Published in final edited form as:
Schizophr Res. 2009 May ; 110(1-3): 173–179. doi:10.1016/j.schres.2009.03.015.

Elementary Neurocognitive Function, Facial Affect Recognition and Social-skills in Schizophrenia

Melissa B. Meyer, Psy.D.[1] and **Matthew M. Kurtz, Ph.D.**[2,3]

[1]Graduate Institute of Professional Psychology, University of Hartford, Hartford, CT. 06117

[2]Department of Psychology, Wesleyan University, Middletown, CT. 06459

[3]Schizophrenia Rehabilitation and Resource Center, Institute of Living, Hartford, CT. 06106

Abstract

Social-skill deficits are pervasive in schizophrenia and negatively impact many key aspects of functioning. Prior studies have found that measures of elementary neurocognition and social cognition are related to social-skills. In the present study we selected a range of neurocognitive measures and examined their relationship with identification of happy and sad faces and performance-based social-skills. Fifty-three patients with schizophrenia or schizoaffective disorder participated. Results revealed that: 1) visual vigilance, problem-solving and affect recognition were related to social-skill; 2) links between problem-solving and social-skill, but not visual vigilance and social-skill, remained significant when estimates of verbal intelligence were controlled; 3) affect recognition deficits explained unique variance in social-skill after neurocognitive variables were controlled; and 4) affect recognition deficits partially mediated the relationship of visual vigilance and social-skill. These results support the conclusion that facial affect recognition deficits are a crucial domain of impairment in schizophrenia that both contribute unique variance to social-skill deficits and may also mediate the relationship between some aspects of neurocognition and social-skill. These findings may help guide the development and refinement of cognitive and social-cognitive remediation methods for social-skill impairment.

Keywords

facial affect recognition; neurocognition; social-skill; schizophrenia

1. Introduction

Deficits in social-skills are one of the hallmarks of schizophrenia which affect the ability to achieve meaningful social relationships, maintain employment, and fulfill personal needs

Address for correspondence: Matthew M. Kurtz, PhD, Department of Psychology, Wesleyan University, Judd Hall, 207 High Street, Middletown, CT. 06459, mkurtz@wesleyan.edu; Tel: (860) 685-2072, FAX: (860) 685-2761.

Conflict of Interest: There are no conflicts of interest.

Contributors: Melissa B. Meyer, PsyD, was involved in initial conceptualization and design of the study, collected a significant portion of the data, analyzed resultant findings and wrote the first draft of the manuscript.
Matthew M. Kurtz PhD, was involved in initial conceptualization and design of the study, formulated a data analytic plan, and edited all portions of the manuscript.

through appropriate interactions with the environment (e.g., Addington & Addington, 1999; Bellack et al., 1990). These deficits are evident in individuals at-risk for developing schizophrenia and at illness onset (e.g., Pinkham et al., 2007), are stable over time (Mueser et al., 1991), and are refractory to pharmacologic intervention (e.g., Bellack et al., 1990). These findings emphasize the importance of social-skill deficit as a key target for the development of novel rehabilitation strategies.

A variety of studies indicate that measures of elementary neurocognition, specifically attention, memory and problem-solving skills, explain a significant proportion of the variance in social-skill (e.g., Addington & Addington, 1999, 2000; Penn et al., 1995) and that neurocognitive deficits are linked to these deficits in a manner similar to that of progress in psychosocial rehabilitation programs and global community function (see Green et al., 2000, Green et al., 2004 for reviews) with estimates suggesting that elementary neurocognition may explain anywhere from 20-60% of the variance in psychosocial outcome, broadly construed (Green et al, 2000).

At the same time, a smaller but rapidly emerging literature has linked measures of social cognition, that is the ability to perceive and process social information, to psychosocial function generally, and social-skills more specifically, in schizophrenia (see Couture et al., 2006, for a review). Measures of social cue recognition, attributional style, knowledge of social situations, and "theory-of-mind" have been linked to deficits in psychosocial function (e.g., Hooker & Park, 2002; Mueser et al., 1996) and in several studies these deficits have been shown to: (1) mediate the relationship of elementary neurocognitive function and psychosocial status (e.g., Addington et al., 2006; Brekke et al., 2005; Sergi et al., 2006; Vaskinn et al., 2008), (2) moderate the relationship between elementary neurocognitive function and social skill (Nienow et al., 2006), and/or (3) account for a proportion of variance beyond that provided by elementary neurocognitive measures (e.g., Brune, 2005; Corrigan & Toomey, 1995; Pinkham & Penn, 2006; Roncone et al., 2002). These findings have led some investigators to hypothesize that deficits in social cognition may occupy a position more proximal to psychosocial status than deficits in elementary neurocognition, and thus may suggest a more advantageous site for intervention.

