Neurocognitive and Social Functioning in Schizophrenia

by Jean Addington and Donald Addington

Abstract

This cross-sectional study examined the relationships between neurocognitive and social functioning in a sample of 80 outpatients with DSM-III-R schizophrenia. The neurocognitive battery included measures of verbal ability, verbal memory, visual memory, executive functioning, visual-spatial organization, vigilance, and early information processing. Positive and negative symptoms were assessed with the Positive and Negative Syndrome Scale. A range of social behaviors were assessed using the Social Functioning Scale (SFS), the Quality of Life Scale (QLS), and a video-based test, the Assessment of Interpersonal Problem-Solving Skills (AIPSS). Social functioning as assessed by the SFS was unrelated to neurocognitive functioning. Poor cognitive flexibility was associated with low scores on the QLS and the AIPSS. Verbal ability and verbal memory were also significantly associated with the AIPSS. Visual-spatial ability and vigilance were associated with the sending skills subscale of the AIPSS. In this study, which used a wide range of neuropsychological tests and measures of community functioning and social problem solving, results support earlier research that suggests an association between certain aspects of neurocognitive functioning and social functioning.

Key words: Neurocognition, social functioning, social problem solving.


In the past few years cognitive remediation for individuals with schizophrenia has received much attention in the literature. It has been predicted that generalization from the training of cognitive processes to improved clinical and social functioning may be enhanced by identifying the cognitive processes that mediate the learning of social skills. Those mediators should then be targeted in the remediation (Brenner et al. 1992). Although it is clear that individuals with schizophrenia have impaired neurocognitive functioning, the actual impact of these deficits on their daily lifestyle is unclear. Thus, it would be important to know which neurocognitive deficits become “rate limiting factors” for effective social and occupational functioning (Bellack 1992). Several studies have examined the relationship between different aspects of social and neurocognitive functioning. In a recent review of this topic, Green (1996) divided the literature into three areas of social functioning or outcome: community outcome, social problem solving, and skill acquisition.

Results of the first group of studies suggested that secondary verbal memory and card sorting were consistently significant predictors of community functioning (Jaeger and Douglas 1992; Goldman et al. 1993; Buchanan et al. 1994; Lysaker et al. 1995a). Secondary verbal memory tasks require memory for stories or lists of words and often include both immediate and delayed recall. Card sorting is a measure of executive functioning and cognitive flexibility. Additionally, associations have been reported between performance on a task involving complex reaction time and rehabilitation success (Wykes et al. 1990, 1992) and between community functioning and visual memory and verbal fluency (Buchanan et al. 1994). Finally, in a large sample Dickerson et al. (1996) reported that the social functioning of outpatient schizophrenia subjects was predicted by a combination of general organicity (as assessed by the Reitan-Indiana Aphasia Screening Test; Reitan 1984) and negative symptoms.

In the second group of studies, significant predictors of social problem solving included verbal memory (Bellack et al. 1994; Corrigan et al. 1994a); vigilance, assessed by the Continuous Performance Test (CPT; Nuechterlein 1991; Bowen et al. 1994; Penn et al. 1995); and early visual processing, assessed by the Span of Apprehension Task (SPAN; Asarnow and Nuechterlein...
Executive functioning, assessed by the Wisconsin Card Sorting Test (WCST; Heaton 1981), was not found to be significantly associated with social problem solving (Corrigan et al. 1994a; Penn et al. 1995). However, all of the studies assessing social problem solving involved inpatients with schizophrenia.

The third group of studies examined the relationship of neurocognitive functioning to the ability to acquire psychosocial skills. Verbal memory and vigilance were found to be consistently associated with skill acquisition (Kern et al. 1992; Mueser et al. 1992; Bowen et al. 1994; Corrigan et al. 1994b), and the SPAN and the WCST were inconsistently associated with skill acquisition (Bowen et al. 1994; Lysaker et al. 1995b). These studies used both inpatients and outpatients.

