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Functional significance of preserved affect recognition in schizophrenia

Joanna M. Fiszdon *, Jason K. Johannesen

Yale University, Department of Psychiatry, New Haven, CT, USA
VA Connecticut Healthcare System, Psychology Service, West Haven, CT, USA

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ABSTRACT

Affect recognition (AR) is a core component of social information processing; thus, it may be critical to understanding social behavior and functioning in broader aspects of daily living. Deficits in AR are well documented in schizophrenia, but there is also evidence that many individuals with schizophrenia perform AR tasks at near-normal levels. In the current study, we sought to evaluate the functional significance of AR deficits in schizophrenia by comparing subgroups with normal-range and impaired AR performance on proxy and interviewer-rated measures of real-world functioning. Schizophrenia outpatients were classified as normal-range ($N=17$) and impaired ($N=31$) based on a logistic cut point in the sample distribution of Bell-Lysaker Emotion Recognition Task (BLERT) scores, referenced to a normative sample of healthy control subjects ($N=56$). The derived schizophrenia subgroups were then compared on proxy [University of California San Diego Performance-Based Skill Assessment (UPSA), Social Skills Performance Assessment (SSPA), Medication Management Ability Assessment (MMAA)] and interviewer-rated [Quality of Life Scale (QLS), Independent Living Skills Survey (ILSS)] measures of functioning, as well as a battery of neurocognitive tests. Initial analyses indicated superior MMAA and QLS performance in the near-normal AR subgroup. Covariate analyses indicated that group differences in neurocognition fully mediated the observed associations between AR and MMAA, and attenuated the observed relationships between AR classification and QLS. These results support three main conclusions. First, AR, like many other domains of psychopathology studied in schizophrenia, is preserved in select subgroups. Second, there is a positive relationship between AR performance and functional outcome measures. Third, neurocognition appears to mediate the relationship between AR and measures of functioning.

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1. Introduction

Deficits in the ability to correctly interpret emotional cues, commonly referred to as affect recognition (AR), have been well documented in schizophrenia (Morrison et al., 1988; Mandal et al., 1998; Edwards et al., 2002; Brekke et al., 2005; Hoekert et al., 2007; Pinkham et al., 2007). It is now generally accepted that patients exhibit marked impairment on measures of AR relative to healthy comparison groups, that these differences are detectable before the onset of psychotic symptoms, and that deficits persist through changes in clinical and treatment status (Lewis and Garver, 1995; Pinkham et al., 2007; Sergi et al., 2007; Addington et al., 2008; Penn et al., 2008). Psychophysiological studies of schizophrenia have shown abnormalities in neuronal processes underlying AR, including visual encoding of structural facial features (Turetsky et al., 2007) and subsequent decoding of facial affect features (Wynn et al., 2008). AR has also been linked to primary targets of psychiatric rehabilitation for schizophrenia, including neurocognitive ability (Bryson et al., 1997), social competence (Mueser et al., 1996), and work behavior (Vauth et al., 2004), as well as rate of improvement in general functioning during psychosocial rehabilitation (Brekke et al., 2007). Importantly, AR may be a mediator of the relationship between neurocognition and functional outcomes in schizophrenia (Vauth et al., 2004; Brekke et al., 2005; Addington et al., 2006; Sergi et al., 2006). Taken together, these findings make clear why psychosocial interventions designed to restore functional capacities in schizophrenia have placed such emphasis on this fundamental social cognitive process (Penn and Combs, 2000; Wolwer et al., 2005; Penn et al., 2007; Horan et al., 2008; Kern et al., 2009).

There are many reasons to suggest that AR deficits could have profound impact on real-world functional outcomes in schizophrenia. Much of the social world is communicated through emotive cues exchanged in social encounters, and social competence is highly dependent on the ability to accurately decipher and integrate these cues with personal behavior. Because social interaction is instrumental to many daily activities, the ability to effectively manage social interactions becomes increasingly important as individuals engage in more complex community living tasks. Consistent with this premise, there is empirical support for associations between AR and various measures of community functioning (Couture et al., 2006). For example,

* Corresponding author. Psychology Service 116B, VA Connecticut Healthcare System, West Haven, CT, 06516, USA. Tel.: +1 203 932 5711x2231.
E-mail address: Joanna.Fiszdon@yale.edu (J.M. Fiszdon).

