Published in final edited form as:

Psychiatry Res. 2012 December 30; 200(2-3): 102–107. doi:10.1016/j.psychres.2012.06.025.

Cognitive and Social Cognitive Predictors of Change in Objective versus Subjective Quality-of-Life in Rehabilitation for Schizophrenia

Matthew M. Kurtz^{a,b,c,*}, Melanie Bronfeld^a, and Jennifer Rose^a

^aDepartment of Psychology, Quantitative Analysis Center and Program in Neuroscience and Behavior, Wesleyan University, Middletown, 06459, USA

^bSchizophrenia Rehabilitation Program, Institute of Living, Hartford, CT. 06106, USA

^cDepartment of Psychiatry, Yale School of Medicine, New Haven, CT. 06511, USA

Abstract

A small but growing body of work has studied the role of cognitive skills in predicting response to integrated programs of rehabilitation in schizophrenia. No studies however, have directly compared the roles and interrelationships of cognition, social cognition and other disease factors in predicting improvements in the separate domains of objective quality-of-life (QOL) and subjective satisfaction with life (SWL) in response to rehabilitation in schizophrenia. Forty-four outpatients with schizophrenia were administered measures of cognition, social cognition, and symptoms at entry to a psychosocial and cognitive rehabilitation program. Change in objective QOL and subjective SWL before and after treatment were measured as outcome variables. Cognitive measures of verbal memory and social cognitive measures of facial affect recognition were linked to improvements in objective QOL, while verbal memory and crystallized verbal skill was linked to improvements in SWL. Facial affect recognition partially mediated the relationship between verbal memory and improvements in objective QOL. The implications of these findings for understanding interrelationships between cognition and social cognition and their role in predicting change in different domains of outcome as a function of behavioral treatment are discussed.

Keywords

schizophrenia; quality-of-life; cognition; social cognition; rehabilitation

1. Introduction

While contemporary pharmacologic strategies are effective at managing positive symptoms, they have had little impact on poor outcome that is a defining feature of schizophrenia (DSM-IV; APA, 1994). Thus, understanding determinants of poor outcome in the disorder has become a central goal of study. A wealth of studies conducted over the past 20 years has

© 2012 Elsevier Ireland Ltd. All rights reserved.

*Corresponding Author. Department of Psychology, Wesleyan University, Judd Hall, 207 High Street, Middletown, CT 06459, USA. Tel +1 860 695 2072, fax: +1 860 685 2761. mkurtz@wesleyan.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

supported a link between cognitive skills and functional outcomes for patients with schizophrenia, whether measured cross-sectionally or longitudinally, with current estimates suggesting that 20–60% of variance in outcomes is explained by cognitive deficits (e.g., Green et al., 2000; Green et al., 2004). Several recent longitudinal studies have suggested that cognitive deficits play a particularly important role in the ability of patients to benefit from integrated programs of behavioral rehabilitation (Woonings et al., 2002; Brekke et al., 2005, 2007; Kurtz et al., 2008).

Objective measures of community function and quality-of-life (QOL) such as frequency and quality of social interactions, employment status and recreational engagement have most frequently been used as endpoints in studies of outcome in schizophrenia, despite the fact that most agree QOL is a multi-dimensional construct that includes not only objective components of community function, but subjective assessments of well-being as well (Test et al., 2005). Indeed, original conceptualizations of QOL in schizophrenia suggested that global well-being should reflect a composite of at least somewhat independent domains of objective indicators of QOL and patient satisfaction across parallel life domains (Lehman, 1988). By this view, for example, the domain of social relations might be measured objectively by asking questions about the frequency of the patient's social contacts, for example, "How often do you spend time with close friends?" In contrast, subjective SWL for social relations measures patient satisfaction, asking for a subjective assessment of quality of the patient's interactions with others, for example, "How do you feel about the amount of time you spend with other people?" (e.g., Quality of Life Interview [QOLI]; Lehman, 1988). Despite importance expressed by consumers, subjective life satisfaction as an outcome domain has been a relatively neglected area of research relative to studies of objective indices of QOL in schizophrenia.