One of the most commonly studied aspects of social cue recognition in schizophrenia is affect recognition. A wealth of studies has shown this skill to be impaired in schizophrenia relative to healthy matched controls (see Edwards et al., 2002 for a review). While questions remain whether facial affect recognition deficits reflect a specific (Bryson et al. 1997), or more generalized neurocognitive deficit in schizophrenia when symptoms are controlled (e.g., Kerr & Neale, 1993; Penn et al., 2000), affect recognition skills play a central role in any model of social cognition specifically, as well as any integrated model of social competence more generally (e.g. Bellack et al. 1990). Despite this fact, data on the relationship between affect recognition, performance-based social skill and elementary neurocognition remains limited.

Four studies, to our knowledge, have investigated this relationship directly. Pinkham and Penn (2006), in a study of 49 outpatients with schizophrenia and 44 healthy controls investigated the relationship of elementary neurocognitive skills in speeded set-shifting and verbal memory, social cognitive skills in facial affect recognition, social knowledge, and theory-of-mind and performance-based social-skill. Results revealed that in the patient sample overall estimated IQ and elementary neurocognitive deficits in set-shifting were linked to social-skill, as were social-cognitive skills of facial affect recognition, social knowledge and theory of mind. Importantly, social-cognitive measures explained an additional 26% of the variance in scores on social skill measures beyond that predicted by other cognitive measures.

In a related study, Nienow et al., (2006) investigated the relationship of two measures of sustained attention, the Continuous Performance Test and Span of Apprehension Test, emotion recognition measures and social-skill in 54 inpatients with schizophrenia. The results of their study found a link between attention and social-skill, a link between emotion recognition and social skill, and that emotion recognition moderated the relationship between attention and social skill. Cohen et al., (2006), in a sample of 28 inpatients with schizophrenia, investigated the relationship between elementary neurocognition, affect recognition, social role-play test performance and a measure of community function. For the role-play test, results revealed that measures of attention, verbal and non-verbal memory and executive function were moderately related to rated social-skill. Lastly, Vaskinn et al. (2008), investigated the relationship between a global index of neurocognitive function, emotion recognition skills, learning potential and observed social-skill in 26 individuals diagnosed with schizophrenia. Results revealed that emotion recognition skills, but not an index of learning potential, partially mediated the relationship between elementary neurocognitive function and observed social-skills.

The primary goal of the current study was to investigate relationship between elementary neurocognitive function, facial affect recognition and a performance-based measure of social-skill in a sample of individuals diagnosed with schizophrenia or schizoaffective disorder. One limitation of many studies to date is their use of neurocognitive batteries that have either not captured important elements of elementary neurocognitive function linked to psychosocial skill in previous literature, (e.g., Nienow et al., 2006; Penn & Pinkham, 2006) or have summed elementary neurocognitive measures into overall cognitive z-scores (Vaskinn et al., 2008, Addington & Addington, 2008). Studies that have utilized larger neurocognitive batteries with elementary measures assessed individually (e.g., Cohen et al., 2006), have been limited by modest samples sizes and inpatient populations that may not be representative of stabilized outpatients with the disease. Thus, in the current study we utilized a broad range of neurocognitive measures, including measures of attention, verbal learning and problem-solving, along with two measures of emotion perception (recognition and differentiation) and observed social-skill in a moderately-sized sample (53) of stabilized outpatients with schizophrenia. We hypothesized: (1) attention, verbal learning and problem-solving would be linked to social skill, (2) relationships between elementary neurocognitive function, facial affect recognition and social skills would be specific, i.e., would remain even when estimated verbal IQ was controlled; (2) facial affect recognition would be linked to social skill, (3) facial affect recognition would provide incremental explanatory power in measured social skill beyond that provided by measures of elementary neurocognitive function, and (4) facial affect recognition would partially mediate the relationship between elementary neurocognitive function and observed social-skill. We analyzed affect recognition performance in terms of total scores as well as sad versus happy valence conditions in light of research suggesting that happy and sad faces are differentially related to elementary neurocognitive function in the absence of marked performance differences between the two valence conditions (Silver et al., 2002).

2. Methods

2.1 Participants

Fifty-three community-dwelling individuals diagnosed with either schizophrenia or schizoaffective disorder according to the Structured Clinical Interview for the DSM-IV (First et al, 1995) and stabilized on antipsychotic medication participated. They were treated in accordance with institutional review procedures and written informed consent was obtained in all cases. Exclusion criteria included auditory and/or visual impairment, mental retardation (MR) as evidenced by a history of MR services, lack of fluency in the English language, history of a traumatic brain injury and/or a neurologic illness, or active substance abuse or dependence.

Forty-nine participants were recruited from the Schizophrenia Rehabilitation Program (SRP), an intensive outpatient setting at the Institute of Living in Hartford, CT. and 4 participants were recruited from Intercommunity Mental Health Center, a community clinic in East Hartford, CT. Refer to Table 1 for demographic and clinical characteristics of the sample.

2.2 Neurocognitive Measures

2.2.1 The Vocabulary subtest from the Wechsler Adult Intelligence Scale-III (Wechsler, 1997)—An oral measure of word knowledge was used as an estimate of verbal intelligence. Scaled scores were selected as the dependent measure.

