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The relationship of social cognition to ward behavior in chronic schizophrenia

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Abstract

The relationship between social cognition (i.e., cognition for social stimuli) and ward behavior among individuals with chronic schizophrenia was investigated. Twenty-seven inpatients completed a battery of cognitive and social-cognitive tasks and were rated by staff on various indices of ward behavior. Overall, there was a relationship between the measures of social cognition and behavior on the ward. Social cognition contributed unique variance beyond cognition to maladaptive behavior on the ward (i.e., irritability). Implications for assessment and future research are discussed.

Keywords: Schizophrenia; Social cognition; Ward behavior; Information processing

1. Introduction

It has long been known that impairments in attention and other cognitive processes are characteristic of schizophrenia, and may play a role in the disorder's etiology (Nuechterlein and Dawson, 1984). However, the cognitive processes most consistently linked to vulnerability for schizophrenia represent fairly molecular stages of information processing[1], such as visual feature detection, continuous attention and span of apprehension. It is not apparent how such deficits could produce the more molar expressions of schizophrenia, such as impaired judgement and problem solving, and impairments in social behavior. Therefore, it has yet to be determined whether vulnerability-linked impairments really contribute to development of schizophrenia, or whether they are simply markers

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[1]'Molecular' and 'molar' are used here as they are in other work on cognition in schizophrenia as relativistic terms which connote a continuum of complexity of cognitive processes. For example, visual and auditory feature analysis is assumed to involve fewer symbol transformations and less integration of different sources of information, and is therefore more molecular than performance of simple learning and memory tasks, which in turn is more molecular than interpersonal problem solving and social role performance. It is heuristically advantageous to order cognitive processes along the molecular–molar continuum, but this is not meant to imply that all cognitive processes are mechanistically linked through a rigid hierarchy of complexity.

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of the operative neurophysiological or neurocognitive etiological factors.

A number of recent studies of chronic schizophrenia have shown that various molecular deficits in cognition are associated with various failures in social behavioral functioning, including social skill acquisition and performance (Spaulding, 1978; Mueser et al., 1991; Penn et al., 1993, 1995; Lysaker et al., 1995), ward behavior (Spaulding et al., in press) and performance in psychoeducational treatment modalities (Kern et al., 1992; Corrigan et al., 1994). These studies have used primarily correlational analytic methods to show that severity of cognitive impairment predicts severity of social-behavioral impairment within schizophrenic populations. This is somewhat stronger evidence of a functional link between molecular cognition and behavioral expression than is provided by group contrast studies in which deficits in both domains are demonstrated only in schizophrenia. Furthermore, group contrast studies neglect the heterogeneity of cognitive and behavioral functioning among people with schizophrenia, an aspect of the disorder increasingly recognized as important for etiological understanding.

Ostrom (1984) has argued that there is a domain of cognition which distinctively involves the perception and interpretation of social information. Social cognition involves stimuli which are more complex and labile than non-social stimuli (e.g., people and socially significant situations and events). To process a social stimulus, the perceiver must draw upon a larger body of stored information (knowledge, attitudes, biases, etc.). Furthermore, the relationship between the perceiver and the stimulus is usually interactive. The stimulus often influences the perceiver's personal situation, and may be associated with a diversity of affective as well as motor responses. In these respects, the difference between social and non-social cognition is similar to the difference between 'hot' and 'cold' cognition (i.e., cognition influenced by affect and arousal versus cognition independent of affect and arousal) (Gjerde, 1983). Perhaps most importantly, social cognition is expected to have more direct influence on social behavior and individual differences (Holyoak and Gordon, 1984).

There is some evidence for social-cognitive deficits in schizophrenia. Patients with schizophrenia have deficits in perception of facial affective expression (reviewed by Morrison et al., 1988), decoding of non-verbal social cues (Monti and Fingeret, 1987), recognition of familiar social situations (Corrigan et al., 1992) and interpersonal problem solving (Bellack et al., 1994). Furthermore, there is evidence that schizophrenia patients have more pronounced impairments on social-cognitive than cognitive tasks (Gillis, 1969; Cutting and Murphy, 1990). Finally, distortions in the perception, interpretation, and attribution of social information have been hypothesized to underlie the positive symptoms of hallucinations and delusions (Bentall et al., 1994). However, the quantitative relationship between these laboratory measures and actual social functioning remains unknown.

