

Symptoms Versus Neurocognitive Test Performance as Predictors of Psychosocial Status in Schizophrenia: A 1- and 4-Year Prospective Study

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In recent years, a growing body of literature has highlighted the significance of neurocognitive deficits as markers for subsequent psychosocial deficits in patients with schizophrenia. Relatively few studies, however, have directly compared symptoms and neurocognitive test performance as predictors of psychosocial status in a prospective design. In two studies with schizophrenia patients, we investigated the relationship between symptom dimensions (psychomotor poverty, disorganization, reality distortion) and neurocognitive measures (problem solving, attention, verbal learning and memory) obtained at study entry, and psychosocial status measured at a 1- and 4-year follow-up. Results from the 1-year followup ($n = 70$) revealed that psychomotor poverty, symptoms of disorganization, and performance on measures of card-sorting and visual vigilance were related to psychosocial status. Results from the 4-year followup ($n = 26$) revealed a similar pattern of findings with the exception of verbal learning, which emerged as a predictor of psychosocial status only at the 4-year followup. Stepwise regression revealed that performance on measures of visual vigilance and psychomotor poverty symptoms explained the largest amount of variance in psychosocial status at both followup intervals. The significance of these findings for the development and assessment of novel treatment interventions for schizophrenia is discussed.

Keywords: Schizophrenia/neurocognition/symptoms/quality of life

A defining feature of schizophrenia is that onset of the disease is associated with a decline in psychosocial status (APA 1994). This phenomenon has long been recognized as a core abnormality of the disorder (e.g., Bleuler 1911; Kraepelin 1919). Deficits in skills associated with self-care, social interactions, recreation, and work function in young and middle-aged patients with schizophrenia are common (Bellack et al. 1994; Patterson et al. 2001) and are more pronounced than those evident in other forms of severe and persistent mental illness (e.g., Schretlen et al.

2000). Patient characteristics most closely linked to measures of psychosocial status, however, remain unclear.

Negative symptoms have been linked to poor outcome in both cross-sectional (e.g., Dickerson et al. 1996) and longitudinal studies (e.g., Wieselgren et al. 1996). Studies have also associated performance on neurocognitive tasks, particularly visual vigilance (Corrigan et al. 1994), secondary verbal memory (Bellack et al. 1994), and executive function (Jaeger and Douglas 1992), with measures of community function, psychosocial skill acquisition, and social problem solving (e.g., Green 1996). Understanding whether symptoms or cognitive skills are more closely related to variations in psychosocial status is particularly crucial in a disease entity as heterogeneous as schizophrenia. Most recent estimates suggest that as many as 75 percent of schizophrenia patients have some form of cognitive deficits on neuropsychological test batteries, with the pattern ranging widely between patients (Palmer et al. 1997). Similarly, patients present with a wide variety of symptom profiles (e.g., Hill et al. 2001). It seems unlikely that specific symptoms and neurocognitive deficits contribute to psychosocial deficit equally. Thus, patients characterized by different patterns of symptom ratings and neurocognitive deficits may show quite different patterns of psychosocial deficits over time. Understanding this relationship is crucial to (1) predicting the subsequent use of health care resources by patients with different clinical presentation, and (2) guiding the development of more specific pharmacological and behavioral treatments that target those aspects of patient presentations most closely tied to psychosocial status. Until recently, however, conclusions regarding the relative role of these factors have been limited because relatively few studies have investigated both sets of factors in a patient sample longitudinally (e.g., Green 1996).