2.2.2 Penn Continuous Performance Test (Kurtz et al., 2001)—A computerized version of the Continuous Performance Test (Rosvold et al., 1956) which measures attention and visual vigilance. The task required participants to respond as quickly as possible to a specific number and the independent measure selected was total true-positive responses.

2.2.3 Penn Conditional Exclusion Test (PCET; Kurtz et al., 2004a,b)—A computerized measure of problem-solving abilities. The test required participants to select out one of four objects according to one of three principles and to infer how to sort these objects based on feedback provided by the program to participants' responses. When the participant consecutively sorted ten items to one principle correctly, the sorting strategy automatically changed, with a total of three sorting principles. Total number of errors was selected as an independent variable.

2.2.4 Hopkins Verbal Learning Test (HVLT; Brandt, 1991)—A measure of verbal learning and memory in which one is asked to attend to a list of 12 words that are read aloud, then to repeat as many of the words as can be recalled. The list is repeated three times. The independent variable selected was the total correct across three trials.

2.3 Facial Affect Recognition Measures

2.3.1 Penn Emotion Acuity Test (PEAT; Erwin et al., 1992)—A computerized task to assess affect recognition consisting of black-and-white pictures of facial expressions obtained from professional actors that has shown a differential deficit in patients with schizophrenia relative to other task performance (Heimberg et al., 1992), with emotions ranging from very happy to very sad. Participants were asked to rate each of 40 photographs on a 7-point Likert scale. Independent variables selected for this study were the number of correctly identified very happy and very sad faces, recorded separately, as well as total correct.

2.3.2 Emotion-Differentiation Task (EMODIFF; Kohler et al., 2000)—Using the same type of facial stimuli as the PEAT, this task consisted of finer gradations of emotion and assessed the participant's ability to recognize subtle distinctions of degrees of happiness and sadness. The numbers of correctly identified happy and sad faces as well total correct were calculated as independent measures

2.4 Social Skill Measure

The Social Skills Performance Assessment (SSPA; Patterson, et al., 2001) is designed to measure functional social skills with the use of role play exercises that mimic real life situations. The first role play exercise required participants to play the role of a tenant greeting a new neighbor, while the second involved the use of assertiveness skills to persuade a landlord to fix a leak as soon as possible. Dimensions of social skill, which are rated on a 5-point Likert scale by trained raters, include interest, fluency, clarity, focus, affect, grooming, social appropriateness, negotiation ability, persistence, and overall conversation/argument. The measure has demonstrated strong interrater and test-retest reliabilities in patients with schizophrenia (Patterson et al. 2001). Procedures for reliability on the scale were established in consultation with the UCSD Department of Psychiatry. All raters in the current study rated at least 4 audiotapes independently with an intraclass correlation of (ICC) >.70 with "gold-standard" ratings provided by UCSD. Mean scores for both the 8 items of role-play 1 and the 9 items of role-play 2 were computed and then an average of these means was computed. This resultant mean-score weighted each role-play equally and was selected as a dependent measure. The battery of all above described tests took participants approximately two hours to complete. Means, SD and ranges for all variables are presented in Table 2.

2.5 Data Analysis

The data were evaluated in three steps. In step 1, to assess relationships between studied variables, Pearson correlation coefficients were computed among demographic/clinical variables, estimated verbal intelligence, neurocognitive variables, facial affect recognition, and performance-based social-skills variables. Second, to assess whether relationships between elementary neurocognitive skills, facial-affect recognition and social-skills ratings were specific, stepwise linear regressions were computed to determine whether those neurocognitive and facial affect variables correlated to social-skills ratings in step 1 contributed distinct variance beyond that of estimated global verbal intelligence (Vocabulary scaled scores). Lastly, a hierarchical block regression was computed using all variables correlated with social skills in step 1. Demographic/clinical variables were entered for block 1, the neurocognitive variables were entered for block 2, and the facial affect recognition variables for block 3. This final part of the data analytic plan allowed us to assess whether: (1) emotion recognition scores explained unique variance in social-skill ratings beyond that accounted for by elementary neurocognitive measures and demographic variables, and/or (2) emotion recognition mediated the relationship between elementary neurocognitive measures and social-skill ratings, while accounting for the influence of clinical/demographic variables. If emotion recognition could be conceptualized as a construct predicting variance in social-skill separate from elementary neurocognitive function, we would expect a significant increase in explained variance when emotion recognition measures are added in block 3 of this regression, with elementary neurocognitive function remaining related to rated social-skill. Alternatively, if emotion recognition mediated the relationship between any of the neurocognitive variables and rated social skill, by the method of Baron & Kenny (1986), we would expect that: (1) the elementary neurocognitive function would be related to social-skill, (b) elementary neurocogntive function would be related to facial-affect recognition, (c) facial-affect recognition would be related to social-skill, and (d) when facial-affect recognition is controlled for statistically the relationship between the elementary neurocognitive variable and rated social skill would be reduced or removed. All analyses were two-tailed and alpha was set at .05.