Despite the differences in methods, the limited statistical power of many of the studies, and the huge variability in the selection of measures, there were some consistent results with respect to the association between neurocognitive functioning and social functioning (Green 1996): verbal memory predicted community functioning, problem-solving skills, and skill acquisition; vigilance was a reliable predictor of social problem solving and skill acquisition; and card sorting was consistently associated with performance on measures of community outcome but inconsistently associated with skill acquisition.

The present study was designed to examine social functioning and neurocognitive functioning in a sample of stable schizophrenia outpatients living in the community. This study was designed to overcome some of the methodological problems of the earlier studies: It has adequate power; it uses a wide range of neurocognitive measures that have been used in previous studies; and it assesses both community functioning and social problem solving in the same sample.

A sequential approach to social functioning (receiving, processing, and sending skills) has been suggested by Wallace et al. (1980) such that dysfunctional receiving skills will affect performance on subsequent processing and sending skills. This may fit with a sequential model of information processing, which suggests that deficits in early information processing would disrupt later cognitive processing. This theory is supported by studies such as Bowen et al. (1994). Furthermore, social interactions can be seen as complex cognitive processes. Such interactions require face and affect recognition, perception and encoding of interpersonal cues, recall of past interactions, retrieval from memory of appropriate responses, and decision making and judgment in conflictual interactions. Social problem solving requires cognitive flexibility by which individuals are able to generate a range of interpersonal skills. This view suggests that social functioning consists of complex tasks; therefore, a relationship with complex cognitive processes would be expected. Thus, by selecting a broad set of measures that assess early information to conceptual ability, we will be able to test whether early information processing or more complex cognitive tasks are associated with social functioning.

Although the focus of this study is on associations between neurocognitive and social functioning, the effects of concomitant psychiatric symptoms need to be examined. In studies of neurocognitive and social functioning, positive symptoms were not associated with social functioning, and negative symptoms tended to be inversely associated more with social problem solving than with community functioning and not associated with skill acquisition (Green 1996). A significant number of studies suggest inverse associations between neurocognitive functioning and negative, but not positive, symptoms (e.g., Addington et al. 1991).

**Methods**

**Subjects.** Eighty outpatients (54 males and 26 females) with a DSM-III-R (American Psychiatric Association 1987) diagnosis of schizophrenia were recruited from two general hospital outpatient programs. Subjects had an average age of 36 years (standard deviation [SD] = 9.5), 12 years of education (SD = 1.7), and 4.5 previous admissions (SD = 3.7). On average, the first admission to hospital occurred at 24.8 years (SD = 7.3), and it had been an average of 43.3 months (SD = 43.4) since the previous admission. For 25 percent of the subjects, the time since last admission was 1 to 9 months, but t-tests revealed that this 25 percent did not differ from the rest of the sample on any of the neurocognitive, social, or symptom measures. The majority of the subjects were single (45 men, 16 women); 6 were in a marital relationship; and 13 (6 men, 7 women) were divorced, separated, or widowed. Seventy received governmental financial support, two were supported by their families, and four men and four women were employed. All but one schizophrenia subject were taking neuroleptics (55 typical antipsychotics, 16 risperidone, 7 clozapine, 1 olanzapine); 25 percent were using anticholinergics. The mean dose in chlorpromazine (CPZ) equivalents was 509.96 (range 20–1,761) (Davis 1985; Chouinard and Beauclair 1988).

Diagnoses according to DSM-III-R criteria were made by the principal investigators using the Structured Clinical Interview for DSM-III-R (SCID; Spitzer et al. 1990). Interrater reliability was determined in a separate sample of 10 subjects by 100 percent agreement on the diagnosis and at least 80 percent agreement for symptom presence. Subjects were excluded from the study if they...
did not meet DSM-III-R criteria; if they had evidence of an organic central nervous system disorder, significant and habitual drug or alcohol abuse in the past year, or mental retardation; or were under 18, or over 65 years of age. The study was described verbally and in writing to each subject and written informed consent was obtained from them all.

