Personality Disorders: Theory, Research, and Treatment
2012, Vol. 3, No. 4, 379–392

1949-2715/12/$12.00 DOI: 10.1037/a0027955

Schizotypy, Social Cognition, and Interpersonal Sensitivity

Allison B. Miller
State University of New York at Binghamton

Mark F. Lenzenweger
State University of New York at Binghamton and
Weill Cornell Medical College

Social cognition in relation to schizophrenia liability remains largely uncharted terrain. Successful social interactions involve sensitivity to the feelings and behavior of others, and the ability to convey and communicate cues to elicit desired responses from others. Disruption in any part of this process will affect social interactions and functioning, including occupational functioning. Individuals who do better on tasks measuring interpersonal sensitivity are more interpersonally skilled and better adjusted (Hall, Andrzejewski, & Yopchick, 2009), and those who perform poorly on tasks of interpersonal sensitivity, such as patients with schizophrenia, have known interpersonal and social functioning deficits (e.g., Toomey, Schuldberg, Corrigan, & Green, 2002). Schizotypic subjects were compared to depression vulnerable and normal control subjects on a well-established dynamic test of interpersonal sensitivity, the Profile of Nonverbal Sensitivity (PONS; Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979, 2011). Results revealed a deficit for schizotypes relative to both the depression-risk and normal control groups on the PONS. Our examination of the interpersonal sensitivity in schizotypes may shed light on the social functioning problems seen in patients with schizophrenia in a translational research framework.

Keywords: schizotypy, interpersonal sensitivity, social cognition, schizophrenia, endophenotype

Impairments in social functioning are primary characteristics of schizophrenia as described early on by both Kraepelin (1919/1971) and Bleuler (1911/1950). Moreover, Lenzenweger and Dworkin (1996) found that premorbid impairments in social functioning stand apart from both positive and negative schizophrenia symptoms. The salience of impairment in social functioning in schizophrenia is evident in the diagnostic criteria for the disorder, namely Criterion B: social/occupational functioning impairment (i.e., work, interpersonal relations), and this criterion represents one of the few criteria that all individuals diagnosed with the disorder must meet (American Psychiatric Association [APA], 1994). Nonetheless, although social dysfunction (e.g., social isolation, failure to respond to others' affect, failure in interpersonal skills) is widely noted in schizophrenia, the basic processes underlying these deficits are not well understood. Rado (1960) and Meehl (1962, 1990) both theorized about the likely importance of interpersonal deficits in relation to schizotypy and schizophrenia. The resurgence of interest in the role of social/interpersonal information processing from a social–cognitive neuroscience perspective (e.g., Ochsner, 2008) echoes these past observations.

Here we explore social cognition deficits in relation to schizotypy, or the putative latent liability for schizophrenia (Lenzenweger, 2010). Penn, Corrigan, Bentall, Racenstein, and Newman (1997) noted that neurocognitive skills are "necessary but not sufficient" for successful social functioning, but the nature of those skills remains to be illuminated. We argue

This article was published Online First May 28, 2012.

Allison B. Miller, Department of Psychology, State University of New York at Binghamton; Mark F. Lenzenweger, Department of Psychology, State University of New York at Binghamton and Department of Psychiatry, Weill Cornell Medical College.

We thank the late Brendan A. Maher for useful comments and suggestions on this research and Jean-Pierre Mileur, former dean of Arts and Sciences at SUNY–Binghamton, for his consistent support of the Laboratory of Experimental Psychopathology. We thank Michael Dawson for a useful consultation.

Correspondence concerning this article should be addressed to Mark F. Lenzenweger, Department of Psychology, State University of New York at Binghamton, Science IV, Binghamton, NY 13902–6000. E-mail: mlenzen@binghamton.edu

the study of social cognition is a necessary step toward the illumination of those processes and skills underpinning social functioning (and dysfunction) in schizophrenia and schizotypic psychopathology. Moreover, despite the breadth of research documenting various deficits among nonpsychotic schizotypes that mirror those found in individuals with schizophrenia (Lenzenweger, 2010), interpersonal perception and sensitivity remain largely unexplored. In this context we note that schizotypy, as a latent liability for schizophrenia, can manifest itself in different ways, not only as schizophrenia per se in some cases, but also through the Cluster A personality disorders (PD) such as schizoid, schizotypal, or paranoid PDs in other instances (Lenzenweger, 2010).

Social cognition refers broadly to a research domain examining those processes underlying social functioning, specifically those cognitive processes involved in perceiving and interpreting interpersonally relevant information (Ostrom, 1984). The subordinate processes of social perception, interpersonal sensitivity, emotion perception, and attribution underlie social cognition. Social cognition in schizophrenia has been studied in two ways to date, through a focus on facial affect recognition (or "emotion perception") and social cue perception (Pinkham, Penn, Perkins, & Lierberman, 2003). Penn et al.'s (1997; see also Pinkham et al., 2003) data on facial affect recognition (emotion perception) suggest that individuals with schizophrenia have deficits in facial affect perception compared to nonclinical comparison subjects and other nonpsychotic disorders. Phillips and Seidman (2008) theorized that individuals "at risk for schizophrenia" should show deficits in emotion processing ("emotion perception"), which are consistent with patients with schizophrenia having similar deficits. Shean, Bell, and Cameron (2007) found the schizotypal symptom feature of "unusual perceptual experiences," in an unselected sample, was associated with deficits in the perception of emotions using a nonverbal, paralinguistic measure. These authors hypothesized that the inability to perceive emotions correctly might underpin, in part, deficits in social cognition seen in connection with schizophrenia. Gibson, Penn, Prinstein, Perkins, and Belger (2010) examined social skills and social cognition, defined in terms of theory of mind concepts, in a group of adolescents deemed to be "genetically at-risk for schizophrenia." Gibson et al. (2010) reported that adolescents genetically at-risk for schizophrenia showed social skills impairments, but these impairments were unrelated to theory of mind related social cognition constructs.

One limitation of prior facial affect recognition (emotion perception) studies in schizophrenia is that they used static rather than dynamic test stimuli, a feature that necessarily limits the real-world quality of the probes. Unlike static test stimuli, dynamic stimuli require multiple sensory modalities to process and, therefore, make such stimuli a better approximate of real life situations. It is likely that dynamic test stimuli—such as video or moving images—therefore, possess greater ecological validity, or are more realistic. The realistic nature of moving image stimuli has been recognized in diverse areas of psychological research with an excellent empirical demonstration in psychopathology research found in the work of Dawson and colleagues (Courtney, Dawson, Schell, Iyer, & Parsons, 2010). We note the greater ecological validity of video or moving (dynamic) stimuli, however we also emphasize that the use of both lexical (word) and static images (photographs) are excellent methodological complements and can provide important research leverage. Our preference, however, for the question at hand was to use stimuli that were as realistic as possible to assess interpersonal sensitivity and social perception.