The purpose of this study is to conduct an initial exploration of the association between measures of social cognition and social functioning in chronic schizophrenia. In addition to determining the strength of association between measures in the social cognitive and social domains, this study includes an initial assessment of the relationships between social and non-social cognitive measures, and the independence of their respective contributions to ward behavior. The specific hypotheses of the study are: (1) there will be a quantitative relationship between the severity of impairments in social cognition and ward behavior among inpatients with severe chronic schizophrenia; (2) social and non-social cognitive impairments contribute independently to impairment in ward behavior. Because only one previous study has compared the contribution of cognitive versus social-cognitive predictors to social functioning (i.e., Corrigan and Toomey, 1995), we did not make any predictions about whether the relative strengths of these predictor variables differ with respect to ward behavior.

2. Methods

2.1. Subjects

Twenty-seven patients hospitalized at the Lincoln Regional Center, Extended Care Unit

(ECU) were subjects in the study. The ECU is a psychiatric rehabilitation program from which patients are typically discharged to a less restrictive setting after 12 to 36 months of treatment. Subjects had the following demographic and clinical characteristics: age: 33.7 (mean), 7.6 (SD); gender: male = 18, female = 9; diagnosis: schizophrenia = 22, schizoaffective = 5; percentage on neuroleptic medication: neuroleptic = 96%, anticholinergic = 54%; CPZ equivalent (based on Baldessarini, 1985): 923.04 mg/day (mean), 756.95 mg/day (SD); positive symptoms: 15.9 (mean), 6.7 (SD); negative symptoms: 16.0 (mean), 6.3 (SD); IQ: 85.9 (mean), 10.4 (SD). Subjects met criteria for either schizophrenia or schizoaffective disorder according to the SCID-P (Spitzer and Williams, 1985). The SCID-P was administered by two research psychiatrists blind to the hypotheses of the study. Schizoaffective patients were included because both family studies and treatment findings suggest that individuals with schizoaffective disorder and schizophrenia are closely related (e.g., similar response to neuroleptics) (Mattes and Nayak, 1984; Levinson and Levitt, 1987; Kraemer et al., 1989; Levinson and Mowry, 1991).

Type and severity of symptomatology was assessed with the Positive and Negative Symptom Scale (PANSS; Kay et al., 1987) by the research psychiatrists who conducted the SCID-P interviews. Raters were trained on the SCID-P and PANSS by watching practice interview tapes, rating them independently, and discussing differences in ratings until a consensus rating/diagnosis was obtained. Raters then conducted their own interviews and rated each others' tapes. Reliability was assessed for five randomly selected patients: SCID-P (% agreement = 0.80), PANSS-positive symptom scale (Pearson's $r = 0.90$), and PANSS-negative symptom scale (Pearson's $r = 0.89$).

2.2. *Social-cognition measures*

The social-cognitive measures described below have either been previously investigated in schizophrenia research (i.e., the Affect Recognition task) or comprise models of social cognition (i.e., Empathy and Scripts tasks) (e.g., Marlowe, 1986; Taylor, 1990).

2.2.1. *Affect recognition*

Visual affect recognition was assessed with the Pictures of Facial Affect of Ekman and Friesen (1975). This task consists of 110 slides of actors depicting one of six emotions (i.e., happy, sad, angry, surprise, fear, and neutral). Each slide was presented for 8 s, during which time the subject circled the emotion being depicted on an answer sheet. The psychometric properties of the Pictures of Facial Affect are described in Ekman and Friesen (1975). The index of performance is the percentage of correct affect responses for the entire set (AFFECT-F).

2.2.2. *Empathy*

Empathy was assessed by a questionnaire developed by Weimer (1992). The Empathy Questionnaire (EQ) is comprised of 42 statements which the subject rates on a 1 (strongly disagree) to 7 (strongly agree) Likert scale (e.g., 'I get very angry when I see someone being ill-treated'.). Weimer (1992) developed the EQ by factor analyzing three widely used measures of empathy: the 64-item Empathy scale of Hogan (1969); the Questionnaire Measure of Emotional Empathy (QMEE; Mehrabian and Epstein, 1972); and a multidimensional scale developed by Davis (1983). Six factors emerged from the analyses: Fantasy, Concern for Others, Perspective Taking, Tolerance for Others, Empathic Distress, and Emotional Control. All factors have alpha values 0.75 or greater (Weimer, 1992). For the present population, all items were read to subjects. To reduce the number of variables, subscales were combined to create a summary score of performance (EMPATHY). The coefficient alpha of the summary score was high for the present sample (0.86).