**Symptoms.** The Positive and Negative Syndrome Scale (PANSS; Kay et al. 1987) was used to obtain ratings for positive and negative symptoms. It was administered by a principal investigator (J.A.) and a clinical research nurse. Interrater reliability was determined in a separate sample of five subjects. Criteria for reliability were scoring of each symptom within 1 point and at least 80 percent agreement on the total score for the PANSS and on the positive, negative, and general psychopathology subscale. Agreement was calculated as the number of ratings within 1 point divided by the total number of ratings.

**Assessment of Social Functioning.** Two measures that reflect community functioning and one measure of social problem solving were used.

The Social Functioning Scale (SFS; Birchwood et al. 1990) is a 79-item scale designed to assess social functioning in schizophrenia. It asks about abilities and performance in seven areas: social engagement (e.g., How much time do you spend alone?), interpersonal communication (e.g., How many friends do you have?), activities of daily living (e.g., How often do you prepare and cook a meal?), recreation (e.g., How often do you play a sport?), social activities (e.g., How often do you visit friends?), competence at independent living (e.g., How able are you to handle your own money?), and occupation/employment. The questionnaire can be filled out by the subject. Scores are calculated for each subscale, and the total score is the sum of the four subscales. The QLS was administered by two experienced clinical research nurses who had been trained to administer the test. Interrater reliability was determined in a separate sample of five subjects. Criteria for reliability were scoring of each item within 1 point and at least 80 percent agreement on the total score. Agreement was scoring each item within 1 point, and percent agreement was calculated as the number of ratings within 1 point divided by the total number of ratings—that is, no more than 4 of the 20 items could vary by more than 1 point.

The Assessment of Interpersonal Problem Solving Skills (AIPSS; Donahoe et al., unpublished manuscript, 1987) is a videotaped vignette test used to assess the social skills of schizophrenia patients. The test measures a subject's ability to describe an interpersonal social problem, to derive a solution to the problem, and to enact a solution in a role-played simulation test. This analysis implies a problem-solving model of social skills. First, recognizing the existence of a problem requires skills of problem identification. The ability to describe both the goal and the obstacle is problem description. Together, problem identification and problem description are called receiving skills. Second, various alternatives must be identified, the consequences considered, and the best alternative chosen. These are processing skills. Third, the solution must be enacted. Sending skills consist of both content and performance skills (terminology from Wallace et al. 1980). The constructs measured by the instrument are operationally defined as receiving—processing—sending (RPS) skills (Donahoe et al. 1990). It has been hypothesized that the RPS model is sequential: competent performance at one stage depends on competent performance at earlier stages (Wallace et al. 1980).

The AIPSS has been shown to have adequate psychometric properties (Donahoe et al. 1990). It consists of 13 short videotaped interactions: 10 involve problems defined as one person preventing another from obtaining a desired goal (e.g., a waitress writes down an order incorrectly) and 3 present no problem (e.g., two friends enjoying a card game). Subjects watch the videotape and are instructed to identify with one of the actors in each vignette. Then they are asked a series of questions about the scene from the perspective of this actor: Is there a problem in the scene? What is the problem? (receiving skills); What would you do about the problem? (processing skills). Subjects are then asked to role-play their response to the problem situation (sending skills).Subjects are familiarized with the AIPSS during a practice scene in which questions and role-play are demonstrated. Scores from the demonstration scene are not included in the final scores.
The examiner records responses and subsequently scores them using a manual of correct responses (Donahoe et al., unpublished manuscript, 1987). For receiving skills, subjects receive 1 point for identifying the principal character's goal and 1 point for identifying the obstacle that prevents that character from obtaining the goal; possible scores for receiving are 0, 1, or 2. Scores for processing skills are based on how likely the described solutions would solve the problem without negative consequences; possible scores are 0, 1, or 2. Three scales are scored for sending skills: content (how effective the verbal content of the subject's response is in terms of its likelihood of solving the problem while minimizing negative consequences); performance (a measure of the social "polish" with which the response is performed); and an overall score (how effective the role-played response is, considering both content and performance). Content and overall rating are made on a scale of 0.0 to 2.0 with 0.5 increments, based on how likely the response is to obtain the goal and minimize negative consequences. Performance ratings are made on a similar scale based on the social appropriateness of the nonverbal characteristics. Overall ratings are used in data analyses as the measure of sending skills.