In normative social–cognitive neuroscience, studies investigating social cue perception via dynamic stimuli have turned increasingly to ecologically valid approaches, such as the thin-slice methodology (Ambady, LaPlante, & Johnson, 2001). A *thin-slice of behavior* is defined as a "brief excerpt of behavior sampled from the behavior stream, less than five minutes in length" (Ambady et al., 2000, p. 90; see also Ambady & Rosenthal, 1992). One study of patients with schizophrenia using the thin-slice approach reported that patients with the illness perform worse on tests of nonverbal interpersonal sensitivity and judgment of social situations relative to normal control groups (Toomey, Schuldberg, Corrigan, & Green, 2002). Better performance on these laboratory tests is positively correlated with better social functioning (Penn et al., 1997).

Successful social interactions involve interpersonal sensitivity, or sensitivity to the feelings, affect, and behavior of others as well as to the ability to convey and communicate cues to elicit desired responses from others. Both the ability to judge and be judged accurately serve adaptive functions in social interactions (Ambady, Hallahan, & Rosenthal, 1995). Thus, it is plausible that a disruption in any part of this process, either sensitivity to or judgments about others (rater accuracy) or being judged accurately by others (target accuracy), will affect social interactions and functioning. Supporting this viewpoint are multiple studies demonstrating that individuals who do better on tasks of interpersonal sensitivity are more interpersonally skilled and better adjusted than people who do poorly (Ambady et al., 2001), and those who perform poorly on tasks of interpersonal sensitivity, such as those diagnosed with schizophrenia, have known interpersonal and social functioning deficits (e.g., Toomey et al., 2002). Accordingly, it seems that possessing or lacking the ability to "read other people" (interpersonal sensitivity) has real-life consequences. Schizotypes are thought to lack this ability across the board in all areas of interpersonal perception (Lenzenweger, 2010; Meehl, 1962, 1990).

An important aspect of interpersonal sensitivity, comes from correctly noticing and interpreting what is communicated nonverbally. The ability to use nonverbal cues that one cannot necessarily describe has been referred to as "tacit knowledge" (Polanyi, 1962). Nonverbal communication includes many different behaviors including but not limited to facial expressions, head nods, eye movements, body movements, hand gestures, postures, and tones of voice (Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979). These different levels of nonverbal interaction are often operationally called, "channels," and many different channels are often involved in even the simplest communication (Rosenthal et al., 1979). Rosenthal et al. (1979, 2011) developed the Profile of Nonverbal Sensitivity test (PONS) as a method to investigate what factors mediate and moderate successful perception of these nonverbal channels. The PONS has been used extensively to assess individual differences in interpersonal sensitivity (Ambady et al., 2001; Hall, Andrzejewski, & Yopchick, 2009). Although new measures of interpersonal sensitivity and emotion recognition appear from time to time (e.g., Gur et al., 2002; Mayer, Salovey, & Caruso, 2002; McDonald, Flanagan, Rollins, & Kinch, 2003), the PONS rests on a vast corpus of reliability and construct validity data that dwarfs in comparison those available for these recently developed tasks (see Bänziger, Scherer, Hall, & Rosenthal, 2011; Hall, 2001; Hall et al., 2009). As such, the PONS represents an important methodological/assessment standard in the field. Finally, although interpersonal sensitivity is a rich construct, it can be studied via a "thin-slice" methodological approach.

Although impaired social functioning is evident in functioning prior to the onset of schizophrenia (Lenzenweger & Dworkin, 1996), we know little about the processes underlying the emergence of social functioning impairment itself premorbidly and, later, the development of the clinical disorder. Whether deficits in interpersonal sensitivity lead to, augment, or maintain social functioning deficits in individuals with schizophrenia remains opaque. This is so simply because once the illness of schizophrenia is expressed; it begins to impact social skills and social functioning quite apart from premorbid social skills. Thus, a critical issue in this area concerns the extent to which these deficits are present prior to the onset of psychosis. A second issue is to what extent interpersonal sensitivity deficits, if they exist in the premorbid period, are directly related to the emergence of clinical schizophrenia. Toomey, Seidman, Lyones, Faraone, and Tsuang (1999) provided a clue to the possible processes involved. They found the relatives of patients with schizophrenia showed impaired interpersonal sensitivity relative to normal controls as measured by the PONS (Rosenthal et al., 1979).

No study to date has investigated interpersonal sensitivity in schizotypic subjects using a dynamic measure, however there is ample reason to believe that this process may be disrupted in such individuals, clearly prior to the possible onset of schizophrenia (see Lenzenweger, 2010; Meehl, 1962, 1990). Although deficits in social functioning predate the manifest illness of schizophrenia, it is not clear if deficits in interpersonal sensitivity contribute to these deficits, and if so, if they are the effect of psychosis or a contributing factor to its manifestation. Studying individuals with schizophrenia cannot illuminate this issue unambiguously as postmorbid

processes may not reflect pre-illness processes. However, studying schizotypes in advance of clinical decompensation can help with this question (Lenzenweger, 2010). In addition, sadness and other features symptoms associated with depression have been demonstrated to detract from interpersonal sensitivity (Ambady & Gray, 2002). Thus, it is not clear if these affective states alone can account for the worse performance of patients with schizophrenia. By examining interpersonal sensitivity in a clinically unaffected population such as schizotypes, we can begin to tease apart this issue. It is hypothesized that schizotypes, identified using the psychometric laboratory approach (Lenzenweger, 2010), as patients with schizophrenia and their first-degree relatives, will demonstrate deficits relative to normal control subjects on our chosen measures of interpersonal sensitivity (i.e., PONS), particularly in the judgment of posed negative social cues.

In addition to examining whether interpersonal sensitivity deficit is present in schizotypes relative to nonschizotypic young adults, it is also important to determine if the deficit is relatively specific to schizotypes. Few studies of schizotypic subjects ever address the issue of specificity by inclusion of a psychopathology control group. To address this substantive issue we introduced a third study group into our design, consisting of individuals who were putatively vulnerable to the development of depression based on a negative cognitive style (Alloy et al., 2000). We find it interesting that although it is known that deficits in social functioning are prominent in individuals with depression, and that these deficits contribute to the maintenance and recurrence of the disorder (Joiner, 2000), it has not been demonstrated that deficits in interpersonal sensitivity contribute to social functioning problems or the onset of depression. An additional benefit of having the at-risk for depression controls is that like patients with schizophrenia, patients who are depressed are known to have biased attributional styles relative to the general population. However, the attributional biases among subjects who are depressed are distinct from those seen in individuals with schizophrenia, and thus it seems likely they will be distinct from those seen schizotypes as well. In particular, in many patients who are depressed (and those vulnerable to develop depression) their attributional styles are characterized by stable, global, and internal attributions (e.g., Alloy et al., 2000), whereas persons with persecutory delusions have been found to make stable, global, external attributions (Bentall, Cornoran, Howard, Blackwood, & Kinderman, 2001). Although it is not clear how these differences might precisely impact interpersonal sensitivity in schizotypes and depression-vulnerable populations, it is hypothesized that individuals who are depression vulnerable will perform better than schizotypes, and comparably to nonvulnerable, nonschizotypal individuals on both tests of interpersonal sensitivity.

Method

Subjects

There were 93 subjects (26 schizotypes, 36 subjects at-risk for depression, and 31 normal controls) in this study. All were recruited from the highly diverse undergraduate student population at the State University of New York at Binghamton (SUNY–Binghamton). We note our schizotypes and depression risk subjects do not represent analog conditions, rather they are people who likely carry an elevated and genuine risk for clinical illness as defined by valid indexes of same.