Norman et al. (1999), in a study of 50 schizophrenia patients, investigated the relationship of symptoms and performance on several neuropsychological measures to psychosocial status measured approximately 10 months later. Significant relationships were evident between positive symptoms and syndromal disorganization to overall psychosocial status, as well as to specific measures of self-care. There were no relationships between neurocognitive indexes and measures of subsequent psychosocial status. In a related study, Dickerson et al. (1999) evaluated the relationship of demographic data, neurocognitive test

performance, and symptoms to ratings on two interview-based assessments of psychosocial status in a sample of 72 schizophrenia patients. Improvement on measures of competence in activities of daily living (ADLs) over a 2-year followup period was related to performance on measures of executive function and visuospatial construction at baseline, as well as illness duration, whereas improvement on a rating of occupational activity was related to vocabulary, visuoconstructive ability, visual memory, and psychomotor speed and sequencing measured at baseline. The strongest baseline predictors of total scores on the two psychosocial rating scales measured 2 years later were the Positive and Negative Syndrome Scale negative symptom factor, an aphasia screening test, and age. The authors concluded that neurocognitive deficits are closely related to both changes in psychosocial status over time and overall measures of psychosocial status. Finally, Velligan *et al.* (2000), in a sample of 40 schizophrenia patients hospitalized multiple times, examined the predictive relationship of neurocognitive functions and the Brief Psychiatric Rating Scale (BPRS) to outcome measured 1 to 3.5 years later with interview-based assessments of community function. Results showed that verbal memory, visual vigilance, and executive function were related to overlapping aspects of psychosocial status. Psychosis and retardation factors computed from the BPRS were not significantly related to any aspect of outcome.

Discrepancies in research findings may reflect the absence of critical measures of potentially rate-limiting cognitive processes in some studies (e.g., Norman *et al.* 1999) and conceptualization of symptom patterns in schizophrenia as expressed along two (positive and negative; e.g., Dickerson *et al.* 1999; Velligan *et al.* 2000) rather than three dimensions (e.g., Liddle 1987) in others. In addition, followup periods varied greatly within and between studies (10 months vs. 3.5 years). Thus, the current longitudinal study was designed to extend previous research by (1) including cognitive variables most closely tied to psychosocial status based on the previous literature (e.g., Green 1996); (2) comparing these variables with a three-dimensional conceptualization of symptom factors; and (3) investigating how the relationship between symptoms, neurocognitive measures, and psychosocial status may vary depending upon the duration of the followup period in a sample of young-adult patients relatively early in their illness.

Methods

Participants. Patients were drawn from an ongoing longitudinal investigation of behavior and brain function at the Schizophrenia Research Center of the University of Pennsylvania. After written informed consent was obtained, participants underwent standard comprehensive screening and assessment procedures (Gur *et al.* 1991). This included the patient edition of the Structured

Clinical Interview for *DSM-IV* (SCID-P; Spitzer *et al.* 1996). Detailed medical history, physical examination, and laboratory tests were obtained for all participants. Entrance criteria included (1) a diagnosis of schizophrenia or schizophreniform disorder by *DSM-IV* criteria (APA 1994); (2) no concomitant Axis I or II disorder, including past or present substance abuse or dependence; and (3) no neurological disorder (e.g., epilepsy, migraine, head trauma with loss of consciousness).

For study 1, the sample included 70 patients with schizophrenia (42 males and 28 females) who met entry criteria, received neuropsychological and symptom assessment, and were followed up, on average 1 year later, with a commonly used measure of psychosocial status, the Quality of Life Scale (QLS; Heinrichs *et al.* 1984). At initial assessment, they had a mean (\pm standard deviation [SD]) age of 28.0 ± 8.1 years and an average of 12.9 ± 2.2 years of education. Patients had a mean age of illness onset of 22.8 ± 6.2 years, an average of 1.6 ± 2.2 hospitalizations, and a mean total BPRS score of 43.4 ± 10.6 . For study 2, the sample included 26 patients with schizophrenia (14 males and 12 females) who met entry criteria, received neuropsychological and symptom assessment, and were followed up, on average 4 years later, with QLS ratings. Eighteen of these patients were part of the 1-year followup sample. At the initial assessment, the sample for study 2 had a mean (\pm SD) age of 29.8 ± 8.7 years and an average of 12.5 ± 1.7 years of education. Patients in this sample had a mean age of illness onset of 22.2 ± 6.2 years, a mean number of hospitalizations of 3.7 ± 5.9 , and a mean total BPRS score of 47.7 ± 10.3 . Demographic and clinical characteristics of the two samples were not significantly different (all p 's > 0.05).