Each subject's percentage mean score for each of the subscales is calculated as described by Donahoe et al. (1990). The AIPSS was administered by an experienced clinical research nurse trained by a principal investigator (J.A.) to administer the test. Interrater reliability was determined in a separate sample of five subjects. The criterion for reliability was at least 80 percent agreement on each of the scale scores, that is, no more than 2 of the 10 items in each of the three subscales could vary by more than 1 point and thus, no more than 6 of the total of the 30 items varied by more than 1 point. In this study the raters did not vary on more than three items (90%). Reliability was checked every 20th assessment and agreement remained at a minimum of 90 percent.

**Neurocognitive Assessment.** Verbal ability, visual-spatial ability, executive and frontal lobe functioning, visual and verbal memory, and visual attention were assessed. Verbal ability was assessed with the vocabulary subtest, and visual-spatial ability was assessed with the block design subtest from the Wechsler Adult Intelligence Scale–Revised (WAIS-R; Wechsler 1981). The immediate and delayed recall of the logical memory and paired associates subtests from the Wechsler Memory Scale–Revised (Wechsler 1987) were used to assess verbal memory. Two scores were used from the Rey-Osterrieth memory for design task: the copy score, which reflects the accuracy of the original copy and is a measure of visual-constructional ability; and a recall score, which assesses the amount of visual information retained over time (Rey 1942). The computerized WCST, the Chicago Word Fluency Test (Thurstone and Thurstone 1943), and the Jones-Gotman Design Fluency Test (Jones-Gotman and Milner 1977) were used to measure executive and frontal lobe functioning. (The WCST computerized version, developed by Wang Laboratories, is comparable to the card version for this population [Hellman et al. 1992].)

Visual attention was assessed with the CPT and the forced-choice SPAN. The CPT measures visual sustained attention. We used Version 4 of the UCLA CPT computer program, the degraded stimulus version (Nuechterlein and Asarnow, unpublished manual, 1992), presented on an IBM-compatible computer with a color monitor. Viewing distance was 1 meter. Whenever subjects saw the target number 0, they responded by pressing the appropriate button on a joystick. Numbers were degraded to a standardized degree by reversing the black/white setting of a random 40 percent of the pixels. Such stimulus degradation places a burden on the early encoding state of information processing. Subjects were shown 160 practice trials followed by 480 experimental trials presented in three blocks of 160. Stimuli were presented for 70 ms at 1-sec intervals for all trials. The target 0 appeared in quasi-random sequence in 20 of every 80 trials. A’, a nonparametric signal detection index of sensitivity (the ability to discriminate targets from nontargets) was determined from subjects' responses (Nuechterlein 1991). The SPAN measures the efficiency of early iconic memory and readout stages of visual information processing relatively independent of active short-term memory (Asarnow et al. 1991). The SPAN is presented on an IBM-compatible computer with a color monitor. Version 4 of the UCLA SPAN (Asarnow and Nuechterlein 1992) was used. The test presents arrays of letters that contain either a “T” or an “F”; each array consists of 16 possible locations arranged in a 4 × 4 matrix. Either 2 or 11 nontarget letters randomly selected from the other 24 letters of the alphabet filled out the arrays. Letters were flashed on the screen for 110 ms. Subjects were told that the letters would flash on the screen and that either a T or an F would be in each array. Viewing distance was 1 meter. Subjects responded by pressing the appropriate button (T or F) on a joystick. Subjects received 20 practice trials and then 128 experimental trials presented in four blocks of each size (3 or 12 letters). An equal number of T’s and F’s appear in each block. Responses are scored to obtain the number of correct detections per array size.

