



# Schizotypy and clinical symptoms, cognitive function, and quality of life in individuals with a psychotic disorder



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## ABSTRACT

**Background:** Schizotypy is a range of perceptual experiences and personality features related to risk and familial predisposition to psychosis. Despite evidence that schizotypy is related to psychosis vulnerability, very little is known about the expression of schizotypal traits in individuals with a psychotic disorder, and their relationship to clinical symptoms, cognition, and psychosocial functioning.

**Methods:** 59 healthy subjects and 68 patients with a psychotic disorder (47 schizophrenia spectrum disorder; 21 bipolar disorder with psychotic features) completed four schizotypy scales, the Perceptual Aberration Scale, the Revised Physical and Social Anhedonia Scales, and the Schizotypal Personality Questionnaire, a brief neuropsychological assessment, and a self-report measure of quality of life. Clinical symptoms of psychosis were quantified in patients with the Positive and Negative Syndrome Scale (PANSS).

**Results:** Psychosis patients scored higher than healthy subjects on all schizotypy scales. Correlations between schizotypy and PANSS scores were modest, ranging from  $r = .06$  to  $r = .43$ , indicating that less than 20% of the variance in self-reported schizotypy overlapped with clinical symptoms. After controlling for clinical symptoms, patients with schizophrenia spectrum disorders reported higher levels of cognitive-perceptual disturbances and negative traits than patients with bipolar disorder. Elevated schizotypy was associated with lower cognitive functioning and self-reported quality of life.

**Conclusions:** Schizotypal personality traits are markedly elevated in psychotic disorders, especially schizophrenia spectrum disorders, relatively weakly correlated with positive and negative psychotic symptoms, and associated with greater cognitive impairment and lower quality of life. Assessing schizotypy in patients with psychosis may be useful for predicting functional outcome and differential diagnosis.

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## 1. Introduction

Schizotypy encompasses a collection of atypical or maladaptive personality traits, odd behaviors, unconventional beliefs, and unusual cognitive and perceptual experiences. Several definitions, approaches, and structures of schizotypy have been proposed in connection with theories of psychotic disorders, primarily schizophrenia. For example, Meehl conceptualized schizotypy as a dichotomous, taxometric construct that represented genetic risk for schizophrenia (“schizogene”) which, when combined with additional genetic potentiators and deleterious life experiences, leads to manifest psychosis (Meehl, 1962). Meehl’s and similar models, such as Rado’s, are based largely on observations that unaffected relatives of probands exhibit unusual personality characteristics and cognitive deficits similar to those observed in schizophrenia (Rado, 1956a, 1956b; Rado, 1953). Alternatively, some have posited that the expression of schizotypal characteristics varies

along a continuum in the general population which is anchored at the extreme end by schizotypal personality disorder and psychosis (Linscott and Van, 2010; Allardyce et al., 2007; Kwapil et al., 2008; Kwapil et al., 2013). The dimensional approach is supported in large part by individual differences in schizotypy in the normal population and evidence that schizotypal traits correlate with many neurobiological abnormalities observed in schizophrenia, including deficits in cognition, sensorimotor gating, and perception, neurological soft signs, and elevated dopamine function (Ettinger et al., 2014; Woodward et al., 2011).

Surprisingly, relatively little is known about the expression of schizotypy in individuals with a psychotic disorder, despite the fact that models of schizotypy, regardless of type, make several testable predictions. First, if schizotypal personality traits represent stable vulnerability markers, then they should be elevated in individuals with a psychotic disorder and only weakly related to clinical symptoms, especially positive symptoms, which wax and wane over time. Horan et al. (2008) tested this hypothesis in a sample of first-episode patients examined longitudinally. Consistent with a stable vulnerability indicator, physical anhedonia was consistently elevated in schizophrenia and varied little with clinical state. Patients also exhibited consistently

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higher levels of perceptual aberrations and magical ideation; although they co-varied to some extent with clinical state over time. While informative, this investigation was limited to just schizophrenia patients and did not include additional important measures of schizotypy, such as social anhedonia (Horan et al., 2007, 2008).