Measures

Schizotypy screening. The Perceptual Aberration Scale (PAS; L. J. Chapman, Chapman, & Raulin, 1978) is a self-report measure of body image and perceptual distortions. The Magical Ideation Scale (MAG; Eckblad & Chapman, 1983) is self-report questionnaire that measures belief in forms of causation that, by conventional standards of the dominant culture, are regarded as invalid and magical in nature. Both measures have been used extensively in laboratory research on schizotypic psychopathology (L. J. Chapman & Chapman, 1985; Lenzenweger, 1994, 2010).

Numerous studies show that high scorers on the PAS–MAG scales generally show many deficits similar to those seen in clinical schizophrenia (L. J. Chapman, Chapman, Kwapil, Eckblad, & Zinser, 1994; Lenzenweger, 2010). Long term follow-up studies of high PAS–MAG scorers support the validity of these scales as measures of schizotypy (L. J. Chap-

man et al., 1994) as do results from a 17-year follow-up of high PAS scorers (Lenzenweger, 2010).

Depression vulnerability screening. The Cognitive Styles Questionnaire (CSQ; Alloy et al., 2000) is a modified version of the original Attributional Style Questionnaire (Peterson et al., 1982) that assessed one's style of inferring causes, consequences, and characteristics about the self for hypothetical positive and negative life events. The CSQ, which has strong psychometric properties, generates an overall score for a negative cognitive style and this score can be used to assess vulnerability for depression (Hankin, Abramson, Miller, & Haeffel, 2004). We used the established Temple–Wisconsin guidelines for subject selection using the CSQ (Alloy et al., 2000; Alloy et al., 1999).

Infrequency Scale. A 13-item version of Jackson's (1984) Infrequency Scale (INFREQ) was used to detect evidence of random, pseudorandom, reckless, or dishonest responding.

SPQ. The Schizotypal Personality Questionnaire (SPQ; Raine, 1991) is a 74-item true–false and yes–no scale designed to measure dimensions of schizotypal personality disorder, as defined by the *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., revised, *DSM–III–R;* APA, 1987).

BDI–II. The Beck Depression Inventory (BDI–II; Beck, Steer, & Brown, 1996) is a 21-item self-report inventory to assess the severity of state dysphoria.

PANAS. The Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) taps state and trait positive and negative mood and is comprised of two 10-item self-report measures. Both sets of instructions (i.e., those assessing state and trait measurements) were used to measure positive affect (PA) and negative affect (NA) in this study. The core constructs of PA and NA assessed by the PANAS are derivative of the theoretical and psychometric instrument work of Tellegen (1985).

Psychopathology screening. All subjects completed the self-administered computerized screening version of the Diagnostic Interview Schedule-IV (DIS–IV; Robins et al., 2000) to rule-out lifetime presence of schizophrenia or schizophreniform psychosis and lifetime or current depressive orders. All responses and laboratory behavior were reviewed carefully for any subject who screened positive to assess for any evidence of actual psychopathology (i.e., psychosis).

Intelligence proxy. The Weschler Adult Intelligence Scale (WAIS–III; Weschler, 1997) Digit Symbol Coding subtest was used as a measure of intellectual processing speed (Joy, Fein, & Kaplan, 2003).

Laboratory Social Cognition Measure

PONS. The PONS (Rosenthal et al., 1979, 2011) is a well-established measure of nonverbal social perception. It rests on a corpus of reliability and validity data far more extensive than any competing measure (Bänziger et al., 2011; Hall, 2001). In its original form, it is a 45-min videotape composed of 220 nonverbal audio and/or visual scenes portrayed by a White female in black and white color. The internal consistency of the PONS is .86 (KR20); the median *r* for test–retest reliability across six studies is .69 (Rosenthal et al., 1979, 2011). The present study used the Half PONS, which is 50% shorter in duration than the original form and has excellent reliability and validity. On the general PONS test, visual channels include the face or the body from the lower neck to the knees, including hands. Audio channels include two sound tracks altered to eliminate verbal content. One track was scrambled by means of random splicing (RS). The second track electronically filtered out high frequencies (content filtered, CF). Each scene is 2 s in duration and includes one to three cues. Immediately after viewing the scene, subjects pick one of two descriptions that best fit (e.g., "expressing jealous anger" or "admiring nature"). Half of the scenes convey positive affective and the other half convey negative affective information. We used the 110 scenes version (Half–PONS) due to time constraints, as has been done with success previously (Ambady et al., 1995; Wynn, Sergi, Dawson, Schell, & Green, 2005). Reliability (internal consistency) of the Half–PONS in this study was .73 (Cronbach's alpha), a value comparable to that reported for PONS research with patients with schizophrenia (Sergi, Rassovsky, Nuectherlein, & Green, 2006).

Procedure

Subject recruitment strategy. A total of 1,384 undergraduates at SUNY–Binghamton were screened for this study. SUNY–Binghamton is a public university with a highly diverse student population in terms of race, ethnicity, and socioeconomic background. To begin, subjects who scored higher than 3 on the INFREQ scale were dropped from the sample. Next, we selected schizotypic subjects using the PER–MAG cut scores based on the extremely large norm based supplied by Kwapil (1998). In particular, eligibility criteria for inclusion in the schizotypy group were scores of at least 21 on the MAG and/or 19 on the PAS. These cut-offs set at two standard deviations above the population average (norm) represents the field standard approach in the psychometric high-risk approach (Lenzenweger, 1994, 2010). The depression vulnerability group was selected on the basis of the CSQ-negative composite score following the recommendations from the Temple–Wisconsin affective disorders research project (Alloy et al., 2000; Alloy et al., 1999). The CSQ-negative selection criterion for the at-risk for depression group was an elevated score (i.e., the highest quartile of CSQ-negative score values or a cut-off score ≥ 4.77). A small number of subjects ($n = 4$) who clearly met criteria for inclusion in the schizotypy group, but showed a moderate elevation on the depression vulnerability measure groups, were assigned to the schizotypy group given the substantive and empirical corpus in support of such a classification (Lenzenweger, 2010; Lenzenweger & Loranger, 1989; Meehl, 1962, 1990, 2001). Finally, the control group consisted of subjects who scored no more than one half a standard deviation above the mean on the PAS and the MIS, (control group cut-off score for the PAS ≤ 7.60 and the MIS ≤ 11.23), and they were in the lower quartile (control group cut point for the CSQ ≤ 3.46) on the CSQ-negative score. Selection of the normal controls was also guided by field standard approaches for both schizotypy and depression vulnerability. Selection of the normal control subjects was done by random selection from among those who met the criteria just described, with men and women selected separately. One of us (Mark F. Lenzenweger) performed the subject selections and did not test subjects. All experimenters, including the first-author (Allison B. Miller), were blind to subject group classification throughout the entire laboratory phase of the study.