All assessments were conducted within a 10-day period. The SCID and PANSS were administered in one session and the three social functioning measures in
another session. The neurocognitive assessment was completed in two sessions either both on the same day or on 2 consecutive days. Different research assistants conducted the social functioning and the neurocognitive assessments.

Results

Correlational analyses revealed that medication dose in CPZ equivalents was unrelated to performance on any of the neurocognitive tests. Analyses with independent t-tests indicated no differences between men and women on any of the symptom, neurocognitive, or social functioning measures.

The means and SDs of the neurocognitive tests are presented in table 1. Neurocognitive data were reduced to summary scores (see table 1). The neurocognitive test scores were converted to z scores and collapsed into the following eight summary scores: verbal ability, verbal memory, visual memory, visual-spatial organization, fluency, executive functioning/cognitive flexibility, vigilance, and early information processing (see table 1). Correlations between single test scores and summary scores for those tests that were collapsed ranged from 0.83 for visual-spatial, 0.83 for fluency, 0.88 for early information processing, and 0.96 for verbal memory.

Table 1. Neurocognitive tests

<table>
<thead>
<tr>
<th>Neurocognitive category</th>
<th>Tests</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal ability</td>
<td>WAIS-R vocabulary</td>
<td>44.4 (13.2)</td>
</tr>
<tr>
<td>Verbal memory</td>
<td>Immediate recall</td>
<td>31.7 (11.1)</td>
</tr>
<tr>
<td></td>
<td>Delayed recall</td>
<td>16.4 (8.1)</td>
</tr>
<tr>
<td>Visual memory</td>
<td>Rey recall</td>
<td>15.5 (7.3)</td>
</tr>
<tr>
<td>Visual-spatial</td>
<td>Rey copy</td>
<td>33.21 (3.09)</td>
</tr>
<tr>
<td>organization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Executive functioning</td>
<td>Word fluency</td>
<td>39.4 (14.6)</td>
</tr>
<tr>
<td>—fluency tasks</td>
<td>Fluency for design</td>
<td>26.6 (12.0)</td>
</tr>
<tr>
<td>Executive functioning</td>
<td>Perseverative errors</td>
<td>27.3 (20.2)</td>
</tr>
<tr>
<td>—cognitive flexibility—</td>
<td>Categories</td>
<td>3.23 (2.24)</td>
</tr>
<tr>
<td>WCST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vigilance</td>
<td>CPT—sensitivity</td>
<td>86.8 (9.8)</td>
</tr>
<tr>
<td>Early information</td>
<td>SPAN—3-letter</td>
<td>58.8 (5.9)</td>
</tr>
<tr>
<td>processing</td>
<td>array</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPAN—12-letter</td>
<td>47.6 (7.3)</td>
</tr>
</tbody>
</table>

Note.—SD = standard deviation; WAIS-R = Wechsler Adult Intelligence Scale—Revised (Wechsler 1981); WCST = Wisconsin Card Sorting Test (Heaton 1981); CPT = Continuous Performance Test (Nuechterlein and Asarnow 1992); SPAN = Forced-Choice Span of Apprehension Task (Asarnow and Nuechterlein 1992).
intrapsychic functioning and SPAN ($r = 0.22$, $p < 0.05$). Positive symptoms were not associated with any of the neurocognitive factors; however, high levels of negative symptoms were significantly associated with low scores on verbal ability, visual memory, fluency, and cognitive flexibility (see table 4).