3. Results

As seen in Table 3, among neurocognitive measures, the number of errors on the PCET and the number of true positives on the PCPT were related to overall SSPA performance ($r = -.42$ and $r = .42$, respectively). HVLT total correct was not related to SSPA performance. Among emotion recognition variables, only the number of correctly identified very happy faces on the PEAT was associated with SSPA mean ($r = .40$). Regarding the demographic/clinical variables, age and duration of illness in years were correlated to SSPA mean ($r = -.33$ and $r = -.48$, respectively), while years of education and number of hospitalizations were not.

Stepwise linear regressions were conducted to test whether those elementary neurocognitive and emotion recognition variables significantly related to SSPA in the correlation analyses had a *specific* relationship to SSPA scores; that is they contributed variance to social skills beyond that explained by global estimated verbal intelligence (Vocabulary scaled scores). When Vocabulary scaled scores were entered in a first step, and PCET errors in a second step, PCET remained a significant predictor of SSPA (B=-.37, t=-2.54; p<.05). When Vocabulary scaled scores were added in a first step and PCPT or very happy correct scores from the PEAT was added in a second step, neither PCPT nor very happy correct scores from the PEAT were a significant predictor of the SSPA (ps>.6).

To assess whether facial affect recognition added unique variance in rated social-skill beyond that contributed by neurocognitive variables, and to help determine whether emotion recognition mediated the relationship between any of the elementary neurocognitive variables and social-skill ratings, we conducted a hierarchical block regression with demographic/clinical variables (age and duration of illness) for block 1, neurocognitive variables with a relationship to SSPA ratings entered for block 2 (PCPT true positives and PCET errors), and social cognitive variables (very happy correct from the PEAT) for block 3. In the first step, age and duration of illness were not significant predictors of rated social skill; in step 2 PCPT true positives were a significant predictor of rated social skill and, along with PCET errors, explained an additional 16% of the variance; in step 3 facial affect recognition predicted rated social-skill even after accounting for measures of elementary neurocognitive functioning and key demographic variables. The change in R-squared was significant (R-square change [1, 41] =5.40; p<.05) in this step, with facial affect recognition measures explaining an additional 7% of the variance in social-skill. In addition, PCPT true positives were no longer a significant predictor of rated social-skill, providing some evidence that facial affect recognition mediates the relationship between PCPT true positives and rated social skill. The relationship between PCET errors and rated social skill was similar in value to block 2 (see Table 4).

4. Discussion

This is among the first studies to investigate the relationship between a range of elementary neurocognitive functions (sustained visual vigilance, verbal learning and problem-solving) with established links to psychosocial status in schizophrenia (e.g., Green et al., 2000; Green et al., 2004), a measure facial affect recognition and a performance-based measure of psychosocial status, rated social-skill. Consistent with our hypotheses: (1) measures of attention and problem-solving were related to a performance-based index of social skill, although contrary to our expectations, verbal learning was not related. Regression analysis revealed that elementary neurocognitive measures explained 16% of the variance in performance-based ratings of social skill even when key demographic variables were controlled. These findings are highly consistent with two recent reports evaluating the relationship of attention (Nienow et al., 2006), and a global assessment of neurocognitive skill (Vaskinn et al., 2008), and a performance-based measure of social-skill; (2) the link between problem-solving, but not sustained visual vigilance or facial-affect recognition, and rated social-skill was specific, remaining significant even when estimates of verbal IQ were controlled; (3) deficits in affect recognition (for happy faces specifically) explained a significant proportion of variance beyond that accounted for by elementary neurocognitive function, and (4) deficits in facial affect recognition partially mediated the relationship of sustained visual vigilance and observed social skill as the relationship between sustained visual vigilance and social-skill was reduced when facial affect recognition was controlled. Contrary to our hypotheses, affect recognition skills did not mediate the relationship between deficits in problem-solving skill and observed social-skill. An unexpected finding was that age and duration of illness explained 23% of the variance in social-skill, suggesting that chronicity was linked to this aspect of functional status in schizophrenia in our sample.

The finding that a measure of social cognition, facial-affect recognition, was linked to observed psychosocial status is consistent with recent reports linking social cognition to behavioral impairment (see Couture et al., 2006 for a review) and that it explained incremental variance in observed social skill beyond that associated with elementary neurocognitive function is consistent with some reports (e.g., Pinkham & Penn, 2006; Roncone et al., 2002), but not others (e.g., Cohen et al., 2006). Negative findings in this latter study might be linked to their study of inpatients who were likely more symptomatic than other study samples, and these symptoms may have influenced the relationship of elementary neurocognition, social cognition and rated social-skill. As a whole, these findings suggests that there may be value in developing novel treatments targeted at deficits in social cognition for enhancing psychosocial status in people diagnosed with schizophrenia. Thus, these findings support recent efforts to develop treatment protocols targeted at key social cognitive skills such as affect recognition, attributional bias, and theory-of-mind (e.g., Combs et al. 2007).