Subjects who met criteria for inclusion in the laboratory phase were first contacted with a standardized email invitation, asking about their willingness to be in a study investigating "individual differences in interpersonal perception" for credit toward their psychology course, $20, or a chance to win one of five $100 gift certificates. If subjects did not respond to the initial email within a week, they were called by phone and offered the same invitation and incentive. Subjects who agreed to participate were asked not to drink more than one cup of coffee on the day of their participation and not to drink alcohol for 24 hr prior to their participation in the study. Subjects were asked not to take attention deficit hyperactivity (ADHD) medication on the day of testing. The laboratory phase of the study took place in the laboratory of experimental psychopathology in the department of psychology at SUNY–Binghamton. Allison B. Miller was the primary experimenter and was assisted by trained undergraduate research assistants; all staff was blind to the subjects' group membership throughout the laboratory phase of the study. All subjects were tested individually.

Results

A total of 1,384 subjects were screened for this study and, of these, 121 (8.7%) were dropped due to incomplete data or invalid response styles, a rate consistent with prior experience. A total of 93 subjects completed the laboratory phase of the study.

Demographic Variables

Table 1 lists the number of subjects in each group along with demographic information. There were no significant differences between the three groups on any of the demographic variables including age, gender, ethnicity, level of parents' education, and current psychotropic medications. It was not necessary to drop any subjects based on the *DSM* psychopathology screening.

Primary Contrast Analyses

The hypotheses for the PONS were analyzed using a focused linear contrast approach

Table 1
Demographic Information for Schizotype, Depression-Vulnerable, and Normal Control Subjects

Characteristic	Schizotypes (n = 26)	Depression vulnerable (n = 36)	Normal (n = 31)
Gender			
% Male	38	36	29
Ethnicity			
% White	50	75	61
Age (M)	19	20	20
Mother completed at least BA (%)	46	40	55
Father completed at least BA (%)	35	53	68
Psychotropic medicines (%)	12	11	3
ADHD medicines (%)	4	3	0

Note. BA = Bachelor of Arts degree; ADHD = attention deficit hyperactivity disorder.

(Rosenthal, Rosnow, & Rubin, 2000). Table 2 lists the means and standard deviations for the three groups' total scores on the PONS. Our primary hypotheses were specific a priori and were clearly directional based on theory (Lenzenweger, 2010; Meehl, 1962, 1990). Contrast analysis, as is well known, confers more power and precision in data analysis than the unfocused analysis of variance (ANOVA) approach (see Rosenthal et al., 2000).

First, we hypothesized that interpersonal perception deficits would be relatively specific to schizotypes (S), with the depression-vulnerable (D) and normal (N) groups performing comparably (S < D = N); lambda or contrast weights (−2, 1, 1)). As predicted, the schizotypes had lower interpersonal sensitivity scores as measured by the PONS total score, $t(90) = 2.15$, $p < .017$ (one-tailed). The effect size r for this contrast was ($r_{contrast} = .23$) a "medium effect" as per Rosenthal et al. (2000). A second contrast tested whether interpersonal sensitivity deficits on the PONS were not specific to schizotypes, but rather they reflected a generalized deficit in groups at risk for psychopathology (S = D < N), tested using the following lambda weights (−1, −1, 2). This hypothesis was not supported for the, $t(90) = 0.8$, $p = .21$ (one-tailed), $r_{contrast} = .08$. To test whether the normal and depression-vulnerable groups differed on the PONS total score, we conducted a t test and found the means of the two groups did not differ significantly, $t(65) = 0.47$, $p > .64$.

We also found that PONS total scores were higher for women than men across the groups (see Table 2). These sex differences are consistent with the PONS total score normative data (Rosenthal et al., 1979). Two-way ANOVA,

Table 2
Mean Interpersonal Perception Scores on the PONS by Group and Gender

	PONS-Total	PONS-Negative	PONS-Positive
Group	M (SD)	M (SD)	M (SD)
Schizotype (n = 26)	85.96 (6.73)	50.42 (4.11)	36.54 (3.54)
Female (n = 16)	86.50 (6.75)	50.69 (3.63)	36.81 (3.90)
Male (n = 10)	85.10 (6.97)	50.00 (4.97)	36.10 (2.99)
Depression Vulnerable (n = 36)	88.75 (4.57)	52.42 (3.43)	37.33 (2.34)
Female (n = 23)	89.52 (4.40)	53.09 (3.62)	37.43 (2.31)
Male (n = 13)	87.39 (4.72)	51.23 (2.83)	37.15 (2.48)
Normal (n = 31)	88.26 (4.00)	52.71 (2.46)	36.52 (2.54)
Female (n = 22)	89.41 (3.75)	53.36 (2.17)	37.00 (2.69)
Male (n = 9)	85.44 (3.24)	51.11 (2.52)	35.33 (1.73)

Note. PONS = Profile of Nonverbal Sensitivity (Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979, 2011); PONS-Negative = score for negatively valenced items on the PONS; PONS-Positive = score for positively valenced items on the PONS.

with between-subjects grouping variables, was used to analyze these differences; a main effect of gender for the PONS total score, $F(1, 87) = 5.10$, $p < .01$ (one-tailed), with no main effect for group, $F(2, 87) = 1.98$, $p < .07$ (one-tailed) or the interaction of group and gender, $F(2, 87) = 0.44$, $p = .32$ was found. Inspection of group means (see Table 2) suggests that these gender differences were due to the poorer performance of the normal men on the PONS as compared to normal women on the PONS as opposed to differences between male and female schizotypes. Independent samples t test supported this impression. There were no differences between male and female performance on the PONS for the schizotype group, $t(24) = -0.51$, $p = .62$ or the depressed group, $t(34) = 1.36$, $p = .18$, but there were for the normal control group, $t(29) = -2.77$, $p < .01$.

Using linear regression, the effect of gender was removed from the PONS total score, and the standardized residuals were retained. The two central focused contrasts were reconducted using the retained standardized residual scores, yielding the same results in support of the specific deficit hypothesis (S < D = N), $t(90) = 2.08$, $p < .02$ (one-tailed), $r_{contrast} = .21$, but not the generalized deficit (S = D < N), $t(90) = 0.63$, $p = .27$ (one-tailed), $r_{contrast} = .07$.

The PONS performance index can be parsed into separate score for PONS trials considered negative or positive in terms of emotional valence of the stimuli. We followed up our PONS-total score analyses with our primary contrast of interest (S > D = N) applied to the PONS-negative and PONS-positive scores. For the PONS-negative score, this contrast was significant, $t(90) = 2.75$, $p < .005$ (one-tailed), $r_{contrast} = .28$; whereas, it was not significant for the PONS-positive score $t(90) = 0.60$, $p = .55$ (one-tailed), $r_{contrast} = .06$. The normal and depression-vulnerable groups, holding aside the schizotypes, did not differ significantly from each other on either the PONS-positive or PONS-negative scores.