Because the three AIPSS scales were significantly related to both negative symptoms and verbal ability and cognitive flexibility and the QLS was significantly related to cognitive flexibility and negative symptoms, partial correlations were conducted. Results showed that when negative symptoms are controlled for, significant associations between the AIPSS subscales and verbal ability, verbal memory, and cognitive flexibility remain. However, the association between QLS and cognitive flexibility is no longer significant. Associations between sending skills and vigilance and visual-spatial ability are also no longer significant (see table 5).

### Discussion

The hypothesis that neurocognitive functioning would predict social functioning was partially confirmed. Neurocognitive functioning predicted social problem solving, but only one neurocognitive test was related to one of the measures of community functioning. All three aspects of social problem solving—receiving skills, processing skills, and sending skills—were predicted by performance on verbal memory, verbal ability, and cognitive flexibility. Visual-spatial ability and vigilance were associated with the sending skills of the AIPSS. These results are in contrast to other studies, which noted an association between community functioning and secondary verbal memory, executive functioning, visual memory, and verbal fluency. In particular, Buchanan et al. (1994) noted that in a 1-year followup of patients on clozapine, improvement or decline in memory was concomitantly related to an improvement or decline in QLS. However, subjects in Buchanan's study were described as patients with treatment-resistant schizophrenia. The present study does support the negative findings of other studies,
problem solving. However, none of these studies used the AlPSS to measure social problem solving (Corrigan et al. 1994a; Penn et al. 1995). We report weak associations between social problem solving and measures of visual-spatial ability or vigilance processing; results in the literature have been inconsistent with respect to these associations. There was no support for the model that the first stage of social problem solving (i.e., receiving skills) would be more clearly associated with cognitive tasks that emphasize early information processing. Instead, neurocognitive deficits were associated with all stages of social problem solving.

The most important finding of this study is that social problem solving, not community functioning, was related to neurocognitive functioning. One possible explanation for the differences in results between this study and previous studies may be the fact that our relatively well-functioning sample may be at the higher end of a functional continuum compared with other samples in the literature. Even though our subjects do exhibit cognitive deficits, their cognitive impairment may not be severe enough to affect their community functioning as assessed by measures such as the SFS and the QLS. In higher functioning samples like ours, less severe cognitive impairment may have a noticeable impact only on more specific measures of community functioning such as occupational functioning (e.g., Lysaker et al. 1995a, 1995b). Occupational functioning measures a more demanding level of community functioning. It is only the less impaired individual who is likely to have returned to the workplace. Additionally, because this sample performed well on the SFS, it is possible that the relationship between cognitive functioning and the SFS might become apparent only in patients whose SFS functioning is more impaired.

Second, compared with social problem-solving measures, the QLS and the SFS tell us how much an individual is doing with respect to community functioning (i.e., how many friends they have, how often they see those friends, how they spend their leisure time). These measures only

Table 4. Correlations between neurocognitive functioning, social functioning, and positive and negative symptoms

<table>
<thead>
<tr>
<th>Neurocognitive</th>
<th>AIPSS</th>
<th>QLS</th>
<th>SFS</th>
<th>Negative symptoms</th>
<th>Positive symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal ability</td>
<td>0.43</td>
<td>0.53</td>
<td>0.21</td>
<td>-0.46</td>
<td>-0.11</td>
</tr>
<tr>
<td>Verbal memory</td>
<td>0.40</td>
<td>0.40</td>
<td>0.08</td>
<td>0.14</td>
<td>-0.22</td>
</tr>
<tr>
<td>Visual memory</td>
<td>0.15</td>
<td>0.13</td>
<td>0.07</td>
<td>0.08</td>
<td>0.19</td>
</tr>
<tr>
<td>Visual spatial</td>
<td>0.22</td>
<td>0.25</td>
<td>0.04</td>
<td>0.07</td>
<td>-0.19</td>
</tr>
<tr>
<td>Fluency</td>
<td>0.10</td>
<td>0.17</td>
<td>0.06</td>
<td>0.51</td>
<td>0.04</td>
</tr>
<tr>
<td>Cognitive flexibility</td>
<td>-0.35</td>
<td>-0.43</td>
<td>-0.28</td>
<td>-0.09</td>
<td>0.30</td>
</tr>
<tr>
<td>Vigilance</td>
<td>0.17</td>
<td>0.25</td>
<td>0.16</td>
<td>0.05</td>
<td>-0.15</td>
</tr>
<tr>
<td>Early processing</td>
<td>0.02</td>
<td>-0.01</td>
<td>0.12</td>
<td>-0.17</td>
<td>-0.15</td>
</tr>
</tbody>
</table>