The relationship between a measure of visual vigilance (CPT) and rated social-skill in individuals with schizophrenia is consistent with several studies utilizing an auditory vigilance task (auditory CPT; e.g., Bowen et al., 1994; Addington & Addington, 1998; Nienow et al., 2006) suggesting that the relationship between sustained attention and social-skills is not modality specific. The finding of a link between a measure of executive-function (PCET) and rated social skill is consistent with two recent studies (e.g., Cohen et al., 2006; Pinkham & Penn, 2006) studying in and outpatient samples, respectively.

The evidence that facial affect recognition, a measure of social cognition, partly mediated the relationship between elementary neurocognitive function (visual vigilance) and observed social-skill is also consistent with two recent reports. Vaskinn et al., (2008) reported that performance on an affect recognition task, the Face/Voice Emotion Identification and Discrimination Task, partially mediated the relationship between neurocognition, as indexed by a composite score computed from Digit Symbol, Semantic Fluency, Inhibition/ Switching and the CVLT-II, and social skill as measured by the sending score of the Assessment of Interpersonal Problem Solving Scale (AIPSS). Similarly, Addington et al., (2006), in a longitudinal study of individuals with first- and multi-episode schizophrenia, showed that a measure of social-cue recognition that included both concrete and abstract social cues, along with a measure of social rule knowledge, mediated the relationship between elementary neurocognition and observed social-skill as measured by the AIPSS. These findings, coupled with the findings reported here, are generally consistent other reports that at least some aspects of elementary neurocognitive function influences global measures functional outcome such as work, social functioning and independent living indirectly through social cognitive measures (e.g., Brekke et al., 2005; Sergi et al., 2006) and extend these findings to a performance-based measure of social skill.

In contrast to our findings, we note that one study, Nienow et al., (2006), did not find evidence that their measure of affect recognition mediated the relationship between two measures of auditory attention (CPT and SPAN) and their measures of observed social skill, a modified version of the AIPSS. One hypothesis that might be advanced for the source of this discrepancy is the measurement of affect recognition in the two studies. Nienow et al. used a multi-modal assessment of affect recognition that included vocal and upper-body cues in additional to facial visual clues (BLERT). In contrast, the measure of emotion recognition selected for the current study used only facial visual cues, most likely increasing the degree to which performance was dependent on intact visual vigilance. We also note that the absence of evidence that facial-affect recognition mediates the relationship between problem-solving and observed social skills suggests that elementary neurocognitive functions may differ in the degree to which their influences on social-skill are direct or indirect.

We note that only accuracy on happy face recognition, on one of two measures of facial affect recognition, was linked to rated social-skill in the current study. This finding is distinct from most studies in this area that have investigated facial affect recognition accuracy scores across two or more emotions (e.g., Nienow et al., 2006). Silver et al. (2002), in a study 24 individuals with schizophrenia, linked accurate recognition of happy faces to several cognitive measures, whereas accurate identification of sad faces was not related to any of the cognitive measures administered in their study. These findings, coupled with our results, suggest that there may be separate evaluative systems for positive and negative affect that are related differentially to cognitive function and social-skill.

Several caveats to the current findings should be mentioned. First, conceptual models relating individual factors to functional status in individuals with schizophrenia typically include negative symptoms as an important model element (e.g., Green & Nuechterlein, 1999). A wealth of empirical evidence also implicates a relationship between negative symptoms and elementary neurocognition (e.g., Nienow et al., 2006), and studies also note a relationship between negative symptoms and affect recognition and social skill (e.g., Kohler et al., 2000; Pinkham & Penn, 2006). Thus, a limitation of the current study is the absence of measures of negative symptoms to delineate the degree to which they influence the relationship of the three domains studied. We do note that several studies have revealed that elementary neurocognitive skills explain variance in social-skill specifically, and psychosocial status more generally, beyond that accounted for by negative symptoms (e.g., Nienow et al., 2006; Velligan et al., 1997), suggesting that elementary neurocognitive skills are not isomorphic with negative symptoms. Second, we did not have a control sample available to determine the relationship between neurocognitive skills, facial affect recognition, and social skill in healthy people as compared to people with schizophrenia. Third, we included a large number of variables in the regression and this may have increased the possibility of Type I error. Fourth, we selected a performance-based measure of social skill that has the advantage of not being dependent on level of community support and financial means, but has the limitation of being a “capacity” measure; that is it indicates only whether the client is capable of performing the social-skill, not whether the skill will necessarily be employed in the client's home environment. Fifth, we included only one social cognitive variable (facial affect recognition), and thus the amount of variance in performed social skill explained by social cognition would most likely have been larger with inclusion of measures of other important social-cognitive domains such at theory-of-mind, and attributional bias. That facial affect recognition still explained incremental variance after the inclusion of three elementary neurocognitive variables, however, points to the importance of this domain of social cognition in observed social-skill. Sixth, we only assessed recognition of happy, sad and neutral faces in the current study. Several studies (e.g., Edwards et al. 2001; Kohler et al., 2003) indicate that greatest impairment in facial affect recognition in schizophrenia is for fear. Future studies in this domain should consider including this affective valence in their battery of tests of emotion.