Symptom Rating Scales. Scales included the BPRS (Overall and Gorham 1980), the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen 1983), the Scale for the Assessment of Negative Symptoms (SANS; Andreasen 1984), and the QLS (Heinrichs *et al.* 1984). The scales for this study were administered by investigators trained to a criterion reliability of 0.90 intraclass correlation (Shtasel *et al.* 1992). Individual item ratings from the SANS and the SAPS were grouped into three symptom categories of psychomotor poverty, disorganization, and reality distortion based on the methods used by Liddle and Morris (1991). The psychomotor poverty syndrome was established using the scores for poverty of speech, the scores for decreased spontaneous movement, and the average of four items reflecting aspects of blunting of affect. The ratings of the disorganization syndrome were from the sum of the scores for inappropriate affect, the scores for poverty of content of speech, and the global ratings of positive formal thought disorder. The score for the reality distortion syndrome was based on the sum of the scores of the items for auditory hallucinations commenting on the patient's behavior, persecutory delusions,

and delusions of reference. We selected this method for calculation of syndromes for two reasons. First, use of these syndromes minimizes overlap between ratings on the negative symptom scale selected for the current study (SANS) and measures of psychosocial status, thus minimizing artificial inflation of the relationship between negative symptoms and quality of life. The SANS includes items related to poor grooming, impersistence at work or school, physical anergia, recreational interests and activities, sexual activity, ability to feel intimacy and closeness, relationships with friends and peers, and social inattentiveness. These items are not included in composite ratings of each syndrome because of their focus on psychosocial status rather than symptoms (see Liddle 1987). Second, previous research has shown a close relationship between the disorganization factor when measured at baseline and outcome measures assessed approximately 10 months later in schizophrenia patients (Norman et al. 1999).

Neurocognitive Test Procedures. Measures of visual vigilance, verbal learning and memory, and executive function were selected in light of previous research suggesting that these neurocognitive variables are most closely related to psychosocial status (Green, 1996).

Problem solving: Wisconsin Card Sorting Test (WCST; Berg 1948). This is a test of rule learning and conceptual flexibility. The subject is required to learn to sort a series of cards according to one of three principles (color, form, or number) based on response feedback. After 10 consecutive sorts to the correct principle, the rule changes without the subject being informed. The subject must infer the change in rule based on response feedback. The two-deck, 128-card paper-and-pencil version of the test was administered (Heaton 1981). Dependent measures included total number of categories achieved and perseverative responses.

Attention: The Gordon Diagnostic System Continuous Performance Test—Vigilance subtest (GDS CPT; Gordon 1986). In this version of the CPT, the subject is presented a series of 360 numbers between 1 and 9 on a front display at a rate of one per second with a 200-msec exposure time. The participant is asked to respond as rapidly as possible when the number 1 is followed by the number 9. True positives, false positives, and reaction time were recorded as dependent measures.

Verbal learning and memory: California Verbal Learning Test (CVLT; Delis et al. 1983). This is a list learning task in which 16 words from four semantic categories are read to the subject over a series of five list presentations. This test measures verbal learning, verbal memory, and semantic organization. Total number of words recalled over the five trials and performance on trial 1 were selected as dependent measures.

Psychosocial Status. The 21-item QLS (Heinrichs et al. 1984) was selected as a measure of psychosocial functioning in schizophrenia. This scale was administered at an approximate 1- and 4-year followup after symptom and cognitive assessment. The QLS balances subjective questions regarding life satisfaction with objective indicators of social and occupational role functioning. Administered by a trained clinician as a semistructured interview, the scale provides information on functioning during the 4 weeks prior to assessment. Behavioral anchors are presented for each item, scored on a 0 (severe impairment) to 6 (high functioning) scale. The QLS assesses four interdependent theoretical constructs: (1) intrapsychic foundations (QLS13–QLS17, QLS20, QLS21), consisting of measures related to sense of purpose and motivation; (2) interpersonal relations (QLS1–QLS8), examining social experience; (3) instrumental role (QLS9–QLS12), related to work functioning; and (4) common objects and activities (QLS18–QLS19), which measures engagement in the community by possession of common objects and participation in a range of activities. The validity of these subscales is supported by principal components factor analysis (e.g., Heinrichs et al. 1984); they were used to evaluate separate dimensions of psychosocial status in the present study. For study 1, the QLS was administered on average 10.5 ± 3.1 months after symptom and cognitive assessment. For study 2, the QLS was administered on average 48.5 ± 1.9 months after symptom and cognitive assessment.