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AR performance has been found to correlate significantly with repeated measures of independent living and social and work functioning taken 12 months apart (Kee et al., 2003; Brekke et al., 2005). Other studies report correlations between AR performance and interview ratings of communication and occupational dysfunction (Hooker and Park, 2002), and quality of life (Poole et al., 2000; Addington et al., 2006).

Despite considerable attention given to AR deficits in schizophrenia research over recent years, important questions remain unanswered. A central issue still under investigation is whether impaired AR performance reflects a specific deficit in the processing of emotive cues or, instead, a manifestation of more generalized neurocognitive impairments in schizophrenia (Chapman and Chapman, 1978; Kerr and Neale, 1993; Miller et al., 1995; Mueser et al., 1996; Salem et al., 1996; Silverstein, 1997; Penn et al., 2000; Silverstein, 2008). In the former case, links between affect recognition and community functioning would be independent of shared associations with neurocognitive ability, while in the latter case this relationship would be fully mediated by general neurocognitive ability. Laboratory tests of affect recognition have typically involved the identification of facial emotional expressions presented in still photographs, or emotional states expressed through affective prosody (Edwards et al., 2002). These tests tend to provide emotive labels in an effort to reduce performance differences related to vocabulary and would not be expected to place high demand on the neurocognitive abilities often found impaired in schizophrenia, such as processing speed, verbal memory, and executive function. Nevertheless, one study found that neuropsychological test performance in these domains accounted for approximately one third of the variance in AR scores (Bryson et al., 1997), while another concluded that affect recognition deficits in schizophrenia can be fundamentally attributed to basic neurocognitive impairment, particularly in attention and executive functions (Bozikas et al., 2004). As noted elsewhere (Addington et al., 2006), reports of shared variance between neurocognition and broader indices of social functioning have ranged from as little as 10% to as much as 50% in studies of schizophrenia.

A second issue pertains to variability in the severity of observed AR impairments. Despite extensive reports of deficient affect recognition in schizophrenia, there is also evidence that some individuals may have only mild impairment or near-normal performance (Bell et al., 1997; Bryson et al., 1997; Nelson et al., 2007). Nelson et al. (2007) report that in a sample of 100 schizophrenia patients, two approximately equal-sized clusters were identified with different degrees of affect recognition deficits; one characterized by deficits in the mild to moderate range, the other characterized by more severe deficits. In other work, Bell et al. (1997) found that although the majority of 50 individuals with schizophrenia evidenced moderate to severe impairment on an audiovisual AR task, the Bell-Lysaker Emotion Recognition Task (BLERT), 42% had scores fully within the range of the healthy comparison sample. Accordingly, it is possible that AR deficits are prominent within only a subgroup of individuals diagnosed with schizophrenia, while AR is relatively spared in others.

With these issues in mind, the present study sought to answer questions concerning the functional implications of AR deficits in schizophrenia by comparing subgroups characterized by impaired and normal-range AR performance. Most previous studies of AR in schizophrenia have been correlational in design and included only schizophrenia patient samples. While this research has been informative regarding interrelationships between AR and other clinical features of schizophrenia, results cannot be meaningfully interpreted in terms of a putative deficit when presented without reference to normative parameters. This issue is particularly critical in the social cognitive area of schizophrenia research due to the fact that commonly used measures, including tests of AR, generally lack norms for interpreting performance levels. To circumvent this limitation, the current study used the overlap in AR score distributions between schizophrenia and healthy community participants to identify a cut point that effectively distinguished normal-range from impaired performance. Schizophrenia participants scoring above (normal-range affect recognition) and below (impaired affect recognition) this cut point were compared on a battery of proxy and interviewer-rated measures of functioning. Our primary aim was to shed light on a basic question concerning the psychosocial remediation of affect recognition deficits in schizophrenia, that is, if impaired AR can be restored, what differences in functioning could also be expected? To conclude that AR is related to functional outcome, we first tested the hypothesis that schizophrenia patients with normal AR performance would have higher functioning than those with impaired AR. A secondary aim was to evaluate the extent to which a specific impairment of AR can be differentiated from generalized neurocognitive deficit. This possibility was examined in two ways, first by comparing the derived subgroups on a battery of neurocognitive tests and, second, by evaluating the mediating effect of neurocognition on predicted differences in functioning. To conclude that AR impairment is dissociable from a generalized deficit, we tested the hypotheses that derived subgroups would be equivalent on basic neurocognitive ability, and that group differences on measures of functioning would be detected while controlling for neurocognitive ability.