A second outstanding question is the specificity of schizotypy to schizophrenia spectrum disorders. Schizotypy has been studied almost exclusively in the context of schizophrenia and is usually considered a latent risk factor specific to schizophrenia (Kwapil, 1998; Lenzenweger and Loranger, 1989a; Lyons et al., 1995). However, there is evidence that some aspects of schizotypy are elevated in individuals with psychotic bipolar disorder and their unaffected relatives (Schurhoff et al., 2005; Etain et al., 2007; Schurhoff et al., 2003; Chapman et al., 1994). Consistent with a latent vulnerability to psychosis more broadly, unaffected relatives of psychotic bipolar patients demonstrate elevated levels of disorganization (Schurhoff et al., 2005). However, in contrast to schizophrenia, physical anhedonia is not elevated in probands with psychotic bipolar disorder and their unaffected family members (Etain et al., 2007; Schurhoff et al., 2003). Similarly, the absence of significant elevations in unaffected family members suggests that among psychosis patients, perceptual aberrations may also be specific to schizophrenia (Lenzenweger and Loranger, 1989a). However, this hypothesis has not been tested.

Finally, the associations between elevated schizotypy, cognitive impairment, and psychosocial functioning in healthy subjects and unaffected family members implies that schizotypy will also correlate with these measures in psychosis patients (Cochrane et al., 2012; Delawalla et al., 2006; Cohen and Davis, 2009). While cognitive impairment and limitations in psychosocial functioning are core features of psychosis, the link between these factors and schizotypy has not been investigated in patients.

To test these predictions, we: 1) compared schizotypal personality traits between healthy individuals and patients with a psychotic disorder and examined the extent to which clinical symptoms overlap with schizotypy; 2) compared schizotypal personality traits between schizophrenia spectrum disorders and bipolar disorder with psychotic features; and 3) examined the relationship between schizotypy, cognitive function, and quality of life in individuals with a psychotic disorder.

## 2. Methods

### 2.1. Participants

68 individuals with a psychotic disorder (i.e., schizophrenia spectrum disorders, bipolar disorder with psychotic features) and 59 healthy subjects were included in this investigation. Study participants were drawn from a repository of clinical and cognitive data collected on individuals with a primary psychotic disorder and healthy subjects recruited at the Vanderbilt University Department of Psychiatry. The study was approved by the Vanderbilt University Institutional Review Board. All study participants provided written informed consent prior to contributing data to the repository. Psychosis patients were recruited through the Vanderbilt Psychotic Disorders Program at Vanderbilt Psychiatric Hospital (Nashville, TN), and healthy subjects were recruited from Nashville and the surrounding area via advertisement and word-of-mouth. Subjects were included in the current investigation if they were diagnosed with a schizophrenia spectrum disorder (i.e., schizophrenia, schizoaffective disorder) or bipolar disorder with psychotic features (hereafter referred to as “psychotic bipolar disorder”), or were a healthy subject and completed at least one of the self-report schizotypy questionnaires described in the Procedures section. Diagnoses were established, or ruled out in the case of healthy subjects, using the Structured Clinical Interview for the DSM-IV-TR (SCID: First et al., 1996). The exclusion criteria included: age less than 16 or greater than 65, pre-morbid intellect less than 70, estimated using the Wechsler Test of Adult Reading (WTAR: Wechsler, 2001) and/or history of

intellectual disability, presence of a systemic medical illness or CNS disorder (e.g., multiple sclerosis, epilepsy), reported pregnancy or lactation, history of significant head trauma, psychotropic drug use (healthy subjects only), and active substance abuse within the past 1 month.

### 2.2. Study procedures

Subjects completed at least one of the following self-report schizotypy scales: Perceptual Aberration Scale (PAS: Chapman et al., 1978), Revised Physical Anhedonia Scale (RPAS: Chapman et al., 1976), Revised Social Anhedonia Scale (RSAS: Chapman et al., 1976) and the Schizotypal Personality Questionnaire (SPQ: Raine, 1991). Subjects were also administered the Screen for Cognitive Impairment in Psychiatry (SCIP: Purdon, 2005). The SCIP is a brief neuropsychological battery that includes a word list learning test of verbal memory analogous to the Hopkins Verbal Learning Test (Brandt and Benedict, 2001), a version of the Auditory Consonant Trigrams working memory test, phonemic verbal fluency test of executive functioning, and a processing speed measure modeled after the Coding sub-test from the Wechsler Adult Intelligence Scales (Wechsler, 1997). Raw scores for each SCIP subtest were converted to Z-scores using published norms and averaged to create a composite Z-score of overall cognitive functioning, which served as the primary dependent variable in the statistical analyses (Purdon, 2005). Psychosis patients also completed the self-report Quality of Life Enjoyment and Satisfaction Questionnaire (Q-LES-Q: Endicott et al., 1993). We used an abbreviated, 18-item version of the scale designed to specifically assess quality of life in patients with mood disorders, schizoaffective disorder, and schizophrenia (Ritsner et al., 2005).

