls in Reading of the Mind in the Eyes Test performance, indicating normal capacity for unimodal, semantic recognition of affect in a Theory of Mind task. This highlights the importance of the Empathic Accuracy task in schizophrenia spectrum research, as a more sensitive, clinically relevant index of empathic processing compared to conventional paradigms requiring semantic matching of static images to descriptors. We found no relationship between general intelligence or working memory deficits and empathic dysfunction in SPD. We similarly found no significant correlations between schizotypal severity, self-reported trait empathy (measured via the BEES), attachment avoidance, attachment anxiety, childhood trauma, and empathic dysfunction.

The present study's focus on SPD provides an understanding of empathic processing in the schizophrenia spectrum, without potential confounds of psychosis or pharmacotherapy. Schizophrenic patients show reduced sensitivity to target expressivity (Lee et al., 2011; Harvey et al., 2012), but, due to milder psychopathology, SPD patients appear sensitive to target expressivity in their empathic judgments. However, SPD subjects are less aware of their

Table 5
Spearman correlations between Empathic Accuracy and self-report measures, for the total sample and separately for the healthy control (HC) and schizotypal personality disorder (SPD) groups. Significant correlations are highlighted in bold. BEES=Balanced Emotional Empathy Scale; SPQ=Schizotypal Personality Questionnaire; CTQ=Childhood Trauma Questionnaire; ECRI=Experiences in Close Relationships Inventory; SNI=Social Network Index.

		BEES	SPQ total	SPQ cp	SPQ ip	SPQ do	CTQ total	ECRI av	ECRI an	ISEL ap	ISEL ta	ISEL se	ISEL be	SNI DIV	SNI PPL
Total	Negative EA	0.37 n=36 **$p<0.03$**	−0.29 n=33 p=0.10	−0.25 n=33 p=0.17	−0.32 n=33 p=0.07	−0.30 n=33 p=0.10	−0.23 n=32 p=0.20	−0.22 n=30 p=0.24	−0.11 n=30 p=0.58	0.42 n=30 **p=0.02**	0.40 n=30 **$p<0.03$**	0.03 n=30 p=0.87	0.47 n=30 **$p<0.01$**	0.34 n=32 p=0.06	0.48 n=32 **p=0.005**
	Positive EA	−0.30 n=36 p=0.08	0.22 n=33 p=0.22	0.20 n=33 p=0.26	0.21 n=33 p=0.25	0.12 n=33 p=0.51	0.02 n=32 p=0.93	0.06 n=30 p=0.75	−0.004 n=30 p=0.98	−0.10 n=30 p=0.59	−0.15 n=30 p=0.45	−0.13 n=30 p=0.51	−0.22 n=30 p=0.24	0.07 n=32 p=0.71	−0.08 n=32 p=0.68
HC	Negative EA	0.13 n=18 p=0.62	0.09 n=18 p=0.72	0.27 n=18 p=0.29	−0.02 n=18 p=0.94	−0.07 n=18 p=0.77	0.07 n=17 p=0.78	−0.02 n=16 p=0.93	−0.09 n=16 p=0.74	0.27 n=17 p=0.30	0.04 n=17 p=0.87	−0.08 n=17 p=0.76	0.39 n=17 p=0.12	−0.06 n=18 p=0.80	0.11 n=18 p=0.66
	Positive EA	−0.34 n=n=18 p=0.16	0.20 n=18 p=0.43	0.06 n=18 p=0.80	0.07 n=18 p=0.78	0.18 n=18 p=0.48	0.07 n=17 p=0.80	−0.06 n=16 p=0.84	−0.01 n=16 p=0.97	0.02 n=17 p=0.94	−0.16 n=17 p=0.54	−0.23 n=17 p=0.37	−0.13 n=17 p=0.62	0.09 n=18 p=0.73	−0.15 n=18 p=0.56
SPD	Negative EA	0.31 n=18 p=0.21	0.18 n=15 p=0.53	0.35 n=15 p=0.21	−0.004 n=15 p=0.99	0.07 n=15 p=0.80	−0.10 n=15 p=0.71	−0.16 n=14 p=0.59	0.31 n=14 p=0.28	0.21 n=13 p=0.50	0.41 n=13 p=0.17	−0.38 n=13 p=0.20	0.22 n=13 p=0.46	0.67 n=14 **$p<0.01$**	0.69 n=14 **$p<0.01$**
	Positive EA	−0.36 n=18 p=0.15	0.10 n=15 p=0.72	0.12 n=15 p=0.68	0.21 n=15 p=0.45	−0.15 n=15 p=0.61	0.07 n=15 p=0.80	0.35 n=14 p=0.22	0.02 n=14 p=0.94	−0.15 n=13 p=0.62	0.001 n=13 p=0.99	0.17 n=13 p=0.59	−0.30 n=13 p=0.32	0.12 n=14 p=0.69	0.002 n=14 p=0.99

own empathic dysfunction, indicative of metacognitive dysfunction. Despite recent interest in metacognitive awareness of social cognition in healthy controls (Kelly and Metcalfe, 2011), the significance of this in the schizophrenia spectrum remains under-appreciated.