2. Method

2.1. Participants

Participants in the study were 56 healthy controls and 48 schizophrenia outpatients. Healthy controls were recruited from the community for single-session assessments of affect recognition and met the following inclusion criteria: no Axis I psychiatric diagnosis, aged 18–65, no visual or auditory impairment that would interfere with study procedures, and no documented mental retardation. Schizophrenia patients were recruited as part of an ongoing study of cognitive remediation in schizophrenia at VA Connecticut Healthcare System and met the following inclusion criteria: Axis I diagnosis of schizophrenia or schizoaffective disorder, aged 18–65, no current substance dependence, psychiatric stability as evidenced by no medication changes and no housing changes in past 30 days. All diagnostic interviews were performed by the first author using the Structured Clinical Interview for DSM-IV (SCID; First et al., 1996). For the current analyses, affect recognition data from healthy community controls were only used to establish guidelines for what constitutes normal-range performance. All other analyses were performed only for the schizophrenia sample, using baseline affect recognition, neurocognition and functioning data. The local Institutional Review Boards approved study protocols, and all participants signed written informed consent.

2.2. Measures

2.2.1. Affect recognition

2.2.1.1. Bell-Lysaker Emotion Recognition Task. The BLERT (Bell et al., 1997) is an affect recognition task. The examinee is presented with short video vignettes where the actor reads one of three neutral scripts while portraying one of seven emotions (happiness, sadness, anger, fear, surprise, disgust, no emotion). Each script is crossed with each of the seven emotions, resulting in 21 video vignettes in total. Participants are provided with a list of the seven emotions from which to choose the correct answer for each vignette. Scores range from 0 to 21. For additional information on this task, the reader is referred to Bryson et al. (1997, 1998). The affect recognition measure was administered to both healthy community controls and schizophrenia patients.

2.2.2. Neurocognition

A comprehensive neuropsychological battery was administered to schizophrenia patients at study baseline. This battery included measures of attention/vigilance (Continuous Performance Test; CPT; Loong, 1991), processing speed (Trails A; Reitan and Wolfson, 1985), verbal and visual memory (Logical Memory subscale of the Wechsler Memory Scale, Revised, WMS-R, Wechsler, 1987; California Verbal Learning Test; CVLT, Delis et al., 2000; Rey-Osterrieth Complex Figure Test; RCFT, Osterreith, 1944), verbal fluency (Controlled Oral Word Association Test; COWAT, Benton, 1968), and executive function (Trails B, Reitan and Wolfson, 1985; Wisconsin Card Sorting Test; WCST, Heaton, 1981). An estimate of current general intelligence was obtained based on the two-subtest (Vocabulary and Matrix Reasoning) version of the Wechsler Abbreviated Scale of Intelligence (WASI, Wechsler, 1999).

2.2.3. Proxy measures of functioning

2.2.3.1. Medication Management Ability Assessment (MMAA) (Patterson et al., 2002). The MMA is a performance-based measure of the ability to manage medication regimens. Examinees are provided with four different medication bottles, which are labeled with the specific directions for taking each of the medications. Each medication has different directions for taking it (i.e. how many times per day, how many pills, whether with or without food). Examinees are then asked to walk the examiner through their day—when they would wake up, when they would take each of the various pills, and when they would eat meals, while handing the appropriate pills to the examiner. The total MMAA score ranges from 0 to 37 and is computed based on whether the correct number of each pill is taken, whether the pills are taken the correct number of times per day, and whether the pills are taken with or without food.