### 2.3. Statistical analysis

Group differences in continuous and categorical variables were examined with independent groups t-test (corrected for violations of equal variances when indicated by significant Levene's test) and chi-square test, respectively. Differences between healthy subjects and psychosis patients in the schizotypy questionnaire scores were examined using univariate ANOVAs with the following a-priori contrasts: 1) healthy subjects vs. all psychosis; 2) healthy subjects vs. schizophrenia spectrum disorders; and 3) healthy subjects vs. psychotic bipolar disorder. We used the Bonferroni method to correct for multiple comparisons. Specifically, the critical alpha was set to  $p = .0125$  (i.e.,  $.05/4$ ) to control for the number of univariate ANOVAs performed.

Correlations between schizotypy and clinical symptoms (i.e., PANSS) were examined with Pearson's correlations. The critical alpha for the correlations was set to  $p = .0042$  to control for the number of correlations performed (i.e.,  $p = .05/12 = \sim .0042$ ). Differences in the expression of schizotypy between schizophrenia spectrum disorders and psychotic bipolar disorder were examined using univariate ANOVAs with PANSS positive, negative, and general scales entered as covariates to control for clinical symptoms. The relationships between schizotypy, and cognition and quality of life were examined using partial correlation analyses with PANSS positive, negative, and general scores entered as covariates. Age and education were also included as covariates in the partial correlation analysis examining the relationship between schizotypy and cognitive functioning. The critical alpha for the correlations of cognition and quality of life was set to  $p = .0125$  to control for the number of correlations performed for each measure (i.e.,  $p = .05/4 = .0125$ ).

## 3. Results

Demographic data, schizotypy, and neuropsychological test scores along with clinical variables (i.e., duration of illness, PANSS scores) and quality of life data for healthy subjects and psychosis patients are presented in Table 1.

**Table 1**  
Sample demographics.

Variable	Healthy subjects		Psychosis		Statistics		
	n = 59		n = 68		t/ $\chi^2$	df	p
Sex (M/F)	35:24		42:26		0.08	1	.779
Ethnicity (W:AA:O)	36:22:1		39:23:6		3.09	2	.213
SCZ:BD	–		47:21		–	–	–
	Mean	SD	Mean	SD			
Age	32.0	12.0	31.0	11.9	0.46	125	.644
Education	5.7	1.8	3.7	1.4	7.00	110.3	<.001
Maternal education	14.7	2.3	13.6	3.1	1.97	102	.052
Paternal education	14.6	4.0	14.0	3.6	0.76	99	.449
SCIP z-score	0.03	0.61	–1.30	0.96	9.34	116.6	<.001
PANSS positive	–		20.3	7.0	–	–	–
PANSS negative	–		15.1	7.7	–	–	–
PANSS general	–		31.8	9.2	–	–	–
APD dose (CPZ equivalents)	–		458.5	257.7	–	–	–

Abbreviations: AA = African American; APD = Antipsychotic Drug; BD = Psychotic Bipolar Disorder; CPZ = Chlorpromazine; df = Degrees of Freedom; F = Female; O = Other; PANSS: Positive and Negative Syndrome Scale; SCIP = Screen for Cognitive Impairment in Psychiatry; SCZ: Schizophrenia Spectrum Disorder and W = White

### 3.1. Relationship between schizotypy and clinical symptoms of psychosis

Bivariate correlations were run between the schizotypy scales and the PANSS to measure which aspects of schizotypy related to psychosis symptomatology. The results of this analysis are shown in Table 2. Scatterplots showing correlations between each schizotypy scale and PANSS positive, negative, and general scores are presented in Supplemental Fig. 1. The positive symptoms did not correlate with any schizotypy scale (all Pearson's  $r < .15$ ,  $p > .253$ ). At the corrected alpha  $p = .0042$ , PANSS negative symptoms correlated with social anhedonia (RSAS:  $r = .37$ ,  $p = .0037$ ), and PANSS general symptoms correlated with physical anhedonia (RPAS:  $r = .41$ ,  $p = .0015$ ) and overall schizotypal traits (SPQ:  $r = .37$ ,  $p = .0029$ ). Additionally, at the uncorrected alpha  $p = .05$ , negative symptoms correlated with physical anhedonia (RPAS:  $r = .33$ ,  $p = .013$ ), and PANSS general symptoms correlated with perceptual aberrations (PAS:  $r = .30$ ,  $p = .014$ ) and social anhedonia (RSAS:  $r = .31$ ,  $p = .018$ ). The magnitude of these correlations was modest. Symptoms accounted for no more than 17% of the variance in schizotypy, indicating a fair degree of independence between schizotypal traits and clinical symptoms.