Cross-sectional research suggests that subjective life satisfaction or quality-of-life, while related to objective measures of quality-of-life in schizophrenia, may be influenced by illness features quite different than those for objective QOL. In a recent meta-analysis of 20 cross-sectional studies, we revealed small-to-moderate relationships between crystallized verbal intelligence, working memory, verbal list learning, processing speed and executive function and objective QOL, but non-significant or inverse relationships between cognitive skills for the vast majority of cognitive measures and subjective measures of QOL (Tolman and Kurtz, 2012). One potential explanation for the inverse relationship between domains of neurocognition and subjective QOL is that those individuals with stronger cognitive abilities may have greater insight into their illness and functional disability, enabling negative social comparison and thus lower subjective life satisfaction.

Despite these very different cross-sectional relationships, to date only one study, to our knowledge has directly compared clinical and cognitive predictors of longitudinal change in subjective vs. objective QOL in the same sample of patients with schizophrenia in response to treatment. Prouteau et al. (2005) in sample of 55 participants studied longitudinally during an integrated program of rehabilitation showed that better baseline visual memory predicted stronger objective community function during follow-up, whereas poorer baseline attention predicted greater subjective measures of QOL during the same follow-up period. Social cognition was not measured as part of this study.

Social cognition is defined as the mental operations involved in understanding, perceiving and interpreting our social world (Fiske and Taylor, 1995). There is a wealth of evidence showing that clients with schizophrenia have social cognitive deficits that are a stable feature of the disorder (e.g., Penn et al., 1997), and that are closely linked to a variety of domains of outcome (see Couture et al., 2007 for a review). Furthermore, a growing number of experts have suggested that functional outcomes (both cross-sectional and longitudinal) in

schizophrenia can be better understood by the relationship of neurocognition and specific aspects of social cognition, for example, the ability to accurately make attributions about another's intentions, or Theory-of-Mind (ToM), and the ability to decode facial affect (see 2006 NIMH Workshop on Social Cognition in Schizophrenia, Green et al., 2008). Consistent with this idea, three recent studies have revealed that measures of facial affect recognition and/or ToM mediate the relationship between cognition and objective measures of community function (Brekke et al., 2005; Sergi et al., 2006; Horton and Silverstein, 2008). However, none included subjective measures of life satisfaction or looked at change in functioning over time. Thus the role of social cognition in mediating the predictive influence of cognition on *change* in objective and subjective indices in functioning remains unknown.

The current study was designed to investigate the degree to which cognitive and social cognitive skills, as well as symptoms, measured at entry to an intensive program of cognitive and psychosocial rehabilitation predicted: (1) change in observer-rated, objective quality-of-life, and (2) change in subjective quality-of-life in schizophrenia. We predicted first, that improvements in objective QOL would be moderately correlated with improvements in subjective QOL, second that cognitive measures, and social cognitive skills but not symptoms, measured at study entry would be linked to improvements in objective QOL, and third that cognitive and social cognitive skills would not be linked to changes in subjective QOL (based on evidence from cross-sectional studies; see Tolman and Kurtz, in press). Lastly, we predicted that social cognitive skills of facial affect recognition would mediate the predictive relationship between baseline cognitive skills and change in objective QOL.

2. Methods

Data for this study were collected as part of an ongoing parent study of the combined effects of cognitive remediation and social skills training on a variety of proximal and distal treatment outcome measures in schizophrenia. All participants were randomly assigned to one of two computerized cognitive rehabilitation groups (cognitive remediation or computer-skills training) as part of this parent study. The current report collapses data across the two cognitive rehabilitation programs, but account for possible differential effects of these interventions in our statistical analysis plan. We note that the sample of participants described in this report does not overlap with a previous report published by our group on predictors of response to psychosocial rehabilitation in schizophrenia (Kurtz et al., 2008).

2.1 Participants

Forty-four clinically stable, community-dwelling individuals with schizophrenia or schizoaffective disorder participated. Diagnosis was confirmed by the patient form of the Structured Clinical Interview for DSM-IV (SCID; First et al., 1996). Exclusion criteria for all potential participants were: (a) known neurological disease, (b) developmental disability, (c) current substance abuse, (d) mental retardation as evidenced by a history of services, or (e) lack of fluency in English. All patients provided written informed consent and all procedures met institutional ethical review. Recruitment for the study was ongoing over a four year period (2007–2011) and occurred at two sites (the Institute of Living in Hartford; n=43 and Intercommunity Mental Health Center in East Hartford, CT, n=1). Participants were assessed approximately 6–12 months after program entry at the termination for their computer training. Clinical and demographic characteristics of the sample are presented in Table 1.