Note.—AIPSS = Assessment of Interpersonal Problem-Solving Skills (Donahoe et al., unpublished manuscript, 1987); QLS = Quality of Life Scale (Heinrichs et al. 1984); SFS = Social Functioning Scale (Birchwood et al. 1990).

Table 5. Partial correlations between neurocognitive functioning and social functioning controlling for negative symptoms

<table>
<thead>
<tr>
<th>Neurocognitive</th>
<th>AIPSS</th>
<th>QLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal ability</td>
<td>0.36</td>
<td>0.44</td>
</tr>
<tr>
<td>Verbal memory</td>
<td>0.37</td>
<td>0.32</td>
</tr>
<tr>
<td>Visual spatial</td>
<td>0.16</td>
<td>0.20</td>
</tr>
<tr>
<td>Cognitive flexibility</td>
<td>-0.35</td>
<td>-0.36</td>
</tr>
<tr>
<td>Vigilance</td>
<td>0.15</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Note.—AIPSS = Assessment of Interpersonal Problem-Solving Skills (Donahoe et al., unpublished manuscript, 1987); QLS = Quality of Life Scale (Heinrichs et al. 1984).

1$^p < 0.001$.
2$^p < 0.001$.
3$^p < 0.05$.
4$^p < 0.01$.
5$^p < 0.01$.
6$^p < 0.05$.
7$^p < 0.01$.
8$^p < 0.001$.

Table 4 shows the correlations between neurocognitive functioning, social functioning, and positive and negative symptoms. Table 5 presents the partial correlations between neurocognitive functioning and social functioning controlling for negative symptoms. The tables indicate the lack of associations between community functioning and visual-spatial ability and vocabulary. One other study that used the SFS also reported a lack of association between the SFS and neurocognitive tests similar to those used in this study (Dickerson et al. 1996). Because the SFS was chosen to assess the more basic end of the social functioning spectrum (e.g., doing laundry, washing dishes), the lack of association may be because these kinds of tasks would be disrupted by more gross neurocognitive impairment (Dickerson et al. 1996).

That social problem solving was associated with several neurocognitive measures is consistent with other research that consistently reported a relationship between social problem solving and more complex cognitive tasks such as verbal IQ and secondary verbal memory (Green 1996). There is no support in the literature for our finding of an association between cognitive flexibility and social problem solving. However, none of these studies used the AlPSS to measure social problem solving (Corrigan et al. 1994a; Penn et al. 1995). We report weak associations between social problem solving and measures of visual-spatial ability or vigilance processing; results in the literature have been inconsistent with respect to these associations. There was no support for the model that the first stage of social problem solving (i.e., receiving skills) would be more clearly associated with cognitive tasks that emphasize early information processing. Instead, neurocognitive deficits were associated with all stages of social problem solving.

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Second, compared with social problem-solving measures, the QLS and the SFS tell us how much an individual is doing with respect to community functioning (i.e., how many friends they have, how often they see those friends, how they spend their leisure time). These measures only
between the social functioning measures and negative symptoms may be inflated. With a narrower measure of social contact, the relationships become independent of the relationship between neurocognitive functioning and the microsocial domain. They also suggested that the microsocial domain may be independent of functioning in the macrosocial domain. It is also possible that the microsocial domain may be one end of a continuum and the macrosocial domain at the other. Different measures of social functioning may fall along this continuum. For example, although the SFS and QLS may both belong to the microsocial domain, the QLS may be closer to the microsocial domain than the SFS.