In a series of exploratory analyses, we further analyzed the correspondence between specific domains of schizotypy and dimensions of psychosis. Specifically, SPQ scores were broken down into the 4-domains, cognitive-perceptual, positive, negative, and disorganized identified by Stefanis et al. (2004) and Compton et al. (2009), and PANSS scores were broken down into the consensus five factor model, positive, negative, disorganized, excited, and depressed described by Wallwork et al. (2012). We then examined the correlation between each PANSS domain and its putative corresponding SPQ domain (e.g., PANSS negative–SPQ negative). As expected, both the PANSS positive and negative factors correlated with their respective SPQ positive and negative factors ( $r = .26$ ,  $p = .040$  and  $r = .44$ ,  $p < .001$ , respectively). However, PANSS disorganized factor did not correlate with the SPQ disorganized factor ( $r = -.01$ ,  $p = .439$ ) indicating a disconnect between patient and clinician ratings of disorganization.

### 3.2. Schizotypy in healthy subjects and psychosis

Group differences, based on one-way ANOVA, were evident for all four schizotypy scales (PAS:  $F(2,121) = 27.39$ ,  $p < .001$ ; RPAS:

$F(2,113) = 9.21$ ,  $p < .001$ ; RSAS:  $F(2,115) = 16.57$ ,  $p < .001$ ; SPQ:  $F(2,119) = 73.25$ ,  $p < .001$ ) as shown in Fig. 1. Follow-up a-priori planned contrasts indicated that psychosis patients reported higher levels of perceptual aberrations (PAS:  $t(121) = 5.68$ ,  $p < .001$ ), physical anhedonia (RPAS:  $t(113) = 3.07$ ,  $p = .003$ ), social anhedonia (RSAS:  $t(115) = 4.55$ ,  $p < .001$ ), and overall schizotypal traits (SPQ:  $t(119) = 9.38$ ,  $p < .001$ ). Broken down by diagnosis, schizophrenia spectrum patients scored significantly higher than healthy subjects on all four schizotypy measures (all  $t$ -values  $> 4.28$ ,  $p < .001$ ), while psychotic bipolar patients reported higher schizotypal personality traits ( $t(119) = 4.24$ ,  $p < .001$ ) and, at uncorrected significance levels, greater perceptual aberrations ( $t(121) = 2.58$ ,  $p = .011$ ) and social anhedonia ( $t(115) = 2.14$ ,  $p = .035$ ).

Differences between psychotic bipolar disorder and schizophrenia spectrum disorder patients in the expression of schizotypy were analyzed using univariate ANCOVAs with clinical symptoms (i.e., PANSS positive, negative, general scales) entered as covariates (see Fig. 1). Patients with a schizophrenia spectrum disorder reported higher levels of schizotypal personality traits on the SPQ ( $F(1,58) = 9.74$ ,  $p = .003$ ). No differences in perceptual aberrations (PAS:  $F(1,61) = 2.22$ ,  $p = .142$ ), physical anhedonia (RPAS:  $F(1,53) = 0.01$ ,  $p = .983$ ), and social anhedonia (RSAS:  $F(1,55) = 0.15$ ,  $p = .702$ ) were detected between psychosis groups.