2.2 Assessment Measures

2.2.1 Cognitive Assessment—All participants were administered a neuropsychological test battery including the Vocabulary, and the Digit Symbol and Symbol Search subtests (Processing Speed index; PSI) from the Wechsler Adult Intelligence Scale-III or IV (WAIS-III and IV; Wechsler, 1997; 2008), the Penn Continuous Performance Test (PCPT; Rosvold et al., 1956; Kurtz et al., 2001); the California Verbal Learning Test-II (Delis et al., 2000), and the Penn Conditional Exclusion Test (PCET; Kurtz et al., 2004). For the PCPT, total true positives divided by true positive mean reaction time (efficiency) was selected as an independent predictor measure. For the CVLT-II, performance on trials 1 and 5 was selected as the independent measures. For the PCET, the total number of errors was selected for analysis. Scaled scores were selected for WAIS subtests. Measures were selected based on their relationships with functional status in previous studies of schizophrenia (e.g., Green et al., 2000; 2004) and are a representative subgroup of the five separable factors underlying cognition in schizophrenia and consistent with the domains of MATRICS (e.g., Nuechterlein et al., 2004). Cognitive testing and scoring were supervised by a doctoral-level psychologist.

2.2.2 Social Cognitive Assessment—The Penn Emotion Acuity Test (PEAT; Erwin et al., 1992) was selected as a measure of social cognition. The PEAT is a computerized task developed to assess affect recognition consisting of 40 black-and-white pictures of facial expressions obtained from professional actors with emotions ranging from very happy to very sad. The independent variable selected for this study was total number of correctly identified very and somewhat happy and sad faces.

2.2.3 Symptom Assessment—The Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987) was used to assess symptoms. This measure is a semi-structured interview that generates ratings of signs and symptoms on thirty 7-point Likert scale items. The subscales for total positive and total negative symptoms were selected as the independent measures.

2.2.4 Objective Quality-of-Life—We selected the Quality-of-Life Scale (QOL; Heinrichs et al., 1984) as an index of clinician-rated objective QOL. We used the abbreviated seven item version of the test (Bilker et al., 2003) which has been shown to correlate with scores from the complete 21-item version with coefficients from .96 to .98 in samples of patients with schizophrenia. Interrater reliability was maintained throughout the study for all study raters for both the QOL and PANSS by achieving a minimum intraclass correlation coefficient (ICC) of .70 based on four consecutive, independently rated QOL interviews. Refresher training was provided periodically during conduct of the study for all raters.

2.2.5 Subjective Life Satisfaction—The Satisfaction with Life Scale (SWL; Stein and Test 1980; Test et al., 2005) was selected to measure subjective quality-of-life or life satisfaction. This is a 21-item self-report measure that targets subjective satisfaction with one's living situation, work, social contacts and psychological state and has been validated for use with the severely mentally ill population.

2.3 Data Analysis

The Statistical Package for the Social Sciences (SPSS 17.0) was used for statistical analyses. Paired-sample t-tests were conducted comparing scores on the QOL scale and the SWL scale before and after treatment, to assess improvement. Pearson's product-moment correlations were calculated between change in objective QOL and subjective SWL during the treatment trial to assess the relatedness of these constructs. The remainder of the data analytic plan was conducted in two stages. In stage 1, Pearson's product-moment