2.2.3. *Sequencing of social stimuli (Scripts)*

A social sequencing task was developed for this study modeled on scripts' tasks used in previous schizophrenia research (i.e., Corrigan et al., 1992). As a first step, 100 undergraduates were presented with the titles of six social situations (i.e., going shoe shopping, going to work or school, going grocery shopping, making an appointment to see a doctor, going to a job interview, going on a date) and asked to generate all the actions which comprised them in sequential order. The next step involved having research assistants code these actions for their frequency and their placement in the social sequence. This was done so as to reduce the number of actions to approximately 10 (subjects typically generated 15–18/situation). Those behavioral actions which had been mentioned over 50% of the time in a particular position were retained.

For the present study, the actions which comprise each social situation were presented to the subject on index cards in a standard mixed up order (analogous to Picture Arrangement on the WAIS-R). The subject was told that the cards described a certain situation (e.g., going shopping) and was instructed to arrange the cards in an order 'which makes sense.' The order of situation presentation was randomly determined for each subject. Performance on this task was indexed as time to complete the task (SCRIPTS-T) and the number of correct adjoining actions in a sequence (SCRIPTS-C). Test–retest data were available for 20 subjects, who were retested approximately three months after the initial assessment. Reliability was adequate for SCRIPTS-T ($r=0.75$, $p<0.01$) and SCRIPTS-C ($r=0.54$, $p<0.03$).

2.3. *Information processing measures*

COGLAB Information processing was assessed with COGLAB, a computer-based battery of cognitive tests developed for research on cognitive deficits in schizophrenia (Spaulding et al., 1989b). COGLAB is comprised of validated test paradigms selected from the experimental psychopathology literature. Tasks selected for the present study were a concept manipulation task based on the Wisconsin Card Sorting Test, a combination Continuous Performance/Span of Apprehension task, a reaction time task, and backward masking task. These tasks were chosen for the present study because they have demonstrated consistent relationships with social functioning in our previous work (Penn et al., 1993,Penn et al., 1995; Spaulding et al., in press). The psychometric properties of COGLAB and procedure for administering the battery are described in previous publications (i.e., Spaulding et al., 1989a; Spaulding et al., in press).

Five summary measures of performance were obtained from COGLAB: total hits on the Continuous Performance/Span of Apprehension task (CP/SPAN), number of false alarms on CP/SPAN (FALRM), total hits on Backward Masking (MASK), Reaction Time (RT), and number of Total Errors on the Card Sorting Test (CARDS T).

2.4. *Ward behavior*

NOSIE-30 ward behavior was assessed weekly by psychiatric technicians using the Nurse's Observation Scale for Inpatient Evaluation (NOSIE-30; Honigfeld et al., 1966). The NOSIE-30 is a behavioral checklist based upon observation of patient behavior over the previous 72 h. Each behavior is rated on a five-point Likert-type frequency scale based on the endpoints 'never' and 'always.' The NOSIE-30 is comprised of seven subscales, three 'Adaptive' scales: social competence (NOSIE-SC), social interest (NOSIE-SI), neatness (NOSIE-N); three 'Maladaptive' scales: irritability (NOSIE-I), psychoticism (NOSIE-P), and psychomotor retardation (NOSIE-R). Staff psychiatric technicians, blind to the hypotheses of the study, made weekly NOSIE ratings. NOSIE data are collected routinely as part of the psychiatric rehabilitation program at the ECU. Reliability analyses revealed Pearson correlations of at least 0.68–0.72 for all scales. To control for minor fluctuations in patient functioning, weekly NOSIE ratings were averaged over a 4-week period.

2.5. *Procedure*

Administration of the social-cognitive and COGLAB batteries was conducted over 2–3 testing sessions to avoid subject fatigue. Subjects were tested shortly after assessment of their positive/negative symptomatology and prior to participation in either a cognitive or supportive therapy group. NOSIE ratings were taken from the month in which the social-cognitive assessment was conducted.