2.2.3.2. Social Skills Performance Assessment (SSPA) (Patterson et al., 2001b). The SSPA is a performance-based measure of social competence. Examinees are asked to engage in two brief standardized role-plays with the examiner (meeting a new neighbor and calling a landlord about a leak). For each role-play, Likert-type ratings are made in different areas of performance (i.e. social appropriateness, clarity, focus). SSPA scores for each of the two scenes are computed by averaging ratings for each performance item, and range from 1 to 5. For the current analyses, scores from the two role-plays were averaged, and ranged from 1 to 5.

2.2.3.3. UCSD Performance-Based Skill Assessment (UPSA) (Patterson et al., 2001a). The UPSA is a performance-based measure of everyday functioning. Five skill domains are measured: planning recreational activities, communication, transportation, finances, and household chores. Standardized role-plays are used in each domain, such as giving the examinee a gas bill and asking her to write out a check to pay the bill, asking the examinee to call a doctor's office to reschedule an appointment, and asking the examinee to indicate what items she would bring on an all-day trip to the beach. Total UPSA scores range from 0 to 100.

2.2.4. Interviewer-rated functioning

2.2.4.1. Independent Living Skill Survey—Self Report (ILSS-SR) (Wallace et al., 2000). The ILSS-SR is an interviewer-administered self-report measure of basic community living skills assessing 10 domains: personal hygiene, appearance and clothing, care of personal possessions and living space, food preparation, care of personal health, money management, leisure activities, transportation, job-seeking, and job maintenance. Examinees are read aloud questionnaire items and asked whether or not they have engaged in domain-relevant behaviors in the past 30 days. Examiners make additional observation-based ratings for personal hygiene and appearance and clothing. Scores for each domain are computed by averaging the number of yes (1) and no (0) responses, and an overall ILSS score, ranging from 0 to 1 is computed by averaging individual domain scores.

2.2.4.2. Quality of Life Scale (QLS) (Heinrichs et al., 1984). The QLS is a semi-structured interview assessing various components of functioning. Each of the 21 items is rated on a 0–6 Likert-type scale, with higher scores indicating better function. Scale items can be further grouped into four domains of function: Interpersonal Relations, Intrapsychic Foundations, Instrumental Role, and Common Objects and Activities. The total score ranges from 0 to 126, with higher scores indicative of better function.

2.3. Data analysis

The data were inspected for normality, and transformations were applied as necessary. Impaired and normal-range affect recognition subgroups were derived following a logistic regression method, used similarly elsewhere (Johannesen et al., 2008), in which BLERT total score was entered into a logistic regression analysis (classification cutoff = 0.50) as a predictor of diagnostic class (healthy control = 0; schizophrenia = 1). A 2 × 2 table was constructed to tabulate the partitioning of the entire sample based on known and predicted diagnostic class. The schizophrenia sample was then assigned to subgroups based on predicted classifications, with those misclassified as healthy assigned to the "normal-range AR" group and those accurately classified as schizophrenic assigned to the "impaired AR" group. *T*-tests and chi-square analyses were then conducted to compare these two subgroups on baseline demographics to identify covariates for subsequent analyses. Comparison of neuropsychological test results was then conducted to identify the cognitive domains most sensitive to differences in level of affect recognition. Test values that differed between the two AR groups were first standardized by *z*-transform across the entire schizophrenia sample and then averaged to create a cognitive composite factor score. Dependent measures were inspected for outliers using the Box Plot function of SPSS v. 14 (SPSS, Inc.). No extreme outliers were identified using the criterion of 3 times the interquartile range.

Main contrasts were tested on the derived normal-range and impaired AR subgroups. Two multivariate analyses of variance (MANOVAs) were performed, one for proxy measures of function (SSPA, MMAA, UPSA), and one for interviewer-rated measures of function (QLS, ILSS). In cases where the groups differed on a functional outcome measure with numerous sub-domains, separate MANOVAs were conducted to determine which domain scores contributed most to between-group differences. Finally, MANOVA analyses were repeated with the cognitive composite entered as a covariate in order to parse out the unique contribution of differences in affect recognition ability to observed group effects.