correlations were calculated between each of the cognitive and social cognitive measures, positive and negative symptom severity ratings measured at baseline, and measures of change in objective QOL and subjective SWL. In stage 2, two stepwise regression models were tested using each of the baseline neurocognitive, social cognitive and symptom measures that were linked to change in objective QOL and subjective SWL, respectively, in stage 1. In the first step of this model, baseline objective QOL or subjective SWL measures was entered, along with group membership, so that the regression results would reflect information regarding *change* in objective QOL and subjective SWL, with any potential differential effect of the two cognitive rehabilitation programs administered as part of the parent study removed. In step 2, measures of cognitive function linked to change in objective QOL and subjective SWL were studied. In step 3, measures of social cognition (PEAT) were entered if the variable had been related to change in objective QOL or subjective SWL in stage 1 of the analysis. This step allowed us to both: (1) identify the unique contribution of social cognitive function to change in objective QOL or subjective SWL beyond cognitive function, and (2) determine whether measures of social cognition mediated the relationship between cognitive function and change in objective QOL or subjective SWL. If social cognition could be conceptualized as a construct predicting variance in change in objective QOL or subjective SWL separate from cognitive function, we would expect a significant increase in explained variance when social cognitive measures were added in step 3 of this regression, with elementary cognitive function remaining related to objective QOL or subjective SWL. Alternatively, if social cognition partially mediated the relationship between any of the cognitive variables and change in objective QOL or subjective SWL, we would expect that, according to the methods of Baron and Kenny (1986): (1) measures of cognition would be related to objective change in QOL or subjective SWL, (b) social cognitive function would be related to change in objective QOL or subjective SWL, (c) social cognition would be related to elementary cognitive function, and (d) when social cognition was controlled for statistically the relationship between cognition and/or change in objective QOL or subjective SWL would be reduced or removed. In the fourth and final step of each regression, we entered the interaction term for the main effects of the cognitive variable and social cognitive assessment to investigate whether social cognition moderated the relationship between cognitive function and objective QOL or subjective SWL. All analyses were two-tailed and alpha was set at .05.

3. Results

3.1 Effects of rehabilitation on objective QOL and subjective SWL

Participants improved on objective and subjective measures of quality-of-life after the rehabilitation intervention. ($t_{36}=2.23$; $p<.05$ and $t_{41}=2.66$; $p<0.05$, respectively). There was a moderate relationship between improvement in objective QOL and subjective SWL ($r=0.53$, $p<0.01$).

3.2 Relationships among the study variables

Correlations between standardized cognitive and social cognitive measures and symptom ratings at study entry and change in objective QOL and subjective SWL after the rehabilitation trial are presented in Table 2. The neuropsychological measure CVLT Trial 1 was positively related to objective QOL ($r=0.38$, $p<0.05$), as was the PEAT ($r=0.36$; $p<0.05$), while neuropsychological measures CVLT Trial 1 ($r=0.42$, $p<0.05$) and WAIS-Vocabulary scores ($r=0.35$, $p<0.05$) were positively related to subjective SWL.

3.3 Associations between cognitive function and objective QOL and subjective SWL

When the cognitive measure linked to change in objective QOL, CVLT Trial 1, was entered into a stepwise regression, with group membership and baseline objective QOL scores

controlled, CVLT T1 produced a significant change in R^2 (.09, $F_{1, 26}=5.28$; $p=0.03$) and explained variance in objective QOL beyond that associated with baseline QOL scores and group membership (see Table 3, step 2). When the cognitive measures linked to change in subjective SWL, CVLT T1 and WAIS-Vocabulary were entered into a stepwise regression, with group membership and baseline subjective SWL scores controlled in the first step, only the CVLT T1 measure remained a significant predictor of explained variance in subjective SWL ($B=0.29$; $t=2.46$, $p<0.05$), with cognitive measures producing a significant change in R^2 (.10, $F_{2, 34}=3.66$, $p<0.05$) explaining additional variance beyond that associated with baseline subjective SWL scores and group membership.

3.4 Social cognition as a mediator of the relationship between cognition and objective QOL and subjective SWL

The correlation analyses revealed general support for the prerequisite relationships between CVLT Trial 1, PEAT and objective QOL for potential mediation (the relationship between CVLT Trial 1 and PEAT was at a trend level [$r=.32$, $p=.066$]). Mediation was tested with stepwise regressions for this social cognitive measure (see Table 3, step 3). In the regression the relationship of CVLT Trial 1 and objective QOL was no longer significant when PEAT was added to the regression model. Because PEAT reduced the relationship of CVLT Trial 1 and objective QOL these data provide support for the idea that PEAT partially mediates the predictive relationship between CVLT Trial 1 and change in objective QOL. Prerequisite relationships were not evident for any of the measures associated with subjective SWL (see Table 2); consequently no tests for mediation were conducted for those measures.

3.5 Social cognition as a moderator of the relationships between cognition and objective QOL and subjective SWL

Results from the stepwise regression analyses testing the moderating effects of social cognition in the relationship between cognition and objective QOL found that the interaction term was not significant in the model (see Table 3, step 4). As social cognition was not significantly related to subjective SWL, social cognition was not tested as a potential moderator of the relationship between cognitive function and subjective SWL.