Sensitivity Analyses

Table 3 lists the means and standard deviations of additional descriptors for the three groups, including mood (BDI–II and PANAS), schizotypal personality traits (SPQ), and intellectual processing speed (WAIS–III Digit Symbol Coding). As expected, the schizotypes had the highest SPQ scores. Contrast analyses revealed that both contrasts (S < D = N and S = D < N) were highly significant, $t(89) = -6.30$, $p < .001$ and $t(89) = 9.07$, $p < .001$. Both psychopathology vulnerable groups had higher BDI–II scores than normal subjects, and differed from each other, $t(88) = 3.09$, $p < .03$. Psychopathology vulnerable groups also had lower state and trait levels of positive affect than normal subjects, $t(90) = 2.25$, $p = .03$ and $t(89) = 3.28$, $p < .001$, and higher state and trait levels of negative affect, $t(90) = -3.99$, $p < .001$ and $t(89) = -3.62$, $p < .001$. No significant differences were found between the groups on the WAIS–III Digit Symbol Coding subtest

Table 3
Mood, Processing Speed, Attention, and Schizotypal Personality Traits

	Schizotypes (n = 26)	Depression Vulnerable (n = 36)	Normals (n = 31)
Measure	M (SD)	M (SD)	M (SD)
BDI–II	15.3 (14.1)	13.1 (7.2)	3.8 (6.2)
PANAS			
NA–State	15.6 (5.4)	15.7 (4.9)	12.4 (2.7)
NA–Trait	20.7 (6.5)	20.7 (6.5)	15.7 (5.0)
PA–State	28.7 (8.9)	25.1 (6.8)	30.7 (7.8)
PA–Trait	33.3 (7.8)	28.4 (6.4)	35.7 (5.8)
Digit Symbol	11.7 (2.7)	12.1 (2.0)	12.0 (2.6)
SPQ	34.2 (13.3)	23.1 (9.8)	9.7 (7.9)

Note. BDI–II = Beck Depression Inventory–II; PANAS = Positive and Negative Affect Scale; NA = Negative Affect; PA = Positive Affect; Digit Symbol Coding = WAIS–III Digit Symbol Coding Scaled score; SPQ = Schizotypal Personality Questionnaire.

(digit symbol), $F(2, 86) = 0.24$, $p = .78$. Bivariate correlations were also examined between the PONS-total and these additional descriptors (see Table 4). The PONS-total was correlated with digit symbol, $r = .34$, $p < .001$, and with state positive affect, $r = -.23$, $p < .05$.

We conducted sensitivity analyses, guided by both theoretical and statistical considerations, to address these correlations. First, based on statistically significant bivariate correlations, mindful of the Miller and Chapman (2001) caveats, analysis of covariance (ANCOVA) was used to examine the effect for subject group net of the effects of digit symbol scores (the covariate). The main effect for group for the PONS-total score remained significant, $F(2, 85) = 3.37$, $p < .04$. To supplement the unfocused ANCOVA, we used linear regression remove the variance in PONS-total scores attributable to digit symbol and then retained the standardized residuals. The primary focused contrast for the study (S < D = N) was then recomputed using these residualized PONS-total scores and this yielded the same results in support of the specific deficit for schizotypes, $t(86) = -2.58$, $p = .012$. The same procedure was used to analyze the impact of state positive affect on PONS-total performance. The unfocused ANCOVA examining state positive affect as the covariate, group as the between-subjects factor, and PONS-total score as the dependent variable, revealed a trend for a main effect of group, $F(2, 85) = 2.24$, $p < .056$ (one-tailed). Then, when the core contrast (S < D = N) was recomputed on the standardized residuals, results supportive of the specific deficit for schizotypes was found, $t(90) = -2.12$, $p < .019$ (one-tailed). Thus, despite the statistical association of digit symbol and state positive affect with the PONS total score, the schizotype group still performed worse than both the depression vulnerable and normal control groups on the PONS after removal of these covariates.

In this context, we also note that supplementary statistical analyses taking medication into account revealed that psychotropic medication status was essentially unrelated to differences in PONS performance across the groups for the total, negative, and positive PONS scores. Finally, as noted above, there were four schizotypes who had depression vulnerability scores that were somewhat elevated (in addition to their clear-cut substantial elevations on the schizotypy indexes) and these subjects were retained in the prior analyses of the schizotypy group performance nonetheless given a strong a priori theoretical reasons and an empirical basis for doing so (Lenzenweger, 2010; Lenzenweger & Loranger, 1989; Meehl, 1962, 1990, 2001). Even so, we completed a parallel series of statistical analyses in which these four schizotypes were deleted from the schizotypy sample for the PONS-total, PONS-negative, and PONS-positive scores. We reevaluated the central planned "specificity" contrast (contrast weights: schizotypes −2, normal 1, depression vulnerability 1) with the reduced schizotypy sample. In short, the results for the reduced sample were entirely consistent with those reported above: PONS-total, $t(86) = 2.27$, $p < .02$ (one-tailed); PONS-negative, $t(86) = 2.96$, $p < .002$; and PONS-positive, $t(86) = .55$, $p > .58$. This pattern is clearly even stronger than those reported above and indicate that inclusion of the four schizotypes in the original total sample did not account for the results in the total sample.

Theory, clinical observation, and data from nonclinical samples (e.g., Ambady & Gray, 2002) suggest that current mental state dysphoria features are associated with interpersonal sensitivity scores. Thus, the same procedure outlined above (first ANCOVA, then one-way ANOVA on standardized residuals, followed by

Table 4
Bivariate Correlations Between PONS Total and Control Variables

Measure	PONS-total
BDI–II	−.09
PANAS	
NA–State	−.14
NA–Trait	−.19†
PA–State	−.23*
PA–Trait	−.14
Digit Symbol	.34**
SPQ	.20†

Note. Values are Pearson product-moment correlation coefficients. PONS = Profile of Nonverbal Sensitivity; BDI–II = Beck Depression Inventory–II; PANAS = Positive and Negative Affect Scale; NA = Negative Affect; PA = Positive Affect; Digit Symbol = WAIS–III Digit Symbol Coding Scaled score; SPQ = Schizotypal Personality Questionnaire.
† $p < .10$, one-tailed. * $p < .05$, two-tailed. ** $p < .001$, two-tailed.

focused linear contrasts) was used to examine the impact of negative affect and mood on the PONS-total. The results remained virtually the same in support of the specific deficit hypothesis (S < D = NC) when the effects attributable to negative affect were removed from the PONS-total scores, $t(90) = -1.96$, $p = .027$ (one-tailed), as well as when the effects of dysphoria (BDI–II) were removed from the PONS total scores, $t(88) = -2.24$, $p = .014$ (one-tailed).

Supplementary Analyses to Address Heterogeneity

Identification of a deviant subgroup of PONS performers. The problem of heterogeneity in schizophrenia research exists similarly in schizotypy research (Lenzenweger, 2010; Lenzenweger, Jensen, & Rubin, 2003). One methodological strategy to deal with this problem is to examine performance at the level of the individual to see if a "deviant subgroup" of subjects exists and examining how well they are classified into their respective groups (schizotypes, others [depression-vulnerable and controls collapsed]) based on their deviant performance classification (Cornblatt & Erlenmeyer-Kimling, 1985; see also Lenzenweger & Korfine, 1994). We employed this analytic strategy here to see if a deviant subject subgroup could be resolved from the study sample. The distribution of PONS-total scores for normal subjects was examined. A cut-score that identified the lowest performing quartile of normal subjects was identified for the PONS. All subjects (schizotypes, depression vulnerable, and normals) were then classified into one of two groups (deviant vs. nondeviant) based on their respective performance on the PONS (i.e., below or above the cut-score). Based on the deviance classifications, 42.31% of schizotypes were classified as deviant based on their PONS performance, as compared to 22.39% of both depression-vulnerable and normal controls combined, $\chi^2(1, N = 93) = 3.70$, $p = .027$ (one-tailed; Fisher's exact test, $p = .05$, one-tailed, exact); Mantel–Haenszel odds ratio estimate = 2.54 ($p < .03$, one-tailed). Overall, of those subjects classified as deviant on this measure of interpersonal sensitivity, a "deviant" subject was about twice as likely to come from the schizotype group.