### 3.3. Schizotypy, cognition, and quality of life in psychosis

Correlations between schizotypy, cognition (i.e., SCIP z-score), and quality of life (i.e., Q-LES-Q) are summarized in the scatterplots presented in Fig. 2. After controlling for age and education, SCIP z-score inversely correlated with SPQ ( $r = -.38$ ,  $p = .002$ ) at the corrected alpha level, and RPAS ( $r = -.28$ ,  $p = .036$ ) at an uncorrected significance level indicating that higher levels of overall schizotypal personality traits and physical anhedonia were associated with worse cognitive functioning. Given the moderate correlations between schizotypy and clinical symptoms, we repeated the partial correlation analyses after adding PANSS positive, negative, and general scores as covariates, along with age and education. The negative correlation between SCIP Z-scores and SPQ remained significant ( $r = -.34$ ,  $p = .010$ ), while the correlation between SCIP Z-score and RPAS did not ( $r = -.18$ ,  $p = .211$ ). The association between higher SPQ scores and worse cognitive functioning persisted even after psychosis diagnosis was included as an additional covariate ( $r = -.27$ ,  $p = .042$ ). Given evidence that negative symptoms and disorganization are especially related to cognitive function, we examined the correlations between SPQ negative and disorganization factors, and cognition. After controlling for PANSS scores, age, and education, both SPQ negative and disorganization factors inversely correlated with SCIP Z-score ( $r = -.37$ ,  $p = .005$  and  $r = -.36$ ,  $p = .006$ ).

With respect to quality of life, higher levels of perceptual aberration and schizotypal personality traits were associated with worse ratings of subjective quality of life (PAS:  $r = -.47$ ,  $p < .001$ ; SPQ:  $r = -.63$ ,  $p < .001$ ). Both perceptual aberrations and schizotypal personality traits remained negatively correlated with quality of life after controlling for severity of psychosis symptoms (PAS:  $r = -.41$ ,  $p = .002$ ; SPQ:  $r = -.57$ ,  $p < .001$ ). There was little evidence of specific associations between SPQ factor scores and quality of life as all four SPQ factors, cognitive-perceptual, positive, negative, and disorganized, correlated inversely with quality of life (all partial correlations  $> -.42$ ,  $p$ -values  $< .003$ ).

## 4. Discussion

The expression of schizotypy in psychotic disorders has received surprisingly little attention despite the theoretical importance of this construct to psychosis. Consistent with the idea that schizotypy represents stable, trait vulnerability for psychosis, we found that clinical symptoms, which vary markedly over time, are only weakly correlated

**Table 2**

Correlations between schizotypal personality traits, cognitive function, and quality of life in psychotic disorders.

Schizotypy measures	Clinical symptoms			Cognition <sup>†</sup>	Quality of life
	PANSS Positive	PANSS Negative	PANSS General	SCIP z-score	Q-LES-Q
Perceptual Aberration Scale	.058	.167	.300*	-.199	-.469**
Physical Anhedonia Scale	.145	.326*	.408**	-.280*	-.170
Social Anhedonia Scale	.072	.369**	.306*	-.041	-.262
Schizotypal Personality Questionnaire	.146	.205	.369**	-.381**	-.626**

Abbreviations: PANSS = Positive and Negative Syndrome Scale; SCIP = Screen for Cognitive Impairment in Psychiatry and Q-LES-Q = Quality of Life Enjoyment and Satisfaction Questionnaire.

<sup>†</sup> Partial correlation adjusted for age and education.

\*  $p < .05$ .

\*\*  $p < .01$ .

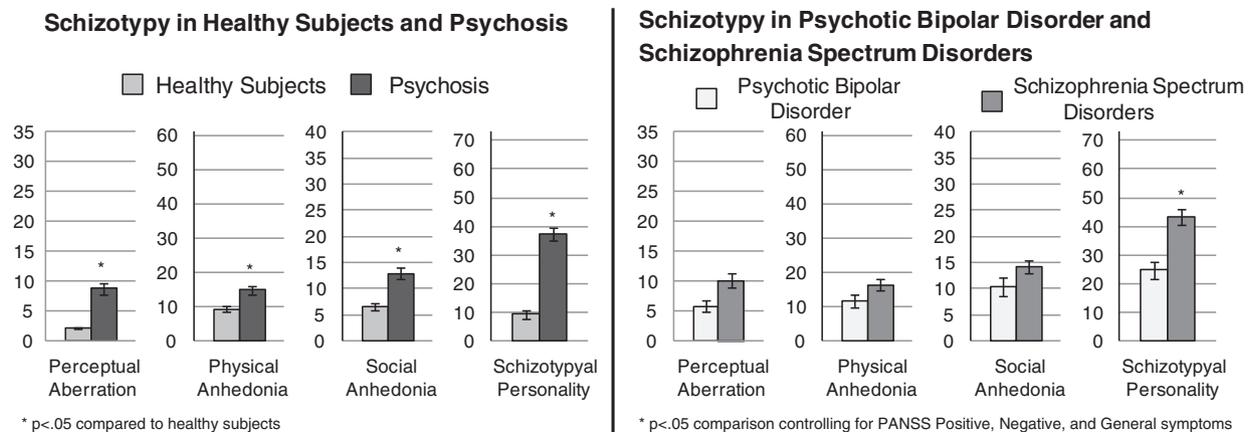
with schizotypy, if at all. All four measures of schizotypy exhibited minimal to moderate correlations with PANSS scores; no clinical symptom, accounted for more than 20% of the variance in schizotypy. Positive symptoms, which represent more transient aspects of psychosis (Ericson et al., 2011; Kwapil et al., 2013), only weakly correlated with schizotypy. While perhaps not surprising given the fluctuating nature of positive symptoms, it does argue against conceptualizing positive symptoms as the penultimate expression of schizotypy. On the other hand, negative symptoms correlated with several aspects of schizotypy, including social and physical anhedonia, and negative SPQ factor, which is consistent with evidence that negative symptoms are stable traits in schizophrenia (Lyons et al., 1995; Clementz et al., 1991; Berenbaum and McGrew, 1993; Rey et al., 1994; Dollfus and Petit, 1995; Keefe et al., 1991; Blanchard et al., 1998). However, even here the correlations were moderate, ranging from  $r = .30$ –.44, indicating only a modest degree of overlap between clinician ratings of negative symptoms and patient self-report of negative schizotypy traits.