4. Discussion

This is the first study, to our knowledge, to evaluate the interrelationships of cognitive, social cognitive and other disease variables for predicting longitudinal improvement in both objective QOL and subjective life satisfaction in response to psychosocial and cognitive rehabilitation in schizophrenia. Our findings revealed four main conclusions: (1) consistent with hypotheses, improvements in objective QOL across the treatment trial were moderately related to improvements in subjective life satisfaction, (2) generally consistent with hypotheses performance on a measure of cognition, verbal memory, and a measure of social cognition, facial affect recognition, administered at study entry was associated with improvement on a measure of objective QOL, (3) inconsistent with hypotheses, two measures of cognition, crystallized verbal skill and verbal memory, were associated with improvements in subjective satisfaction with life, and (4) consistent with hypotheses there was evidence that a measure of social cognition, facial affect recognition, partially mediated the predictive relationship of verbal memory and improvements in objective QOL. Symptoms measured at study entry were not related to change in either domain of outcome in response to psychosocial and cognitive rehabilitation.

We note that the similar predictive relationship between cognitive variables and change in both objective QOL and subjective life satisfaction in this study is different from findings comparing cross-sectional (e.g., Brekke et al., 2001; Narvaez et al., 2008; Tolman and

Kurtz, 2012), and longitudinal (Prouteau et al., 2005) relationships between cognitive variables and objective and subjective SWL measures. Our findings suggest that cognition may play a common role in influencing the ability of clients to benefit from psychosocial and cognitive rehabilitation interventions in schizophrenia, as measured by objective milestones of psychosocial success (attaining competitive employment, increasing the number and quality of social interactions) and the subjective experience of success in these same life domains. These findings also suggest that cross-sectional predictors of objective and subjective SWL may be different from longitudinal predictors of treatment response. Differences in our findings from those of Prouteau et al., the only other longitudinal study comparing objective and subjective QOL measures may reflect the more detailed assessment of subjective QOL selected for the current study, or other assessment or sample differences.

The link between cognition and social cognition and objective measures of community function evident in this study is consistent with a growing body of literature supporting the rate-limiting role of baseline cognitive and social cognitive function in the ability to benefit from integrated programs of behavioral rehabilitation for people with schizophrenia (Woonings et al., 2002; Prouteau et al., 2005; Brekke et al., 2005, 2007; Kurtz et al., 2008). Furthermore, the finding that facial affect recognition partially mediates the predictive relationship between verbal memory and change in objective QOL adds to a small but growing body of literature suggesting that social cognitive skills mediate the relationship between more elementary aspects of cognition and observer-rated community functioning (Sergi et al., 2006; Horton and Silverstein, 2008), and extends this work by suggesting that this type of mediation extends to the likelihood of benefitting from integrated programs of rehabilitation in schizophrenia (see also Brekke et al., 2005). Thus, the current report provides evidence on *how* rather than just *which* patient factors influence response to behavioral interventions. These findings also suggest that novel interventions aimed at enhancing closely linked cognitive and social cognitive variables in schizophrenia may allow patients to take better advantage of existing, evidence-based behavioral rehabilitation interventions.

Several caveats to the current findings should be mentioned. First, this study measured cognitive, social cognitive and symptom variables at baseline and related them to change in functioning during a behavioral treatment trial. Thus, the mechanism by which *change* in cognitive variables influences change in subjective and objective indices of outcome in rehabilitation remains to be elucidated. Recent research suggests these relationships may be complex and quite different from cross-sectional relationships (Fiszdon et al., 2008). Second, given the exploratory nature of our study, along with a moderate sample size, we chose not to correct for multiple statistical comparisons and consequently the risk for Type I error was elevated. Third, in order to minimize the number of statistical comparisons, we did not formally evaluate demographic factors, some of which have been linked to different aspects of QOL in previous studies (e.g., Caron et al., 2005). Exploratory analyses indicated that a higher number of hospitalizations at study entry was related to less improvement in subjective, but not objective, quality of life at a trend level ($r = -.30$; $p < .06$) after rehabilitation. Duration of illness at study entry was unrelated to change in either objective or subjective indices of QOL. Fourth, concerns have been raised regarding the specificity of cognitive deficits in schizophrenia and whether impairments on cognitive tests reflect a common impairment across all domains of cognition (Dickinson et al., 2008). We note however, that in the current study links between verbal memory at baseline and change in objective QOL and subjective SWL were at least somewhat specific as evidenced by the pattern of correlative relationships and that in the regression analysis verbal memory remained a predictor of improvements in subjective life satisfaction even when crystallized verbal skill, often considered a proxy for full-scale verbal IQ, was controlled. Fifth, ratings on our objective QOL measure were based on patient self-report and in that sense were