This idea of microsocial and macrosocial domains has also been suggested by Corrigan and Toomey (1995) who imply that social problem-solving measures (e.g., AIPSS, Social Cue Recognition Task [SCRT; Corrigan and Toomey 1995]) could be conceived as social information processing tasks and as such are closer to neurocognitive tasks than are measures of community functioning. Corrigan and associates (Corrigan et al. 1992; Corrigan and Green 1993) have suggested that neurocognitive deficits may interfere with accurately recognizing and understanding the subtleties of interpersonal situations. These speculations imply that an association between neurocognitive functioning and the microsocial domain would be less likely than an association between neurocognitive functioning and the microsocial domain.

Consistent with all other studies, positive symptoms were found to be unrelated to neurocognitive functioning, social problem solving, or community functioning. The exception was the QLS, which was also related to negative symptoms. This is not surprising as the authors described the QLS as a measure of symptoms as well as current functioning (Heinrichs et al. 1984).

Negative symptoms were related to social problem solving, the QLS, and neurocognitive functioning, but it is impossible to assess whether negative symptoms are independent of the relationship between neurocognitive functioning and social functioning. What we can say is that the associations among social problem solving and verbal ability, verbal memory, and cognitive flexibility cannot be entirely due to negative symptoms. This may not be true for the association between QLS and cognitive flexibility and between sending skills and visual-spatial ability and vigilance. Because the negative symptoms on the PANSS include items that reflect social contact, the relationships between the social functioning measures and negative symptoms may be inflated. With a narrower measure of negative symptoms, the relationship between symptoms and social outcome might be reduced.

In summary, this study used a range of neurocognitive and social functioning measures in a large outpatient sample. The main conclusion is that certain aspects of neurocognitive functioning, such as verbal ability, verbal memory, and executive functioning, appear to be predictors of social problem solving, and as such may be rate limiting factors. Overall, these results add support to Green’s conclusions, particularly because this study has adequate statistical power. For a medium effect size of $r = 0.30$ with an alpha value of 0.05, two-tailed, the statistical power of this study is 0.78 (Cohen 1988).

This is a “rate limiting” study; that is, one that examined associations between neurocognitive functioning and outcome measures believed to be relevant to functioning in the real world. The next step would be a feasibility study in which remediation of specific deficits occurs. The third step would be generalizability studies in which improvement in social functioning is observed following remediation of an associated neurocognitive deficit. Rate limiting studies are a necessary prerequisite to generalizability studies because they determine an appropriate selection of neurocognitive measures (Green 1996). Alternatively, if the neurocognitive deficits known to occur in schizophrenia are associated with measures of social problem solving, perhaps, as Corrigan and Toomey (1995) suggest, remediation ought to focus on the deficits in social and interpersonal problem solving that have been observed on tasks such as the AIPSS, the SCRT, and the Situation Familiarity and Feature Recognition Test (Corrigan et al. 1996). These deficits in social cognition (Penn et al. 1995) are possibly stable deficits that do not vary from inpatient phase to outpatient (Addington and Addington 1998; Corrigan et al., unpublished manuscript, 1995). Thus, an alternative to generalizability studies might be training programs that emphasize remediation of social cognition and introduce compensatory strategies that put limited demands on those aspects of neurocognitive functioning known to be compromised. Such strategies could directly help improve interpersonal situations.

References


Lysaker, P.H.; Bell, M.D.; Zito, W.S.; and Bioty, S.M. Social skills at work, deficits and predictors of improvement in schizophrenia. *Journal of Nervous and Mental Disease*, 183:688–692, 1995b.


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