As discussed earlier, the construct of schizotypy arose as part of etiological models of schizophrenia and has been studied almost exclusively in this context. As such, relatively little is known about the relationship between schizotypy and other psychotic disorders; although there is some evidence that some aspects of schizotypy are also elevated in psychotic bipolar probands and their unaffected relatives (Etain et al., 2007; Schurhoff et al., 2005). After adjusting for clinical symptoms, we found that schizophrenia spectrum patients report higher levels of schizotypy than psychotic bipolar patients. Moreover, in comparison to healthy subjects, the elevations in schizotypy among psychotic bipolar patients were substantially attenuated relative to the marked increase observed in schizophrenia patients. Consistent with a prior study in unaffected family members and the putative central role of anhedonia in schizophrenia, psychotic bipolar patients did not report higher

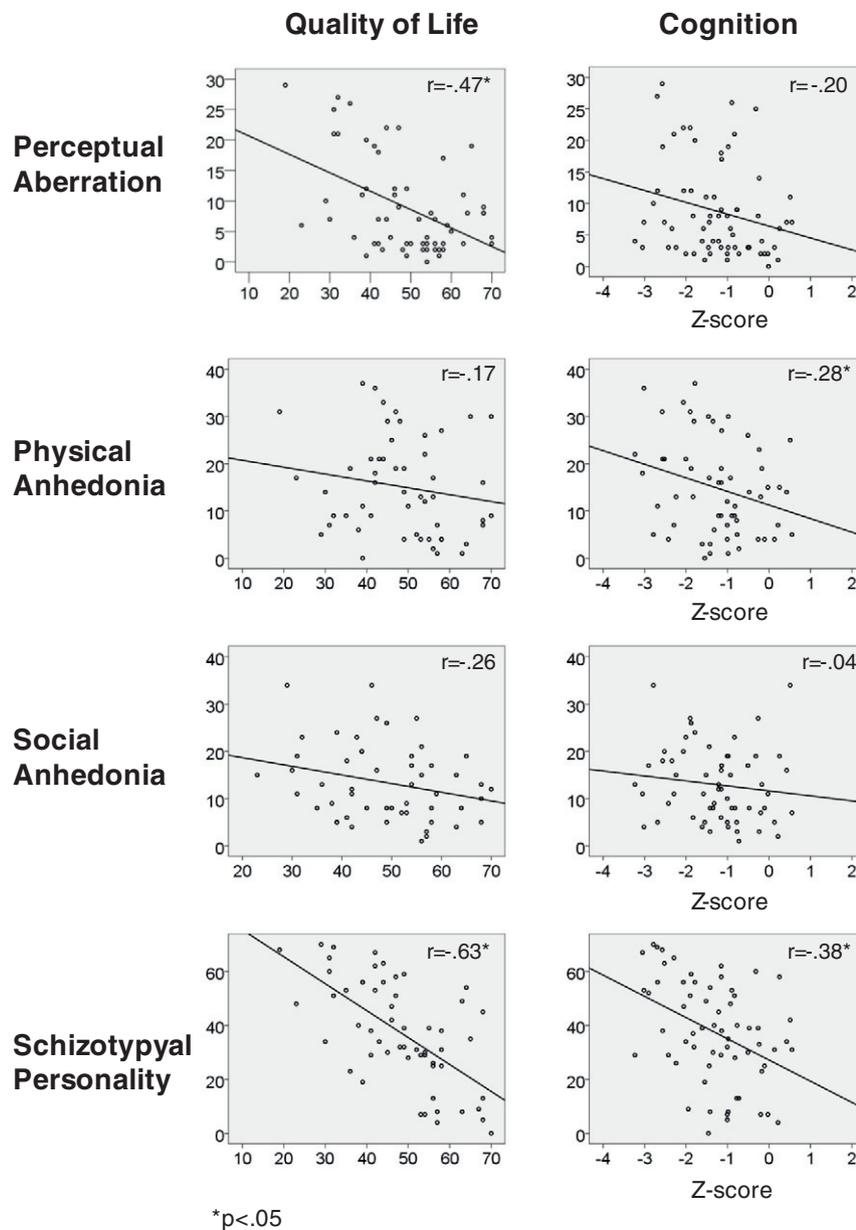
levels of physical anhedonia (Chapman et al., 1984; Schurhoff et al., 2003).