similar to findings from the subjective SWL Scale selected for our study. Nonetheless, while ratings from the objective QOL measure are based on reports on objective functioning, ratings from the subjective SWL scale are based on how *satisfied* are patients about the quality of similar life domains. Sixth, our mediation results would have been strengthened by the computation of parameter estimates via PATH analysis, but the size of our sample precluded use of such procedures. Lastly, we did not include a control condition that did not receive comprehensive psychosocial and cognitive rehabilitation, and thus it remains unclear to what degree these predictor variables are specific to this integrated behavioral intervention studied in this report.

In summary, cognitive measures of verbal memory and social cognitive measures of facial affect recognition were linked to improvements in objective QOL, while verbal memory and crystallized verbal skill were linked to improvements in SWL in response to comprehensive outpatient behavioral rehabilitation in schizophrenia. Facial affect recognition partially mediated the relationship between verbal memory and improvements in objective QOL. These findings emphasize the importance of cognitive factors in the ability to benefit from behavioral treatments in both subjective and objective outcome domains, and suggest that with respect to objective measures of outcome, cognition may influence improvements through its impact on aspects of social cognition.

References

- American Psychiatric Association. DSM-IV: Diagnostic and Statistical Manual of Mental Disorders. 4. American Psychiatric Association; Washington, D.C: 1994.
- Baron RM, Kenny DA. The moderator-mediator distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*. 1986; 21:1173–1182. [PubMed: 3806354]
- Bilker WB, Brensinger C, Kurtz MM, Kohler CG, Siegel SJ, Gur RE. Development of an abbreviated quality of life scale using a new method. *Neuropsychopharmacology*. 2003; 28:773–778. [PubMed: 12655324]
- Brekke J, Hoe M, Long J, Green MF. How neurocognition and social cognition influence functional change during community-based psychosocial rehabilitation for individuals with schizophrenia. *Schizophrenia Bulletin*. 2007; 33:1247–1256. [PubMed: 17255120]
- Brekke JS, Kay DD, Lee KS, Green MF. Biosocial pathways to functional outcome in schizophrenia. *Schizophrenia Research*. 2005; 80:213–225. [PubMed: 16137859]
- Brekke JS, Kohrt B, Green MF. Neuropsychological functioning as a moderator of the relationship between psychosocial functioning and the subjective experience of self and life in schizophrenia. *Schizophrenia Bulletin*. 2001; 27(4):697–708. [PubMed: 11824495]
- Caron J, Mercier C, Diaz P, Martin A. Socio-demographic and clinical predictors of quality-of-life in patients with schizophrenia and schizoaffective disorder. *Psychiatry Research*. 2005; 137:203–213. [PubMed: 16298428]
- Couture SM, Penn DL, Roberts DL. The functional significance of social cognition in schizophrenia: A review. *Schizophrenia Bulletin*. 2006; 32:S44–S63. [PubMed: 16916889]
- Delis, DC.; Kramer, JH.; Kaplan, E.; Ober, BA. CVLT-II. The Psychological Corporation; New York: 2000.
- Dickinson D, Ragland JD, Gold JM, Gur RC. General and specific deficits in schizophrenia: Goliath defeats David? *Biological Psychiatry*. 2008; 64:823–827. [PubMed: 18472089]
- 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 Research*. 1992; 42:231–240. [PubMed: 1496055]
- Fiske, ST.; Taylor, SE. Social Cognition. 2. New York, NY: McGraw-Hill; 1991.
- Fiszdon JM, Choi J, Goulet J, Bell MD. Temporal relationships between change in cognition and change in functioning in schizophrenia. *Schizophrenia Research*. 2008; 105:105–113. [PubMed: 18657398]