Discussion

The study of social cognition in schizotypic subjects represents an excellent focus for experimental psychopathology research given (a) the rich theoretical and methodological corpus concerning social cognition in the normative literature, (b) the salience accorded to social–cognitive deficits in classic clinical descriptions of the schizotype (Meehl, 1962, 1990, 2001; Rado, 1960), and (c) the robust evidence for social skills and other social deficits in schizophrenia proper. The present study examined if interpersonal sensitivity deficits were evident in schizotypes relative to both depression vulnerable and normal control subjects. Evidence was found to support the specificity of interpersonal sensitivity deficits for schizotypes, relative to both control groups. The schizotypes demonstrated poorer performance on the PONS, a task that required them to judge nonverbal, posed, interpersonal social cues. More important, impairment on the PONS was not accounted for by differences across the study groups in intellectual processing speed, or different levels of state affect.[1] We examined individual differences on the PONS in search of a potential deviant subgroup of performers, which would be consistent with theoretical expectations (Lenzenweger, 2010; Lenzenweger & Korfine, 1994). We found that subjects scoring in the lowest quartile on the PONS were twice as likely to have been classified as a schizotype. Finally, it was apparent that the schizotypic subjects showed their worst performance, as a group, on the negatively valenced PONS stimuli, relative to the other two groups.

The results from the current study of nonpsychotic schizotypes mirrored previous findings demonstrating schizophrenic patients' impaired performance on the PONS (Sergi & Green, 2003; Toomey et al., 2002; Toomey et al., 1997). Are there studies of interpersonal sensitivity in nonpsychotic schizotypes? There was only one previous investigation of interpersonal sensitivity in schizotypes (i.e., biological relatives of patients with schizophrenia), which found schizotypes revealing a deficit on the

[1] Though not a focus of this study, we also note that performance on the PONS was unrelated to sustained attention performance in this sample.

PONS as compared to normal controls (Toomey et al., 1999). Of interest, McCown et al. (1989) found facial affect recognition deficits in schizotypes (relatives of patients with schizophrenia) when there was limited time to view still photographs. In the current study there too was a relationship between processing speed and the PONS, but controlling for this process did not account for the deficits observed in schizotype group.

In this context we note, using a different measure of interpersonal sensitivity that has not been used in research with patients with schizophrenia, Toomey and Schuldberg (1995) did not find differences between psychometrically defined schizotypes and normal controls; however, ceiling effects may have limited their ability to find true differences between the groups. Finally, Toomey and Schuldberg noted that the stimuli used in their study had limited ecological validity due to their static nature (still photographs).

What can these results tell us about the phenomenological experience of schizotypes? Everyday life is strewn with interactions in which it is often necessary to make judgments based on little information. In each of these interactions successfully "reading" others or "picking up" on both verbal and nonverbal cues regarding intent and meaning is critical; without such an implicit understanding of what is being communicated, the extent to which these interactions are rewarding and worthwhile, and not disadvantageous, may be considerable. Thus, the potential to translate these data into treatment strategies to help Cluster A personality disorder (e.g., schizotypal, paranoid, schizoid) and schizophrenic patients in social functioning exists.

The relative specificity of these deficits to the schizotypic group marks a first step in identifying a class of interpersonal sensitivity deficits that could serve as potential endophenotypes for schizophrenia. Deficits in interpersonal sensitivity may represent a potential endophenotype for the latent liability of schizophrenia (Gottesman & Gould, 2003; Lenzenweger, 1999). If so, it may be a useful research focus in efforts to better clarify the nature of the social deficits seen in patients with schizophrenia long before the process is corroded by illness effects, neuroleptic treatment, and deterioration.

Replication of these findings with an increased sample size is an obvious next step. In addition, future research should aim to compare the various dimensions (e.g., gender, posed vs. genuine, verbal vs. nonverbal, and the combination of these), in relation to positive versus negative affective valences and processing demands to further unpack the relationship that each of these variables has to interpersonal sensitivity in schizotypes. Concerning complexity, another important factor to consider is the type of nonverbal cue (i.e., body gesture, tone of voice), which also could not be adequately analyzed in the present study due to a lack of power. Further clarification of the hemispheric contributions to social cue perception and the role that attributional biases play in social cue perception should also be pursued. Another set of limitations speaks more broadly to the problems faced by experimental psychopathologists. Despite the strong psychometric properties of the screening and dependent measures employed, none of these measures is perfect and there remains the problem of heterogeneity (Lenzenweger, 1999; Lenzenweger et al., 2003) within groups selected for schizotypy. Our measures are not error-free rather they do generate false positives and false negatives, as well as can be associated with "unspecified" noise in our dependent variables. Thus, future work utilizing statistical methods aimed to deal with these problems (e.g., Lenzenweger et al., 2003), as well as refining the dependent measures that we use need to be continuously pursued.

In closing, this study was the first to investigate interpersonal sensitivity in schizotypes, selected using field standard methods in the psychometric tradition. Interpersonal sensitivity deficits were found in the schizotype group vis-à-vis the other two study groups, a finding that mirrors deficits seen in patients with schizophrenia. The study of deviant social cognition in pathological populations promises to have some bearing on our efforts to better understand those same processes in normal populations, while simultaneously offering some guidance regarding how to help patients. Our examination of the interpersonal sensitivity in schizotypes may provide additional leverage to efforts seeking to better understand the social functioning problems seen in patients with schizophrenia as well as Cluster A PDs in a translational research framework.

References

Alloy, L. B., Abramson, L. Y., Hogan, M. E., Whitehouse, W. G., Rose, D. T., Robinson, M. S., . . . Lapkin, J. B. (2000). The Temple–Wisconsin cognitive vulnerability to depression project: Lifetime history of Axis I psychopathology in individuals at high and low risk for depression. *Journal of Abnormal Psychology, 109,* 403–418. doi: 10.1037/0021-843X.109.3.403

Alloy, L. B., Abramson, L. Y., Whitehouse, W. G., Hogan, M. E., Tashman, N. A., Steinberg, D. L., . . . Donovan, P. (1999). Depressogenic cognitive styles: Predictive validity, information processing, and personality characteristics, and developmental origins. *Behaviour Research and Therapy, 37,* 503–531. doi: 10.1016/S0005-7967(98)00157-0

Ambady, N., Bernieri, F. J., & Richeson, J. A. (2000). Toward a histology of social behavior: Judgmental accuracy from thin slices of the behavioral stream. In M.P. Zanna (Ed.), *Experimental social psychology* (pp. 200–271). New York: Academic Press.