Consistent with findings in healthy subjects and unaffected relatives of probands, schizotypy correlated with cognitive functioning and self-reported quality of life (Lenzenweger and Loranger, 1989b; Ritsner et al., 2005; Cohen and Davis, 2009; Cohen et al., 2006; Kwapil, 1998). With respect to cognition, overall schizotypal personality traits, as measured with the SPQ, and physical anhedonia correlated with cognitive functioning. Similarly, overall schizotypal personality traits and perceptual aberrations in particular correlated with quality of life. Critically, with the exception of physical anhedonia and cognitive functioning, these correlations persisted after accounting for clinical symptoms. It is noteworthy that in psychosis, clinical symptoms are only weakly correlated with cognitive impairment. For instance, in the CATIE study baseline data, which included over 1000 patients, positive and negative symptoms accounted for less than 10% of the variance in cognition (Keefe et al., 2006). The association between schizotypy and cognition further underscores the independence of clinical symptoms and schizotypy. The significant correlations with quality of life and cognitive functioning suggest that measuring schizotypy is warranted in psychotic disorders as it may be useful for predicting functional outcome.

This study has several limitations. There is evidence indicating that structured psychiatric interviews are better than self-report measures at assessing familial liability for schizophrenia raising the possibility that we might have obtained different results had we used interview-based ratings of schizotypy (Kendler et al., 1996). However, face-to-face interviews come with their own limitations including socially desirable responding and lower accuracy compared to self-report questionnaires (Richman et al., 1999). Our assessment of psychosocial functioning was limited to a self-report measure of quality of life. It would be interesting to know if elevated schizotypy is also related to



**Fig. 1.** Schizotypy scores in healthy subjects and patients with psychosis (left panel), and schizophrenia and psychotic bipolar disorder (right panel).



**Fig. 2.** Correlations between schizotypy, and quality of life and cognitive impairment, as measured by the Quality of Life and Enjoyment Satisfaction Questionnaire (Q-LES-Q) and Screen for Cognitive Impairment in Psychiatry (SCIP), respectively, in psychotic disorders.

objective measures of functional outcome, such as employment. Finally, the relatively small number of psychotic bipolar patients resulted in limited statistical power to detect differences between patient groups. It is likely that we would have detected more statistical differences between patient groups had the sample sizes been larger given the clear trend of higher schizotypy in schizophrenia spectrum patients.

In conclusion, our results indicate that elevated schizotypy in psychosis is related to greater cognitive impairment and poorer psychosocial functioning, and only weakly correlated with clinical symptoms. Moreover, schizophrenia spectrum patients tend to demonstrate higher elevations in schizotypy compared to psychotic bipolar patients. Our findings are consistent with the concept of schizotypy as a stable trait and suggest that assessing schizotypy in psychosis may be useful in predicting functional outcome and differential diagnosis.

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#### Contributors

Authors EB and NDW conceived and designed the research reported on, analyzed the data, and co-wrote the final draft of the manuscript. Author NDW provided funding for the project.

#### Conflict of interest

No commercial support was received for this manuscript and the authors have no conflicts of interest to report.

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