This is the first study to document attachment style in patients meeting full criteria for SPD. In healthy couples, attachment avoidance is associated with lower empathic accuracy during relationship-threatening situations (Simpson et al., 2011). SPD subjects reported higher levels of attachment anxiety and attachment avoidance, and more severe childhood trauma but these did not correlate directly with Empathic Accuracy. Sexual trauma is associated with social cognitive impairment in schizophrenia (Lysaker et al., 2011), and early maternal separation predicts the subsequent development of schizotypal symptoms in vulnerable, angry children (Anglin et al., 2008). Without prospective research design, we are unable to discern the relationships between childhood trauma, attachment anxiety or avoidance, schizotypy, and Empathic Accuracy. The present study demonstrates that general cognition, working memory, schizotypal severity, nor attachment style effectively explain differences in empathic functioning for negative affect in SPD. Despite a preponderance of negative results, this suggests that empathic dysfunction in SPD patients is caused by some other factor, unique to this disorder. The conceptual overlap between the interpersonal factor of schizotypy on the one hand, and attachment anxiety and avoidance on the other, further complicates the present difficulty in characterizing empathy in the schizophrenia spectrum.

The present study has several other limitations. First, the sample is small. Groups differed in sex composition, although we controlled for this difference in data analysis. In non-clinical research with the present Empathic Accuracy task, there is no evidence of a sex advantage (Zaki et al., 2008). Others utilizing a distinct, non-computerized Empathic Accuracy paradigm document a seeming female advantage, mediated by greater task motivation or greater sympathy toward targets (Ickes et al., 2000; Klein and Hodges, 2001). Another statistical limitation is that we did not control for multiple comparisons and report significant tests with alpha < 0.05, in an effort to include exploratory analyses potentially accounting for Empathic Accuracy differences. Moreover, correlational analyses do not necessarily prove causality. Multiple variables were not normally distributed in our sample, suggesting that some subjects reported extreme values or a relatively constant distribution across subjects.

The present SPD sample demonstrates psychiatric comorbidity, although we excluded patients with comorbid borderline personality disorder because recent research in this population suggests a distinct type of social cognitive impairment in this disorder, introducing too great a confound. If only SPD patients without psychiatric comorbidity were included, the sample would be highly rarified, and findings would not be generalizable. Another limitation of our sample is that we did not assess whether healthy controls had a first-degree relative with a schizophrenia spectrum disorder. Prior research documents subtle social cognitive impairment in unaffected individuals with schizophrenic relatives (Pinkham et al., 2003; Kee et al., 2004; Brune, 2005; Irani et al., 2006; Bediou et al., 2007; Penn et al., 2008; de Achaval et al., 2010). The findings would thus have been strengthened if this had been an exclusion criterion.

Another limitation concerns generalizability of findings related to general cognition. In the present sample, SPD subjects did not differ significantly from controls in visuospatial working memory, but past research has highlighted working memory deficits in SPD (Siever and Davis, 2004). The present sample may be characterized by patients with relatively intact visuospatial working memory and higher prevalence of childhood trauma. A larger sample is likely needed to demonstrate significant deficits in working memory associated with SPD, which are often subtle relative to those associated with schizophrenia. Nevertheless, variance in visuospatial working memory, IQ, or childhood trauma did not correlate or covary with Empathic Accuracy. Other, distinct neuropsychological methods may nevertheless ultimately explain differences in Empathic Accuracy.

Limitations of the Empathic Accuracy task include that it is focused primarily on affect (rather than empathic attribution of thoughts or intentions). Nevertheless, thoughts or intentions are more difficult to operationalize, as it would require greater subjective judgment as to the similarity of perceivers' and targets' attributions. Also, the Empathic Accuracy task uses one Likert scale for both positive and negative affect. Some evidence suggests that positive and negative affect do not lie on a continuum, but are rather separate constructs (Reich et al., 2003; Jacobs et al., 2012). Nevertheless, requiring subjects to perform separate positive and negative affect ratings at once while watching each video would prove too taxing, and performing each rating serially would unduly skew the second ratings.

Our research suggests that the schizophrenia spectrum is characterized by empathic dysfunction independent of schizotypal symptoms, intelligence, trait empathy, or working memory. We demonstrate empathic dysfunction for negative affect in SPD, which is associated with lower quantity and diversity of social support. In order to accurately assess empathic dysfunction in the schizophrenia spectrum, research paradigms are needed with greater ecologic validity, involving coordinated implementation of several neurobiological processes. Future research will examine the neurobiological underpinnings of differential empathic processing in SPD and identify potential genetic and environmental etiological factors contributing to empathic dysfunction over the course of development. This will assist in earlier identification of individuals at-risk and more effective treatments for the interpersonal disability characteristic of the schizophrenia spectrum. Comparison of performance in the Empathic Accuracy paradigm with static, affect-recognition paradigms isolating specific components of empathy will also clarify distinct types of social cognitive dysfunction seen in individuals with schizophrenia spectrum disorders.

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