Ambady, N., & Gray, H. M. (2002). On being sad and mistaken: Mood effects on the accuracy of thin-slice judgments. *Journal of Personality and Social Psychology, 83,* 947–961. doi: 10.1037/0022-3514.83.4.947

Ambady, N., Hallahan, M., & Rosenthal, R. (1995). On judging and being judged accurately in zero acquaintance situations. *Journal of Personality and Social Psychology, 77,* 538–547. doi: 10.1037//0022-3514.69.3.518

Ambady, N., LaPlante, D., & Johnson, E. (2001). Thin-slice judgments as a measure of interpersonal sensitivity. In J. A. Hall & F. J. Bernieri (Eds.), *Interpersonal sensitivity: Theory and measurement* (pp. 89–101). Mahwah, NJ: Erlbaum.

Ambady, N., & Rosenthal, R. (1992). Thin slices of expressive behavior as predictors of interpersonal consequences: A meta-analysis. *Psychological Bulletin, 111,* 256–274. doi: 10.1037/0033-2909.111.2.256

American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3rd ed., revised). Washington, DC: Author.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Bänziger, T., Scherer, K. R., Hall, J. A., & Rosenthal, R. (2011). Introducing the MiniPONS: A short multichannel version of the Profile of Nonverbal Sensitivity (PONS). *Journal of Nonverbal Behavior, 35,* 189–204. doi: 10.1007/s10919-011-0108-3

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory manual* (2nd ed.). San Antonio, TX: Psychological Corporation.

Bentall, R. P., Cornoran, R., Howard, R., Blackwood, N., & Kinderman, P. (2001). Persecutory delusions: A review and theoretical integration. *Clinical Psychology Review, 21,* 1143–1192.

Bleuler, E. (1911/1950). Dementia praecox or the group of schizophrenias. (J. Zinkin, Trans.). New York: International Universities Press.

Chapman, L. J., & Chapman, J. (1985). Psychosis proneness. In M. Alpert (Ed.), *Controversies in schizophrenia: Changes and constancies* (pp. 157–172). New York, NY: Guilford Press.

Chapman, L. J., Chapman, J. P., Kwapil, T. R., Eckblad, M., & Zinser, M. (1994). Putatively psychosis-prone subjects ten years later. *Journal of Abnormal Psychology, 103,* 171–183. doi:10.1037/0021-843X.103.2.171

Chapman, L. J., Chapman, J. P., & Raulin, M. (1978). Body image aberration in schizophrenia. *Journal of Abnormal Psychology, 87,* 399–407. doi: 10.1037/0021-843X.87.4.399

Cornblatt, B. A., & Erlenmeyer-Kimling, L. (1985). Global attentional deviances as a marker of risk for schizophrenia: Specificity and predictive validity. *Journal of Abnormal Psychology, 94,* 470–486. doi: 10.1037/0021-843X.94.4.470

Courtney, C. G., Dawson, M. E., Schell, A. M., Iyer, A., & Parsons, T. D. (2010). Better than the real thing: Eliciting fear with moving and static computer-generated stimuli. *International Journal of Psychophysiology, 78,* 107–114. doi: 10.1016/j.ijpsycho.2010.06.028

Eckblad, M., & Chapman, L. (1983). Magical ideation as an indicator of schizotypy. *Journal of Consulting and Clinical Psychology, 51,* 215–225. doi: 10.1037/0022-006X.51.2.215

Gibson, C. M., Penn, D. L., Prinstein, M. J., Perkins, D. O., & Belger, A. (2010). Social skill and social cognition in adolescents at genetic risk for psychosis. *Schizophrenia Research, 122,* 179–184. doi: 10.1016/j.schres.2010.04.018

Gottesman, I. I., & Gould, T. (2003). The endophenotype concept in psychiatry: Etymology and strategic intentions. *American Journal of Psychiatry, 160,* 636–645. doi: 10.1176/appi.ajp.160.4.636

Gur, R. C., Sara, R., Hagendoorn, M., Marom, O., Hughett, P., Macy, L., Turner, T., Bajcsy, R., Posner, A., & Gur, R. E. (2002). A method for obtaining 3-dimensional facial expressions and its standardization for use in neurocognitive studies. *Journal of Neuroscience Methods, 115,* 137–143.

Hall, J. A. (2001). The PONS test and psychometric approach to measuring interpersonal sensitivity. In J. A. Hall & F. J. Bernieri (Eds.), *Interpersonal sensitivity: Theory and measurement* (pp. 143–160). Mahwah, NJ: Erlbaum.

Hall, J. A., Andrzejewski, S. A., & Yopchick, J. E. (2009). Psychosocial correlates of interpersonal sensitivity: A meta-analysis. *Journal of Nonverbal*

Behavior, 33, 149–180. doi: 10.1007/s10919-009-0070-5

Hankin, B. L., Abramson, L. Y., Miller, N., & Haeffel, G. J. (2004). Cognitive vulnerability-stress theories of depression: Examining affective specificity in the prediction of depression versus anxiety in three prospective studies. *Cognitive Therapy and Research, 28,* 309–345. doi: 10.1023/B:COTR.0000031805.60529.0d

Jackson, D. (1984). *Manual for the Personality Research Form* (3rd ed.). Port Huron, MI: Research Psychologists Press.

Joiner, T. E. (2000). Depression's vicious scree: Self-propagating and erosive processes in depression chronicity. *Clinical Psychology: Science and Practice, 7,* 203–218. doi: 10.1093/clipsy.7.2.203

Joy, S., Fein, D., & Kaplan, E. (2003). Decoding digit symbol. *Assessment, 10,* 56–65. doi: 10.1177/0095399702250335

Kraepelin, E. (1919/1971). *Dementia praecox and paraphrenia* (R. M. Barclay, Trans., G. M. Robertson, Ed.). Huntington, NY: Krieger. (Original work published 1909–1913; original translation of selected portions published 1919.)

Kwapil, T. (1998). *Normative data for the University of Wisconsin psychosis-proneness scales.* Unpublished manual. Department of Psychology, University of North Carolina at Greensboro: Greensboro, NC.

Lenzenweger, M. F. (1994). Psychometric high-risk paradigm, perceptual aberrations, and schizotypy: An update. *Schizophrenia Bulletin, 20,* 121–135.

Lenzenweger, M. F. (1999). Schizophrenia: Refining the phenotype, resolving endophenotypes. *Behaviour Research and Therapy, 37,* 281–295. doi: 10.1016/S0005-7967(98)00138-7

Lenzenweger, M. F. (2010). *Schizotypy and schizophrenia: The view from experimental psychopathology.* New York, NY: Guilford.

Lenzenweger, M. F., & Dworkin, R. (1996). The dimensions of schizophrenia phenomenology: Not one or two, at least three, perhaps four. *British Journal of Psychiatry, 168,* 432–440. doi: 10.1192/bjp.168.4.432

Lenzenweger, M. F., Jensen, S. T., & Rubin, D. B. (2003). Finding the "genuine" schizotype: A model and method for resolving heterogeneity in performance on laboratory measures in experimental psychopathology research. *Journal of Abnormal Psychology, 112,* 457–468. doi: 10.1037/0021-843X.112.3.457

Lenzenweger, M. F., & Korfine, L. (1994). Perceptual aberrations, schizotypy and the Wisconsin Card Sorting Test. *Schizophrenia Bulletin, 20,* 345–357.