- Green MF, Kern RS, Braff D, Mintz J. Neurocognitive deficits and functional outcome in schizophrenia: Are we measuring the “right stuff”? *Schizophrenia Bulletin*. 2000; 26(1):119–136. [PubMed: 10755673]
- Green MF, Kern RS, Heaton RK. Longitudinal studies of cognition and functional outcome schizophrenia: implications for MATRICS. *Schizophrenia Research*. 2004; 72(1):41–51. [PubMed: 15531406]
- Green MF, Penn DL, Bentall R, Carpenter WT, Gaebel W, Gur RC, et al. Social cognition in schizophrenia: an NIMH workshop on definitions, assessment and research opportunities. *Schizophrenia Bulletin*. 2008; 34:1211–1220. [PubMed: 18184635]
- Heinrichs DW, Hanlon TE, Carpenter WT. The Quality of Life Scale: an instrument for rating the schizophrenic deficit syndrome. *Schizophrenia Bulletin*. 1984; 10:388–398. [PubMed: 6474101]
- Horton HK, Silverstein SM. Social cognition as a mediator of cognition and outcome among deaf and hearing people with schizophrenia. *Schizophrenia Research*. 2008; 105:125–137. [PubMed: 18722092]
- Kay SR, Fiszbein A, Opler LA. The positive and negative syndrome scale for schizophrenia. *Schizophrenia Bulletin*. 1987; 13:261–276. [PubMed: 3616518]
- Kurtz MM, Wexler BE, Fujimoto M, Shagan DS, Seltzer JC. Symptoms versus neurocognition as predictors of change in life skills in schizophrenia after rehabilitation. *Schizophrenia Research*. 2008; 102:303–311. [PubMed: 18495433]
- 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. *Schizophrenia Research*. 2001; 48(2–3):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. *Archives of Clinical Neuropsychology*. 2004; 19(2):191–201. [PubMed: 15010085]
- Lehman AF. A Quality of Life Interview for the Chronically Mentally Ill. *Evaluation and Program Planning*. 1988; 11:51–62.
- Narvaez JM, Twamley EW, McKibbin CL, Heaton RK, Patterson TL. Subjective and objective quality of life in schizophrenia. *Schizophrenia Research*. 2008; 98(1–3):201–208. [PubMed: 17919890]
- Nuechterlein KH, Barch DM, Gold JM, Goldberg TE, Green MF, Heaton RK. Identification of separable factors in schizophrenia. *Schizophrenia Research*. 2004; 72:29–39. [PubMed: 15531405]
- Penn DL, Corrigan PW, Bentall RP, Racenstein JM, Newman L. Social cognition in schizophrenia. *Psychological Bulletin*. 1997; 121:114–132. [PubMed: 9000894]
- Prouteau A, Verdoux H, Briand C, Lesage A, Lalonde P, Nicole L, et al. Cognitive predictors of psychosocial functioning outcome in schizophrenia: a follow-up study of subjects participating in a rehabilitation program. *Schizophrenia Research*. 2005; 77:343–353. [PubMed: 16085207]
- Rosvold HE, Mirsky A, Sarason I, Bransome ED, Beck LH. A continuous performance test of brain damage. *Journal of Consulting and Clinical Psychology*. 1956; 20:343–350.
- Sergi MJ, Rassovsky Y, Nuechterlein KH, Green MF. Social perception as a mediator of early visual processing on functional status in schizophrenia. *American Journal of Psychiatry*. 2006; 163:448–454. [PubMed: 16513866]
- Stein LI, Test MA. Alternatives to mental hospital treatment: I. Conceptual model treatment program and clinical evaluation. *Archives of General Psychiatry*. 1980; 37:392–397. [PubMed: 7362425]
- Test MA, Greenberg JS, Long JD, Brekke JS, Burke SS. Construct validity of a measure of subjective satisfaction with life of adults with severe mental illness. *Psychiatric Services*. 2005; 56:292–300. [PubMed: 15746503]
- Tolman AW, Kurtz MM. Neurocognitive predictors of objective and subjective quality of life in individuals with schizophrenia: a meta-analytic investigation. *Schizophrenia Bulletin*. 2012; 38:304–315. [PubMed: 20624752]
- Wechsler, D. WAIS-III Manual. The Psychological Corporation; New York: 1997.
- Wechsler, D. WAIS-IV Manual. The Psychological Corporation; New York: 2008.
- Woonings FMJ, Appelo MT, Kluiter H, Slooff CJ, van de Bosch RJ. Learning (potential) and social functioning in schizophrenia. *Schizophrenia Research*. 2002; 59(2–3):287–2. [PubMed: 12414086]