3. Results

Healthy community controls were on average 42.14 (13.03) years old, and had 14.95 (2.78) years of education. Twenty-seven (48.2%) were female, thirty-six (64.3%) were Caucasian, and twenty-eight (50%) had never been married. Schizophrenia patients were on average 48.85 (8.73) years old, and had 12.38(1.83) years of education. Average age of onset was 22.64 (6.16). Nine (18.8%) were female, twenty-seven (56.2%) were Caucasian, and thirty-one (64.6%) had never been married. Eight (16.7%) had a diagnosis of schizoaffective disorder, with the remainder having schizophrenia diagnoses. The total Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987) score was 54.88 (12.91), suggestive of moderate symptom severity overall. The healthy community control and schizophrenia samples differed significantly on age, education, and gender, but not on race or marital status.

Due to a skewed distribution, Blom's transform was applied to MMAA and UPSA scores. Three subjects were unable or refused to complete the MMAA; therefore, the sample size was $N = 45$ for analyses that included this variable. For all other variables, distributional properties were acceptable, and non-transformed values were used for analyses.

Initial comparison of BLERT scores between schizophrenia [13.44 (3.83)] and healthy control participants [17.32(2.70)] confirmed that, overall, performance in the patient sample was significantly lower [$t(102) = 6.04$, $P < 0.001$]. An empirically derived cut point for separating normal-range from impaired AR was established based on logistic regression results; those with BLERT scores of 16 or above were classified as healthy controls. Overall classification accuracy was 71.2%, with 64.6% ($N = 31$) of schizophrenia patients and 76.8% ($N = 43$) of healthy controls accurately classified into their respective groups. Accordingly, 35% ($N = 17$) of the schizophrenia patients had BLERT performance in the healthy control range, and were thus considered "normal-range AR".

Sample characteristics for the two AR subgroups are presented in Table 1. Three between-group differences were noted. First, while Global Assessment of Functioning (GAF) scores indicate serious symptomatic and functional impairment in this schizophrenia sample generally, those classified as impaired AR scored significantly lower than those with preserved AR. Second, the impaired AR subgroup scored significantly lower on a measure of estimated intellectual function (WASI FSIQ). Third, performance on the following neuropsychological variables differed significantly between groups: WCST number of perseverative errors, CPT, CVLT trials 1–5 Total, WMS-R Logical Memory I, and COWAT letter fluency. These neuropsychological measures were combined as a cognitive composite score, based on the average of *z*-transformed scores taken across this sample. Correlational analyses conducted within the schizophrenia sample indicated a strong association between cognitive composite scores and BLERT performance (Table 2), supporting the use of this score as a reasonable index of differences in neurocognitive ability between AR subgroups.

MANOVA comparing the normal-range vs. impaired AR schizophrenia groups on proxy measures of functioning (UPSA, MMAA, SSPA) was significant [$F(3, 41) = 3.28$, $P < 0.05$]. The simple between-group comparisons indicated a significant group difference on the MMAA only [$F(1, 44) = 9.45$, $P < 0.01$], with the normal-range AR group having better performance. A MANOVA comparing the two schizophrenia groups on interviewer-rated measures of functioning (ILSS, QLS) was also significant [$F(2, 45) = 4.40$, $P < 0.05$]. The simple between-group comparisons indicated a significant group difference on the QLS only [$F(1, 47) = 4.40$, $P < 0.05$], with higher scores observed in the normal-range AR group. An additional MANOVA comparing the two schizophrenia groups on the four domain scores of the QLS (Intrapsychic Foundations, Interpersonal Function, Instrumental Role, and Common Objects and Activities) was significant [$F(4, 43) = 3.40$, $P < 0.05$]. The simple between-group comparisons indicated a significant group difference on the Intrapsychic Foundations domain [$F(1, 47) = 10.49$, $P < 0.01$], and the Common Objects and Activities domain [$F(1, 47) = 7.86$, $P < 0.01$], with the Instrumental Role domain approaching significance [$F(1, 47) = 3.53$, $P = 0.07$]. All differences were in the expected direction.