Data Analysis. The data analysis comparing scores on the cognitive and symptom measures at baseline with functional status, as measured by the QLS at followup, addressed the following predictions. First, at a 1-year followup, patients with greater impairment on measures of visual vigilance, verbal learning and memory, and problem solving at baseline would show greater impairment on total scores on the QLS as well as intrapsychic foundations, interpersonal relations, instrumental role, and common objects and activities subscales. Patients with higher overall symptom factor scores would not show greater impairment on total scores on the QLS or intrapsychic foundations, interpersonal relations, instrumental role, and common objects and activities subscales. Second, at a 4-year followup, a similar relationship between neurocognitive test performance, symptom ratings, and functional status, as measured by the QLS, would be evident. Patients with greater impairment on measures of visual vigilance, verbal learning and memory, and problem solving at baseline would show greater impairment on total scores on the QLS as well as the intrapsychic foundations, interpersonal relations, instrumental role, and common objects and activities subscales. Patients with higher symptom factor scores would not show greater impairment on total scores on the QLS or the intrapsychic foundations, interpersonal relations, instrumental role, and common objects and activities subscales.

Table I. Mean (SD) scores on symptom ratings and neurocognitive measures and Pearson bivariate correlations with the QLS total score and IPF, INTR, IR, and CO factor scores at a 1-year followup

	<i>n</i>	Mean (SD)	QLS Total	IPF	INTR	IR	CO
Psychomotor poverty factor	70	3.1 (3.2)	−0.31*	−0.27*	−0.38**	−0.05	−0.28*
Disorganization factor	70	5.0 (3.1)	−0.32*	−0.33*	−0.32**	−0.21	−0.16
Reality distortion factor	70	6.4 (3.3)	−0.15	−0.10	−0.11	−0.13	−0.31*
WCST CAT	61	3.8 (2.7)	0.31*	0.25	0.32*	0.20	0.31*
WCST PR	58	29.7 (27.5)	−0.26*	−0.22	−0.17	−0.34**	−0.25
VIG TP	63	26.0 (4.6)	0.42**	0.45**	0.28*	0.41**	0.30*
VIG FP	62	4.2 (6.9)	−0.30*	−0.32*	−0.22	−0.23	−0.33*
CVLT T1	68	4.8 (2.3)	0.17	0.15	0.10	0.17	0.33*
CVLT Total	66	37.5 (14.9)	0.17	0.15	0.10	0.18	0.30*

Note.—CAT = categories achieved; CO = common objects and activities; CVLT = California Verbal Learning Test; FP = false positives; INTR = interpersonal relations; IPF = intrapsychic foundations; IR = instrumental role; PR = perseverative responses; QLS = Quality of Life Scale; SD = standard deviation; T1 = number of words recalled on trial 1; TOT = total number of words recalled across five trials; TP = true positives; VIG = Gordon Diagnostic System Continuous Performance Test—Vigilance subtest; WCST = Wisconsin Card Sorting Test.

* $p < 0.05$; ** $p < 0.005$.

Planned contrasts were used to reduce the overall number of correlations computed and to minimize experiment-wise type I error. To test the first and second hypotheses, Pearson bivariate product moment correlations were computed between the symptom and cognitive scores with ratings on the QLS total and subscale scores at the 1- and 4-year followups. After initial data analysis, we substituted Pearson correlations with Spearman rank-order correlations for each pair of variables to compare the overall pattern of relationships using parametric versus nonparametric methods. To assess the independent contribution of neurocognitive and symptom variables to functional outcome, variables that were significant in these correlations for both the 1-year followup and the 4-year followup were entered into stepwise multiple regression analysis to predict QLS total and subscale scores at followup. For all analyses in this article, a p value of <0.05 was considered to be statistically significant.