Table 1

Mean demographic and clinical characteristics of schizophrenia patients (n=44)

Variable	Mean (SD)	Range
Age	30.8 (9.4)	19–56
Percent male	73	NA
Education (years)	12.2 (2.1)	8–16
Duration of illness (years)	9.1 (9.4)	0–39
Number of hospitalizations	4.6 (4.6)	0–20
Vocabulary Scaled Score (WAIS)	8.4 (3.9)	3–17
Positive Symptoms (PANSS)	16.5 (5.6)	9–32
Negative Symptoms (PANSS)	17.9 (5.0)	9–30
Percent treated with atypical antipsychotic medication	89	NA
Percent of sample treated with different types of antipsychotic medication		
Risperidone	24	2–8 mg
Olanzapine	20	16–40 mg
Aripiprazole	20	10–30 mg
Clozapine	16	75–700 mg
Quetiapine	11	60–700 mg
Haloperidol	9	1–30 mg
Perphenazine	7	6–16 mg
Haloperidol injection	4	50–200 mg/month
Ziprasidone	4	120–240 mg
Paliperidone	2	9 mg

Note: WAIS=Wechsler Adult Intelligence Scale; PANSS=Positive and Negative Syndrome Scale.

Table 2

Pearson intercorrelations between baseline neurocognitive, social cognitive and symptom severity measures and change in objective QOL and subjective SWL, from study entry to termination of rehabilitation interventions (n=30–44).

Variable	1. Vocab	2. PCPT Eff	3. CVLT T1	4. CVLT T5	5. PCET Errors	6. Processing Speed Index	7. Penn Emotional Acuity Test	8. Objective QOL change	9. Subjective SWL Change	10. Positive
Neurocognitive										
1. Vocab (WAIS)	-		-	-		-	-	-	-	-
2. PCPT Eff	0.00	-	-	-	-	-	-	-	-	-
3. CVLT T1	0.28	0.19	-	-	-	-	-	-	-	-
4. CVLT T5	0.12	-0.09	0.49**	-	-	-	-	-	-	-
5. PCET Errors	0.31*	0.15	0.03	0.02	-	-	-	-	-	-
6. Processing Speed Index(WAIS)	0.12	-0.05	0.09	0.22	0.08	-	-	-	-	-
Social Cognitive										
7. Penn Emotional Acuity Test	0.04	0.13	0.32	0.36	0.22	0.13	-	-	-	-
Outcome										
8. Objective QOL change	0.14	-0.28	0.38*	0.28	-0.15	0.17	0.36*	-	-	-
9. Subjective SWL change	0.35*	-0.11	0.42*	0.15	-0.07	0.14	0.27	0.53**	-	-
Symptoms										
10. Positive	0.12	0.09	0.15	-0.13	0.14	0.07	0.06	0.14	0.02	-
11. Negative	0.30	0.38**	0.06	-0.05	0.34*	0.41**	0.34	-0.12	-0.03	0.09

Table 3

Multiple regression for the prediction of objective quality-of-life (QOL) at the termination of the rehabilitation intervention (controlling for baseline QOL scores and group membership [cognitive remediation or computer skills]) by baseline measures of word recall (CVLT T1), facial affect recognition (PEAT), and the interaction of word recall skills and facial affect recognition.

Measure	Step 1	Step 2	Step 3	F-value	R ²	R ² -change
Baseline QOL	B=0.68 P=0.000	B=0.71 P=0.000	B=0.64 P=0.000			
Group Membership	B=-0.00 P=0.986	B=-0.04 P=0.771	B=-0.03 P=0.836	B=11.87 P=0.000	0.47	0.47 P=0.000
CVLT T1		B=0.30 P=0.030	B=0.17 P=0.225	B=10.92 P=0.000	0.56	0.09 P=0.03
PEAT			B=0.33 P=0.02	B=11.45 P=0.000	0.65	0.09 P=0.02
CVLTT1XPEAT			B=0.14 P=0.308	B=9.41 P=0.000	0.67	0.02 P=0.31