Table 1
Sample characteristics for normal-range and impaired AR schizophrenia patients.

Variable	Normal-range AR M(S.D.) (range) $N=17$	Impaired AR M(S.D.) (range) $N=31$	t or χ^2	P-value
BLERT	17.18(1.29) (16–21)	11.39(3.13) (4–15)	7.28	<0.01**
Age	48.24(10.31) (27–63)	49.19(7.89) (32–60)	−0.36	0.72
Education	12.29(2.11) (7–15)	12.42(1.69) (7–16)	−0.23	0.82
Gender (% male)	71%	87%	1.96	0.16
Marital (% ever married)	35%	35%	<0.01	0.99
Race (% white)	53%	58%	0.12	0.73
PANSS total	52.76(9.87) (38–69)	56.03(13.04) (39–93)	−0.90	0.37
GAF score	42.24(4.37) (33–50)	36.93(6.71) (25–50)	3.21	<0.01**
Current IQ	102.29(16.00) (75–134)	92.10(13.25) (65–125)	2.70	0.02*
WCST	100.59(20.57) (55–145)	81.32(17.92) (55–116)	3.38	<0.01**
CPT	95.08(7.56) (68–100)	85.54(18.60) (24–100)	2.37	0.02*
Trails A	42.29(9.07) (26–55)	39.10(7.53) (20–51)	1.31	0.20
Trails B	44.00(12.03) (20–63)	39.16(10.91) (18–63)	1.42	0.16
CVLT	48.82(10.36) (35–77)	40.39(11.77) (24–70)	2.47	<0.05*
RCFT	36.00(14.87) (20–72)	28.36(10.69) (20–54)	1.95	0.06
WMS-R LM I	53.59(29.34) (6–95)	27.13(20.52) (3–70)	3.66	<0.01**
COWAT letter	50.88(8.73) (34–64)	39.16(8.49) (26–63)	4.53	<0.01**
COWAT animal	43.00(9.57) (28–57)	37.03(10.83) (15–63)	1.90	0.06
ILSS	0.75(0.09) (0.56–0.88)	0.79(0.13) (0.46–1.00)	−1.13	0.26
QLS	73.41(15.82) (49–102)	63.23(16.24) (39–107)	2.10	<0.05*
UPSA	86.01(7.89) (61–96)	80.73(9.95) (45–95)	1.89	0.07
SSPA	4.00(0.55) (3.06–4.94)	3.92(0.72) (2.59–4.94)	0.43	0.67
MMAA	33.88(3.44) (27–37)	27.82(9.25) (4–37)	2.58	<0.05*

*0.05 level, **0.01 level (2-tailed). AR = Affect Recognition, PANSS = Positive and Negative Syndrome Scale, GAF = Global Assessment of Functioning; Current IQ = Wechsler Abbreviated Scale of Intelligence full-scale IQ estimate; BLERT = Bell-Lysaker Affect Recognition Task, WCST = Wisconsin Card Sorting Test, Number Perseverative Errors standard score; CPT = Continuous Performance Test, relative %; CVLT = California Verbal Learning Test, Trials 1–5 standard score; RCFT = Rey-Osterrieth Complex Figure Task, immediate recall age corrected T; WMS-R LM I = Wechsler Memory Scale revised Logical Memory I percentile equivalent; COWAT = Controlled Oral Word Association Test standard scores; ILSS = Independent Living Skills Survey; QLS = Quality of Life Scale; UPSA = UCSD Performance-Based Skill Assessment; SSPA = Social Skills Performance Assessment; MMAA = Medication Management Ability Assessment.

When the above analyses were re-run, adding the cognitive composite as a covariate, the cognitive composite entered significantly in the proxy measures analysis [$F(2, 40)=5.19$, $P<0.01$], and the between-group differences were reduced to below statistical significance [$F(2, 44)=0.65$, $P=0.50$]. When the cognitive composite covariate was added to the primary interviewer-rated analyses (ILSS and QLS total), the covariate did not enter [$F(2, 44)=0.81$, $P=0.45$], and a significant multivariate between-group difference remained [$F(2, 44)=3.45$, $P<0.05$]. However, when this MANCOVA was repeated in a separate analysis of the four QLS domains, the previous multivariate group effect and the simple main effects for the individual QLS domains were reduced to below statistically significant levels.