Results

Correlations Between Symptom Ratings, Neuro-psychological Measures, and Total and Subscale Scores on the QLS at a 1-Year Followup. Table 1 shows Pearson bivariate correlation coefficients between total scores on the QLS, as well as the four subscale scores, and neuro-psychological measures and symptom indexes. A similar pattern of results was obtained when Spearman rho values were substituted. Both symptom and neuro-psychological measures obtained at study entry were significantly related to psychosocial status as measured by total and subscale QLS scores at a 1-year followup. When symptom ratings were divided into three dimensions,

based on factor analysis of component positive and negative symptom ratings (e.g., Liddle 1987), both psychomotor poverty and disorganization factor scores were most closely linked with psychosocial status at followup.

For neurocognition, poor performance on measures of executive function and sustained visual vigilance were most strongly related to poorer scores on the QLS measured at a 1-year followup. Specifically, a greater number of categories achieved and a smaller number of perseverative responses from the WCST were related to better ratings on the QLS. A higher number of true positives on the Vigilance subtest of the CPT was related to better total and subscale scores from the QLS. A smaller number of false positives from the Vigilance subtest of the CPT was related to higher total scores from the QLS. With the exception of the common objects and activities subscale of the QLS, verbal list learning performance, as measured by the CVLT, was not related to total or subscale scores on the QLS.

Symptom and Neurocognitive Variables: Prediction of QLS Scores at a 1-Year Followup. Symptom and neurocognitive variables correlated with QLS total scores at 1-year followup were entered into stepwise regression analysis to determine which of these variables in combination would best predict psychosocial status at followup and how much of the variance in functional status would be captured by these measures. Independent variables were psychomotor poverty and disorganization factor scores, executive function, and sustained visual vigilance measures. Sustained visual vigilance predicted the majority of the variance (21%) in the QLS ($F[1,51] = 12.89$; $p < 0.005$). Psychomotor poverty symptom factor entered

Table II. Mean (SD) scores on symptom ratings and neurocognitive measures and Pearson bivariate correlations with the QLS total score and IPF, INTR, IR, and CO factor scores at a 4-year followup

	<i>n</i>	Mean (SD)	QLS Total	IPF	INTR	IR	CO
Psychomotor poverty factor	26	3.3 (3.5)	−0.41*	−0.44*	−0.38	−0.23	−0.27
Disorganization factor	26	6.5 (3.2)	−0.58**	−0.58**	−0.45*	−0.58**	−0.57**
Reality distortion factor	26	7.8 (2.7)	0.32	0.31	0.19	0.41*	0.38
WCST CAT	23	3.5 (2.8)	0.35	0.40	0.27	0.23	0.40
WCST PR	19	27.9 (20.5)	−0.38	−0.36	−0.26	−0.34	−0.57*
VIG TP	19	27.0 (3.0)	0.58*	0.61**	0.36	0.66**	0.53*
VIG FP	19	3.6 (4.6)	−0.43	−0.39	−0.40	−0.22	−0.51*
CVLT T1	26	4.6 (2.2)	0.42*	0.41*	0.33	0.39	0.44*
CVLT Total	25	36.8 (15.1)	0.55**	0.54**	0.44*	0.51*	0.60**

Note.—CAT = categories achieved; CO = common objects and activities; CVLT = California Verbal Learning Test; FP = false positives; INTR = interpersonal relations; IPF = intrapsychic foundations; IR = instrumental role; PR = perseverative responses; QLS = Quality of Life Scale; SD = standard deviation; T1 = number of words recalled on trial 1; TOT = total number of words recalled across five trials; TP = true positives; VIG = Gordon Diagnostic System Continuous Performance Test—Vigilance subtest; WCST = Wisconsin Card Sorting Test.

p* < 0.05; *p* < 0.005.

into the model second and accounted for an additional 7 percent of the variance ($F[2,51] = 9.59; p < 0.001$). All other variables were excluded from the model because they did not provide additional information about QLS scores.