In summary, the results of the current study found relationships between attention and executive-function, facial-affect recognition and rated social-skill, but only relationships between executive-function and social-skill were specific. Affect recognition was found to both partially mediate the relationship between the specific neurocognitive skill of attention and social-skill, and explain variance beyond that accounted for by elementary neurocognitive functions more generally. Thus, these findings suggest complex and differential relationships between specific elementary neurocognitive measures, facial affect recognition and social-skill and emphasize the importance of generating explanatory models for individual factors and social-skill in schizophrenia that account for a diversity of relationships between different elementary neurocognitive skills, measures of facial affect recognition and social-skill.

Acknowledgments

This work is partially based on a dissertation submitted by the first author (Dr. Meyer) in partial fulfillment of the Doctor of Psychology (PsyD) degree at the University of Hartford Graduate Institute for Professional Psychology. It was supported by grant K08 MH-69888 from the National Institute of Mental Health (NIMH), and a Young Investigator Award from the National Alliance for Research on Schizophrenia and Depression (NARSAD) to Dr. Kurtz.

Role of funding source: The funding sources for this study had no role in the study design, collection, analysis or interpretation of the data, the writing of the report and in the decisions to submit the manuscript for publication.

References

Addington J, Addington D. Neurocognitive and social functioning in schizophrenia. Schizophr Bull 1999;25(1):173–182. [PubMed: 10098920]

Addington J, Addington D. Neurocognitive and social functioning in schizophrenia: A 2.5 year follow-up study. Schizophr Res 2000;44:47–56. [PubMed: 10867311]

Addington J, Saeedi H, Addington D. Facial affect recognition: a mediator between cognitive and social functioning in psychosis? Schizophr Res 2006;85:142–150. [PubMed: 16678388]

Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. J Pers Soc Psychol 1986;51:1173–1182. [PubMed: 3806354]

Bellack AS, Morrison RL, Wixted JT, Mueser KT. An analysis of social competence in schizophrenia. Br J Psychiatry 1990;156:809–818. [PubMed: 2207511]

Brandt J. The Hopkins Verbal Learning Test: Development of a new memory test with six equivalent forms. Clin Neuropsychol 1991;5(2):125–142.

Brekke J, Kay DD, Lee KS, Green MF. Biosocial pathways to functional outcome in schizophrenia. Schizophr Res 2005;80(23):213–225. [PubMed: 16137859]

Brune M. Emotion recognition, 'theory of mind,' and social behavior in schizophrenia. Psychiatry Res 2005;133:135–147. [PubMed: 15740990]

Bryson G, Bell M, Lysaker P. Affect recognition in schizophrenia: A function of global impairment or a specific cognitive deficit? Psychiatry Res 1997;71:105–113. [PubMed: 9255855]

Cohen AS, Forbes CB, Mann MC, Blanchard JJ. Specific cognitive deficits and differential domains of social functioning impairment in schizophrenia. Schiz Res 2006;81:227–238.

Combs DR, Adams SD, Penn DL, Roberts D, Tiegreen J, Stern P. Social Cognition and Interaction Training (SCIT) for inpatients with schizophrenia-spectrum disorders: preliminary findings. Schizophr Res 2007;91:112–116. [PubMed: 17293083]

Corrigan PW, Toomey R. Interpersonal problem solving and information processing in schizophrenia. Schizophr Bull 1995;21(3):395–403. [PubMed: 7481570]

Couture SM, Penn DL, Roberts DL. The functional significance of social cognition in schizophrenia. Schizophr Bull 2006;32:S44–63. [PubMed: 16916889]

Edwards J, Jackson HJ, Pattison PE. Emotion recognition via facial expression and affective prosody in schizophrenia: A methodological review. Clin Psychol Rev 2002;22:789–832. [PubMed: 12214327]

Erwin RJ, Gur RC, Gur RE, Skolnick B, Mawhinney-Hee M, Smailis J. Facial emotion discrimination: 1. Task construction and behavioral findings in normal subjects. Psychiatry Res 1992;42:231–240. [PubMed: 1496055]

First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JBW. Structured Clinical Interview for DSM-IV Axis I Disorders-Patient Edition (SCID-I/P, Version 2.0). Biometrics Research Department, New York State Psychiatric Institute; New York: 1995.

Green MF, Kern RS, Braff DL, Mintz J. Neurocognitive deficits and functional outcome in schizophrenia: are we measuring the "right stuff"? Schizophr Bull 2000;26(1):119–36. [PubMed: 10755673]

Green MF, Kern RS, Heaton RK. Longitudinal studies of cognition and functional outcome in schizophrenia: implications for MATRICS. Schizophr Res 2004;72(1):41–51. [PubMed: 15531406]

Green MF, Nuechterlein KH. Should schizophrenia be treated as a neurocognitive disorder? Schizophr Bull 1999;25:309–319. [PubMed: 10416733]

Heimberg C, Gur RE, Erwin RJ, Shtasel DL, Gur RC. Facial emotion discrimination: III. Behavioral findings in schizophrenia. Psychiatry Res 1992;42:253–265. [PubMed: 1496057]