Table 2
Bivariate correlations (and significance level) for affect recognition, cognition, and functional outcome variables.

	Cognitive composite	BLERT	UPSA	SSPA	MMAA	ILSS	QLS
Cognitive composite	–						
BLERT	0.75** (0.00)	–					
UPSA	0.55** (0.00)	0.49** (0.00)	–				
SSPA	0.33* (0.02)	0.28 (0.12)	0.33* (0.02)	–			
MMAA	0.58** (0.00)	0.52** (0.00)	0.33* (0.03)	0.11 (0.46)	–		
ILSS	0.04 (0.79)	−0.12 (0.43)	0.16 (0.28)	0.28 (0.06)	−0.20 (0.18)	–	
QLS	0.25 (0.08)	0.18 (0.22)	0.29* (0.05)	0.11 (0.48)	0.00 (0.99)	0.33* (0.02)	–

*0.05 level, **0.01 level (2-tailed). $N=48$ across bivariate pairs with exception of MMAA ($N=45$). BLERT = Bell-Lysaker Emotion Recognition Task; UPSA = UCSD Performance-Based Skill Assessment; SSPA = Social Skill Performance Assessment; MMAA = Medication Management Ability Assessment; ILSS = Independent Living Skills Survey; QLS = Quality of Life Scale.

4. Discussion

The primary aim of the current study was to evaluate the functional implications of affect recognition deficits in schizophrenia. We pursued this aim by identifying a subgroup of individuals with schizophrenia with normal-range AR performance and comparing them to a cohort with impaired AR on proxy and interviewer-rated measures of functioning. Based on a growing literature linking affect recognition to overall functioning, we hypothesized that those schizophrenia patients with near-normal affect recognition performance would have better functioning as assessed by both proxy and interviewer-rated measures.

As expected, BLERT scores reflected considerable variability in affect recognition performance in the schizophrenia sample. Approximately one-third ($N=17$) of the schizophrenia sample had AR performance in an empirically determined "near-normal" range. Comparisons of the near-normal AR vs. impaired AR schizophrenia subgroups on measures of functioning indicated that the near-normal AR group had higher scores on one of the examined proxy measures of functioning, MMAA, as well as one of the interviewer-rated measures, QLS. Additional analyses of the QLS sub-domains indicated that the group differences were significant for the Intrapsychic Foundations domain and the Common Objects and Activities domain. These findings suggest that near-normal AR performance in schizophrenia is in fact associated with superior independent and community functioning, as assessed by both proxy and interviewer-rated measures. Specifically, those with near-normal AR performed significantly better on tasks involving organization, planning, and sustained attention (MMAA), and received higher ratings on core intrapsychic features like sense of purpose, motivation, curiosity, empathy, and interest in and pursuit of pleasurable activities (QLS Intrapsychic Foundations), as well as on ratings of community participation (QLS Common Objects and Activities). These findings are consistent with previous reports on relationships between affect recognition and functioning (Mueser et al., 1996; Hooker and Park, 2002; Poole et al., 2000; Brekke et al., 2005; Couture et al., 2006).

The significance of the above relationships is tempered, however, by difficulty demonstrating a specific effect of affect recognition impairment in the schizophrenia sample. Schizophrenia participants classified by level of affect recognition performance differed significantly in general intelligence estimate, with the near-normal AR subgroup scoring in the average range, and the impaired AR subgroup scoring approximately 1 S.D. below average. Contrary to our hypothesis, analysis of performance on specific neuropsychological tests of executive function, visual attention, and verbal learning and memory also indicated significant differences. This finding is consistent with correlations between affect recognition and neurocognition reported elsewhere (Bryson et al., 1997; Bozikas et al., 2004) and cannot be attributed to group differences in overall symptom severity or demographic composition. Moreover, when a cognitive composite score based on these neurocognitive measures was entered as a covariate in between-group contrasts of functioning, observed effects on MMAA were reduced to non-significant levels. While the covariate did not enter into the main interviewer-rated analysis and the between-group effects of QLS total score remained significant, in a subsequent analysis of the QLS sub-domains the main effects for the individual QLS domains were reduced to below statistically significant levels. Based on these covariate analyses, we conservatively conclude that neurocognition fully mediated the observed associations between AR performance and MMAA, and partially mediated the observed associations between AR and QLS ratings.