Lenzenweger, M. F., & Loranger, A. W. (1989). Psychosis proneness and clinical psychopathology: Examination of the correlates of schizotypy. *Journal of Abnormal Psychology, 98,* 3–8. doi: 10.1037/0021-843X.98.1.3

Mayer, J. D., Salovey, P., & Caruso, D. R. (2002). Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) item booklet, Version 2.0. Toronto, Ontario, Canada: MHS Publishers.

McCown, W., Johnson, J., Austin, S., & Shefsky, M. (1989). Deficits in ability to decode facial affects in families of schizophrenics. *Psychotherapy in Private Practice, 6,* 93–101.

McDonald, S., Flanagan, S., Rollins, J., & Kinch, J. (2003). TASIT: A new clinical tool for assessing social perception after traumatic brain injury. *Journal of Head Trauma Rehabilitation, 18,* 219–238.

Meehl, P. E. (1962). Schizotaxia, schizotypy, and schizophrenia. *American Psychologist, 17,* 827–838. doi: 10.1037/h0041029

Meehl, P. E. (1990). Toward an integrated theory of schizotaxia, schizotypy, and schizophrenia. *Journal of Personality Disorders, 4,* 1–99. doi:10.1521/pedi.1990.4.1.1

Meehl, P. E. (2001). Primary and secondary hypohedonia. *Journal of Abnormal Psychology, 110,* 188–193. doi: 10.1037/0021-843X.110.1.188

Miller, G. A., & Chapman, J. P. (2001). Misunderstanding analysis of covariance. *Journal of Abnormal Psychology, 110,* 40–48. doi: 10.1037/0021-843X.110.1.40

Ochsner, K. N. (2008). The social-emotional processing stream: Five core constructs and their translational potential for schizophrenia and beyond. *Biological Psychiatry, 64,* 48–61. doi: 10.1016/j.biopsych.2008.04.024

Ostrom, T. (1984). The sovereignty of social cognition. In R. Wyer & T. Srull (Eds.), *Handbook of social cognition* (Vol. 1, pp. 1–37). Hillsdale, NJ: Erlbaum.

Penn, D. L., Corrigan, P. W., Bentall, R., Racenstein, J., & Newman, L. (1997). Social cognition in schizophrenia. *Psychological Bulletin, 121,* 114–132. doi: 10.1037/0033-2909.121.1.114

Peterson, C., Semmel, A., Von Baeyer, C., Abramson, L., Metalsky, G. I., & Seligman, M. E. P. (1982). The Attributional Style Questionnaire. *Cognitive Therapy and Research, 6,* 287–299. doi: 10.1007/BF01173577

Phillips, L. K., & Seidman, L. J. (2008). Emotion processing in persons at risk for schizophrenia. *Schizophrenia Bulletin, 34,* 888–903. doi: 10.1093/schbul/sbn085

Pinkham, A. E., Penn, D. L., Perkins, D. O., & Lieberman, J. (2003). Implications for the neural basis of social cognition for the study of schizophrenia. *American Journal of Psychiatry, 160,* 815–824. doi: 10.1176/appi.ajp.160.5.815

Polanyi, M. (1962). Tacit knowing: Its bearing on some problems of philosophy. *Reviews of Modern*

Physics, 34, 601–616. doi: 10.1103/RevModPhys.34.601

Rado, S. (1960). Theory and therapy: The theory of schizotypal organization and its application to the treatment of decompensated schizotypal behavior. In S. C. Scher & H. R. Davis (Eds.), *The outpatient treatment of schizophrenia* (pp. 87–101). New York, NY: Grune and Stratton.

Raine, A. (1991). The SPQ: A scale for the assessment of schizotypal personality based on *DSM–III–R* criteria. *Schizophrenia Bulletin, 17,* 555–564.

Robins, L. N., Cottler, L. B., Bucholz, K. K., Compton, W. M., North, C. S., & Rourke, K. M. (2000). *Diagnostic Interview Schedule for the* DSM–IV *(DIS–IV).* St. Louis, MO: Washington University.

Rosenthal, R., Hall, J. A., DiMatteo, M. R., Rogers, P. L., & Archer, D. (1979). *Sensitivity to nonverbal communication: The PONS test.* Baltimore, MD: Johns Hopkins University Press.

Rosenthal, R., Hall, J. A., DiMatteo, M. R., Rogers, P. L., & Archer, D. (2011). *Profile of Nonverbal Sensitivity (PONS test):Manual.* [Unpublished manuscript available from J. A. Hall, Northeastern University, Boston, MA]

Rosenthal, R., Rosnow, R., & Rubin, D. (2000). *Contrasts and effect sizes in behavioral research: A correlational approach.* New York, NY: Cambridge University Press.

Sergi, M. J., & Green, M. F. (2003). Social perception and early visual processing in schizophrenia. *Schizophrenia Research, 59,* 233–241. doi: 10.1016/S0920-9964(01)00405-4

Sergi, M. J., Rassovksy, Y., Nuechterlein, K. H., & Green, M. F. (2006). Social perception as a mediator of the influence of early visual processing on functional status in schizophrenia. *American Journal of Psychiatry, 163,* 448–454. doi: 10.1176/appi.ajp.163.3.448

Shean, G., Bell, E., & Cameron, C. D. (2007). Recognition of nonverbal affect and schizotypy. *Journal of Psychology, 141,* 281–291.

Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In A. H. Tuma & J. D. Maser (Eds.), *Anxiety and the anxiety disorders* (pp. 681–706). Hillsdale, NJ: Erlbaum.

Toomey, R., & Schuldberg, D. (1995). Recognition and judgment of facial stimuli in schizotypal subjects. *Journal of Communication Disorders, 28,* 193–203. doi: 10.1016/0021-9924(94)00008-N

Toomey, R., Schuldberg, D., Corrigan, P., & Green, M. F. (2002). Nonverbal social perception and symptomatology in schizophrenia. *Schizophrenia Research, 53,* 83–91. doi: 10.1016/S0920-9964(01)00177-3

Toomey, R., Seidman, L., Lyones, M. Faraone, S., & Tsuang, M. (1999). Poor perception of nonverbal social-emotional cues in relatives of schizophrenia patients. *Schizophrenia Research, 40,* 121–130. doi: 10.1016/S0920-9964(99)00036-5

Toomey, R., Wallace, C. J., Corrigan, P. W., Schuldberg, D., & Green, M. F. (1997). Social processing correlates of nonverbal social perception in schizophrenia. *Psychiatry, 60,* 292–300.

Watson, D., Clark, L., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063–1070. doi: 10.1037/0022-3514.54.6.1063

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale—Technical manual* (3rd ed.). San Antonio, TX: Psychological Corporation.

Wynn, J. K., Sergi, M. J., Dawson, M. E., Schell, A. M., & Green, M. F. (2005). Sensorimotor gating, orienting and social perception in schizophrenia. *Schizophrenia Research, 73,* 319–325. doi: 10.1016/j.schres.2004.07.013