Hooker C, Park S. Emotion processing and its relationship to social functioning in schizophrenia patients. Psychiatry Res 2002;112:41–50. [PubMed: 12379449]

Kerr SL, Neale JM. Emotion perception in schizophrenia: specific deficit or further evidence of poor performance? J Abnorm Psychol 1993;102:312–318. [PubMed: 8315144]

Kohler CG, Bilker W, Hagendoorn M, Gur RE, Gur RC. Emotion recognition deficit in schizophrenia: Association with symptomatology and cognition. Biol Psychiatry 2000;48:127–136. [PubMed: 10903409]

Kohler CG, Bilker W, Brensinger CM, Siegel SJ, Kanes SJ, Gur RE, Gur RC. Facial emotion recognition in schizophrenia: intensity effects and error pattern. Am J Psychiatry 2003;160:1768–1774. [PubMed: 14514489]

Kurtz MM, Ragland JD, Bilker W, Gur RC, Gur RE. Comparison of the continuous performance test with and without working memory demands in healthy controls and patients with schizophrenia. Schizophr Res 2001;48(23):307–316. [PubMed: 11295383]

Kurtz MM, Ragland JD, Moberg PJ, Gur RC. The Penn Conditional Exclusion Test: a new measure of executive-function with alternate forms of repeat administration. Arch Clin Neuropsychol 2004;19 (2):191–201. [PubMed: 15010085]

Kurtz MM, Wexler BE, Bell MD. The Penn Conditional Exclusion Test (PCET): relationship to the Wisconsin Card Sorting Test and work function in patients with schizophrenia. Schizophr Res 2004;68(1):95–102. [PubMed: 15037343]

Mueser KT, Bellack AS, Douglas MS, Morrison RL. Prevalence and stability of social skill deficits in schizophrenia. Schizophr Res 1991;5:167–176. [PubMed: 1931809]

Mueser KT, Doonan R, Penn DL, Blanchard J, Bellack AS, Nishith P, DeLeon J. Emotion recognition and social competence in schizophrenia. J Abnorm Psychol 1996;105:271–275. [PubMed: 8723008]

Nienow TM, Docherty NM, Cohen AS, Dinzeo TJ. Attentional dysfunction, social perception, and social competence: What is the nature of the relationship? J Abnorm Psychol 2006;115:408–417. [PubMed: 16866582]

Patterson TL, Moscona S, McKibbin CL, Davidson K, Jeste DV. Social skills performance assessment among older patients with schizophrenia. Schizophr Res 2001;48:351–360. [PubMed: 11295387]

Penn DL, Combs DR, Ritchie M, Franics J, Cassisi J, Morris S, Townsend M. Emotion recognition in schizophrenia: further investigations of generalized versus specific deficit models. J Abnorm Psychol 2000;109:512–516. [PubMed: 11016120]

Penn DL, Mueser KT, Spaulding W, Hope DA, Reed D. Information processing and social competence in chronic schizophrenia. Schizophr Bull 1995;21(2):269–281. [PubMed: 7631174]

Pinkham AE, Penn DL. Neurocognitive and social cognitive predictors of interpersonal skill in schizophrenia. Psychiatry Res 2006;143:167–178. [PubMed: 16859754]

Pinkham AE, Penn DL, Perkins DO, Graham KA, Siegel M. Emotion perception and social skills over the course of psychosis: a comparison of individuals at risk for psychosis and individuals with early and chronic schizophrenia spectrum illness. Cognit Neuropsychiatry 2007;12:198–212. [PubMed: 17453901]

Roncone R, Falloon IR, Mazza M, De Risio A, Pollice R, Necozione S, Morosini P, Cassachia M. Is theory-of-mind in schizophrenia more strongly related to clinical and social functioning than neurocognition. Psychopathology 2002;35:280–288. [PubMed: 12457019]

Sergi MJ, Rassovsky Y, Nuechterlein KH, Green MF. Social perception as a mediator of the influence of early visual processing on functional status in schizophrenia. Am J Psychiatry 2006;163:448–454. [PubMed: 16513866]

Silver H, Shlomo N, Turner T, Gur RC. Perception of happy and sad facial expressions in chronic schizophrenia: Evidence for two evaluative systems. Schizophr Res 2002;55:171–177. [PubMed: 11955976]

Vaskinn A, Sundet K, Friis S, Simonsen C, Birkenaes AB, Jonsdottir H, Ringen PA, Andreassen OA. Emotion perception and learning potential: Mediators between neurocognition and social problem-solving in schizophrenia? J Int Neuropsychol Soc 2008;14:279–288. [PubMed: 18282325]

Velligan DI, Mahurin RK, Diamond PL, Hazleton BC, Eckert SL, Miller AL. The functional significance of symptomatology and cognitive function in schizophrenia. Schizophr Res 1997;25:21–31. [PubMed: 9176924]

Wechsler, D. WAIS-III Manual. The Psychological Corporation; New York: 1997.

Table 1

Demographic and clinical characteristics of participant sample (n=53).