Whereas the link between affect recognition and neurocognition has been well established (Schneider et al., 1995; Bryson et al., 1997; Silver and Shlomo, 2001; Bozikas et al., 2004; Addington et al., 2006), the degree of overlap between neurocognition and AR, and the direct and indirect roles of these variables in predicting functional outcomes is still under debate. Some authors suggest that deficits specific to affect recognition are separable from generalized neurocognitive deficits (Bryson et al., 1997; Streit et al., 1997) and make a unique contribution above and beyond that of neurocognition in predicting functional outcome (Poole et al., 2000; Couture et al., 2006), while others have argued against this dissociation (Kerr and Neale, 1993; Salem et al., 1996; Bozikas et al., 2004; Sachs et al., 2004). The wide range of tests used to assess cognition, affect recognition, and functioning, along with a range of data analytic procedures, make it even more difficult to draw definitive conclusions from these studies about the interrelationships between neurocognition, affect recognition, and outcome.

We present a simple methodological solution to a formidable limitation of affect recognition research in schizophrenia, the frequent lack of normative performance parameters for the measures under investigation. In the present study, logistic regression was used to predict diagnostic classification (schizophrenia vs. healthy normal) based on AR performance in a mixed sample of patients and community volunteers. Because of the heterogeneity of schizophrenia, it is often the case that significant portions of the patient and healthy normal score distributions overlap, even for measures on which large effect-size differences are found. Using this approach, we are in effect asking the regression to identify the schizophrenia cases with AR scores that deviate most from the healthy sample (true-positive schizophrenia classification) and those with scores overlapping the healthy distribution (false-negative schizophrenia classification). In this manner, we derive two subgroups from the patient sample that differ meaningfully on the classification variable (e.g., AR) and related features, but are comparable in terms of features that are not highly correlated with that variable. The comparison of derived groups on theoretically relevant dependent measures (e.g., community functioning) provides a test of the impact of impairment vs. normal-range ability in the domain used for classification against the features common to both subgroups (e.g., schizophrenia). As demonstrated in previous work (Johannesen, et al., 2008), this approach may add interpretative value to data that would otherwise be analyzed by group contrasts between schizophrenia and healthy normal samples. Although we do not consider this approach to be an adequate alternative to population-based standardized scores, it may provide a useful analytic tool in the interim, while we await normative data collection on instruments used in many areas of schizophrenia research.

The current study does have several limitations. In addition to the moderate sample size, the majority of schizophrenia patients were male veterans, potentially restricting the generalizability of the findings. Additionally, our affect recognition task is distinct from most others used in schizophrenia research in that the presentation of affective information is multimodal, offering affective cues based on facial expression, affective prosody and gestures. Although this difference may limit generalizability of our results to studies using unimodal stimuli (i.e. still photos, affective prosody), this approach is considered a better proxy of actual affect recognition performance in the real world (Bellack et al., 1996); thus, it is advantageous with respect to ecological validity.

In closing, our data indicate that a subsample of schizophrenia patients with near-normal affect recognition ability can be identified within a modestly sized sample. Although near-normal AR in schizophrenia is associated with higher functioning, our results suggest that this link is mostly mediated by neurocognitive function, which varied considerably between normal-range and impaired AR schizophrenia groups. As has been done to some extent with normal-range cognitive function in schizophrenia (Palmer et al., 1997; Weickert et al., 2000; Badcock et al., 2005; Fiszdon et al., 2006; Rund et al., 2006; Heinrichs et al., 2008; Wexler et al., 2009), future studies can more closely examine the functional relevance of intact affect recognition in relation to other important outcomes, such as symptomatology, course, or response to rehabilitation.

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