Correlations Between Symptom Ratings, Neuropsychological Measures, and Total and Subscale Scores on the QLS at a 4-Year Followup. Table 2 shows Pearson bivariate correlation coefficients between total and subscale scores on the QLS and neuropsychological measures and symptom indexes. A similar pattern of results was obtained when Spearman rho coefficients were calculated. Both symptom and neuropsychological measures assessed at study entry were significantly related to total and subscale scores on the QLS at a 4-year followup. The relationship between symptoms and psychosocial status measured at a 4-year followup was largely unchanged as compared with a 1-year followup. When symptoms were grouped into psychomotor poverty, disorganization, and reality distortion factors, the disorganization and psychomotor poverty factors were related to total scores from the QLS. The disorganization factor was related to all QLS subscales, whereas the psychomotor poverty factor was related to the intrapsychic foundations subscale only.

The relationship of neurocognitive measures to psychosocial status at a 4-year followup was somewhat different from that evident at a 1-year followup. Consistent with previous findings, sustained visual vigilance was related to subsequent psychosocial status as measured by QLS scores. In contrast to findings at a 1-year followup, CVLT verbal learning was significantly related to overall

psychosocial status at 4-year followup. Specifically, better CVLT performance on trial 1 and across learning trials related to better functioning on the intrapsychic foundations and common objects scales from the QLS. Total scores from the CVLT were also related to interpersonal relations and instrumental role function subscales. With the exception of the common objects and activities subscale of the QLS, executive function, as measured by the WCST, was not related to psychosocial status on the QLS at a 4-year followup. However, correlation coefficients approached significance and were of similar size to those reported for the 1-year followup.

Symptom and Neurocognitive Variables: Prediction of QLS Scores at a 4-Year Followup. Symptom and cognitive variables with correlations with QLS total scores at a 4-year followup were entered into stepwise regression analysis to determine which of these variables in combination would best predict psychosocial status at followup and how much of the variance in functional status would be captured by these measures. Independent variables were psychomotor poverty and disorganization factor scores, sustained visual vigilance, and verbal learning and memory.

Similar to the regression analysis at a 1-year followup, sustained visual attention, as measured by true positives on the CPT, predicted the majority of the variance (35%) in the total score from the QLS ($F[1,17] = 8.43; p < 0.05$). Psychomotor poverty entered into the model second and accounted for an additional 21 percent of the variance ($F[2,17] = 9.67; p < 0.005$). All other variables were excluded from the model because they did not provide additional information about QLS scores.

Discussion

The most notable finding from this study is that both symptoms and neurocognitive test performance, measured at entry to the study, were related to psychosocial status, as measured by the QLS, at a 1- and 4-year follow-up in this young-adult sample of community-dwelling patients with schizophrenia. Component ratings from the SANS and the SAPS were combined to create the three symptom dimensions of psychomotor poverty, disorganization, and reality distortion. The disorganization factor, consisting of ratings of thought disorder and inappropriate speech, and the psychomotor poverty factor, consisting of measures of negative symptoms of poverty of speech and movement, and blunting of affect, were significantly related to psychosocial status at followup. The reality distortion factor, consisting of measures of positive symptoms of delusions and hallucinations, was not related to psychosocial status. Length of interval to followup (1 vs. 4 years) did not influence the relationship of symptoms to psychosocial status.

The findings regarding the psychomotor poverty and reality distortion factors are consistent with findings from several recent studies using different measures of negative and positive symptoms in both young-adult (e.g., Bow-Thomas *et al.* 1999; Dickerson *et al.* 1999) and elderly (McGurk *et al.* 2000) patient samples. The finding of a relationship of disorganization symptoms to psychosocial status also replicates that of Norman *et al.* (1999) extending to a 4-year followup. These findings suggest that while a growing number of studies have highlighted the role of cognitive variables in predicting subsequent psychosocial function (e.g., Green 1996), symptoms clearly account for a significant proportion of the variance in psychosocial status as well.