Variable	Mean (SD)	Range
Age	35.1 (11.6)	19-55
Percent male	72	
Percent Caucasian	74	
Education (years)	12.9 (2.2)	7-16
Percent employed	23	
Duration of illness (years)	12.2 (9.7)	1-37
Age of onset (years)	22.9 (6.5)	13-41
Number of hospitalizations	5.3 (4.0)	0-20
Percent treated with atypical antipsychotic medication	94%	
Daily CPZ equivalent antipsychotic dose (mg.)	659.4 (568.4)	67-2500

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 2

Mean, SD and range for neurocognitive, facial-affect recognition, and social-skill variables.

Variable	**Mean (SD)**	**Range**
Neurocognitive		
HVLT total score	20.7 (6.1)	6-33
PCPT true positives	33.9 (5.6)	7-36
PCET errors	41.6 (29.2)	5-99
Facial Affect Recognition		
PEAT very happy correct	3.8 (1.5)	0-6
PEAT very sad correct	3.0 (1.3)	0-5
PEAT total correct	23.9 (6.9)	8-34
EMODIFF happy correct	7.6 (3.7)	1-17
EMODIFF sad correct	10.4 (3.3)	2-15
EMODIFF total correct	18.0 (6.4)	4-32
Social skills		
SSPA mean	3.6 (.6)	2-5

Note: HVLT = Hopkins Verbal Learning Test; PCPT = Penn Continuous Performance Test; PCET = Penn Conditional Exclusion Test; PEAT = Penn Emotion Acuity Test; EMODIFF = Emotion Differentiation Task; SSPA = Social Skills Performance Assessment.

Table 3

Pearson correlations among demographic/clinical variables and study measures.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Demographic/Clinical																
1. Age	------															
2. Education (years)	.25	------														
3. Number of hospitalizations	.23	-.20	------													
4. Duration of illness (years)	.85**	.00	.32*	------												
5. Antipsychotic med. (cpz. eq.)	-.13	-.19	-.03	-.01	------											
Estimated verbal IQ (WAIS III)																
6. Vocabulary scaled score	-.09	.30*	-.29	-.13	-.22	------										
Neurocognitive																
7. HVLT total correct	-.12	.11	.07	-.13	-.19	.33*	------									
8. PCPT true positives	-.15	.13	.22	-.18	.08	-.06	.42**	------								
9. PCET errors	.26	-.12	-.09	.31*	.17	-.34*	-.14	-.31*	------							
Facial affect recognition																
10. PEAT very happy correct	-.12	-.00	.14	-.19	-.01	.25	.29*	.33*	-.10	------						
11. PEAT very sad correct	-.20	.10	-.18	-.10	.25	.23	.03	.00	-.10	.26	------					
12. PEAT total correct	-.26	-.08	-.02	-.31*	.07	.29	.09	.10	-.09	.47**	.21	------				
13. EMODIFF happy correct	.04	.06	-.19	.10	-.12	.28	.00	-.19	-.26	.02	.26	.03	------			
14. EMODIFF sad correct	-.09	.07	-.02	-.11	-.18	.24	.11	-.09	-.37**	.11	.17	.06	.72**	------		
15. EMODIFF total correct	-.02	.07	-.11	.00	-.16	.28	.06	-.16	-.34*	.07	.24	.05	.94**	.92**	------	
Social skills																
16. SSPA mean	-.33*	.21	-.01	-.48**	-.09	.22	.22	.42**	-.42**	.40**	-.04	.27	-.07	.19	.05	------

Note: CPZ EQ=chlorpromazine dose equivalents; WAIS = Wechsler Adult Intelligence Scale III; HVLT = Hopkins Verbal Learning Test; PCPT = Penn Continuous Performance Test; PCET = Penn Conditional Exclusion Test; PEAT = Penn Emotion Acuity Test; EMODIFF = Emotion Differentiation Task; SSPA = Social Skills Performance Assessment.

* $p < .05$.

** $p < .01$.

Table 4

Results of stepwise regression predicting mean SSPA performance.

Variable	Beta	t-value	p-value
Step 1[a]			
Age	-.03	-.129	.90
Duration of illness (years)	-.45	-1.84	.07
Step 2[b]			
Age	.01	0.06	1
Duration of illness (years)	-.37	-1.61	.11
PCPT true Positives	.30	2.39	.021
PCET errors	-.21	-1.54	.13
Step 3[c]			
Age	-.02	-.10	.92
Duration of illness (years)	-.31	-1.39	.17
PCPT true positives	.22	1.69	.10
PCET errors	-.19	-1.51	.14
PEAT very happy correct	.29	2.32	.03

[a] R^2=.23, F=6.90, df=2, 46, p<.005

[b] R^2=.39, F=6.71, df=4, 42, p<.001

[c] R^2=.46, F=7.00, df=5, 41, p<.001

Note: SSPA = Social Skills Performance Assessment; PCPT = Penn Continuous Performance Test; PCET = Penn Conditional Exclusion Test; PEAT = Penn Emotion Acuity Test.