With respect to neurocognitive measures, visual vigilance and problem solving, measured at study entry, were related to psychosocial status measured at a 1-year followup. In contrast to symptom findings, however, neurocognitive variables' relationship to psychosocial status changed depending on the length of followup interval. Although CVLT measures of verbal learning and memory were not related to psychosocial status at a 1-year followup, they were related to total QLS scores and QLS subscales of intrapsychic foundations, interpersonal relations, instrumental role function, and common objects and activities, at 4-year followup. Problem solving was no longer related to outcome at a 4-year followup, although the magnitude of the correlation was quite similar to that seen at a 1-year followup. The observed relationships between card sorting, visual vigilance, and verbal memory measured at baseline and psychosocial status, measured at followup, are consistent with the results of Green's (1996) review article and with more recent studies (Velligan *et al.* 2000). Stepwise regression including both symptom and neurocognitive variables revealed that performance

on a CPT measure of visual vigilance and the psychomotor poverty symptom syndrome explained the greatest amount of variance in psychosocial status scale scores at both a 1- and a 4-year followup.

Results from the Norman *et al.* (1999) study failed to show a significant relationship between any of the neuropsychological measures used in their study at baseline and psychosocial status measured 10 months later in a similar sample of primarily young-adult patients with schizophrenia. One explanation for the discrepancy in results is the absence of a measure of sustained visual vigilance in their test battery. Stepwise regression revealed the CPT as the variable explaining the most independent variance in psychosocial status in the current study. A second potential factor is the discrepancy in duration of followup interval. Verbal memory could have emerged as a predictor of psychosocial status in their study after a longer followup period.

Several caveats should be mentioned. First, the sample size at a 4-year followup was small ($n = 26$), thus the power for this part of the study was low. Second, while the QLS was designed as a measure of psychosocial status, it was also developed with a focus on assessing the deficit syndrome of schizophrenia (Heinrichs *et al.* 1984). While care was taken in the computation of component symptom syndromes to use only those items from the negative symptom rating scale (SANS) that did not directly overlap with ratings on the QLS, relationships between the disorganization and psychomotor poverty symptom syndromes and psychosocial status could potentially be attenuated with a measure of psychosocial status designed to assess ADLs more directly. Third, the psychosocial status measure selected for the current study was dependent on patient self-report and clinician rating. Limitations regarding the use of these instruments in the severely mentally ill have been described (e.g., Atkinson *et al.* 1997), and there is evidence that patients with schizophrenia often over- or underestimate their ability to perform ADLs (see Sager *et al.* 1992). The current study would have been strengthened by the use of a performance-based measure of psychosocial status not subject to the limitations of patient self-report (e.g., Patterson *et al.* 2001). Of note is that the study participants were not severely ill and information regarding their daily activities was available from family members and care providers.

The results of the current study are part of a growing body of research designed to help us understand the pathogenesis of social disability in schizophrenia patients by identifying those patient characteristics that account for the greatest amount of variance in psychosocial status. These studies suggest which symptoms and neurocognitive deficits evident in the disorder can be targeted most profitably by novel pharmacological and behavioral interventions. Thus, the findings from the current study suggest that future research should focus on interventions that target deficits in visual vigilance and psychomotor

poverty, as well as syndromal disorganization and deficits in problem solving and verbal learning, to maximize impact on patient outcome.

It should also be noted that all of the patients participating in this study were receiving psychiatric care, including medications, support, education, and, when indicated, community case management. A small but increasing number of studies have revealed the effectiveness of cognitive remediation treatment for deficits in executive function, working memory, and other cognitive functions evident in schizophrenia (e.g., Bell et al. 2001). These interventions are typically time- and labor-intensive and frequently involve the use of limited resources. Thus, another important area of future study will be to investigate those aspects of symptoms and cognitive dysfunction at treatment entry that best predict response to behavioral interventions in order to maximize benefit for the largest number of patients.

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