3. Results

3.1. Preliminary analyses

Prior to analysis, distributions of all variables were examined for presence of outliers and deviations from assumptions of normality. Due to the small sample size, outliers were not removed from analyses but were converted to less extreme values based on standard criteria[2]. All correlations reported below are based on one-tailed significance tests. Furthermore, because of the large number of correlational analyses, Bonferroni correction was employed to prevent type I errors.

3.2. Correlations between social cognition and COGLAB variables

Table 1 summarizes the relationship between the social-cognitive and COGLAB measures. As a first step in the data analysis, an omnibus test of the correlation matrix was conducted (Cohen and Cohen, 1983)[3]. The omnibus test is analogous to a MANOVA for determining whether significant results are present in a multivariate design. The omnibus test of the correlation matrix was significant ($\chi^2[20]=34.6$, $p<0.05$), indicating that the set of social-cognitive variables are related to the set of COGLAB variables. Furthermore, the positive relationship between number of hits on the CP/SPAN task and number of correct adjoining parts on the Scripts task was significant at the Bonferroni-corrected alpha level. Therefore, there is an overall significant relationship between social-cognitive and cognitive tasks.

3.3. Inter-correlations between COGLAB and ward behavior

The inter-correlations between COGLAB and ward behavior are summarized in Table 2. The omnibus test of the correlation matrix was not significant ($\chi^2[30]=35.5$, ns), indicating that the set of COGLAB variables was not related to the set of NOSIE variables. The only bivariate correlation meeting Bonferroni-corrected significance was the association between higher Social Competence and fewer total errors on the Card Sorting task (CARDS-T).

3.4. Inter-correlations between social cognition and ward behavior

The inter-correlations between the social-cognitive variables and ward behavior are summarized in Table 3. An omnibus test of the correlation matrix was significant ($\chi^2[24]=56.03$, $p<0.05$), indicating that the set of social-cognitive variables is related to the set of ward behavior variables. A number of salient findings emerge from this analysis. First, facial affect recognition was the most consistent correlate of adaptive ward behavior among the social-cognitive variables, with its association with Neatness meeting Bonferroni-corrected criteria. Second, time to complete the script sequencing task (SCRIPTS-T) was positively associated with Irritability on the ward (Bonferroni-corrected alpha level). Finally, a counter-intuitive relationship was found regarding greater Empathy and more Irritability (uncorrected alpha level).

3.5. Multiple regression analyses

To evaluate the relative association of COGLAB and social-cognitive measures with ward behavior, stepwise multiple regression analyses were performed. For each index of ward behavior as the dependent variable, a regression equation was conducted using COGLAB and social-cognitive mea-

[2]Tabachnick and Fidell (1989) recommend that rather than removing extreme data points, they be converted to less deviant values. To do this, the following steps were taken: (1) compute the frequency distribution of the variable in question; (2) obtain the variable values at the 25th and 75th percentiles of the distribution; (3) subtract the variable value at the 25th percentile from the value at the 75th percentile; (4) the difference was then multiplied by 1.5 and added to the value at the 75th percentile and subtracted from the value at the 25th percentile; this created new outlier boundaries (i.e., for high and low outliers); (5) any values beyond the boundaries were converted to the boundary values (e.g., if the lower and upper boundaries were 5 to 95, respectively, a value of 102 was converted to 95). This procedure was utilized for the following variables: EMPATHY, AFFECT-F, SCRIPTS-T, IQ-FS, NOSIE-N, NOSIE-P, and CPZ.

[3]The formula for computing the omnibus test of the correlation matrix is: $x^2=(N-3)\sum(z')^2$, where N is the sample size and z' = converted r.

Table 1
Inter-correlations between social-cognitive variables and COGLAB tasks

Social-cognitive measures	COGLAB				
	FALRM	CP/SPAN	CARDS-T	RT	MASK
AFFECT-F	−0.14	0.38[a]	−0.30	−0.14	0.32
SCRIPTS-C	0.30	**0.46**[b]	−0.41[a]	−0.29	0.35[a]
SCRIPTS-T	−0.18	0.01	0.17	0.06	−0.07
EMPATHY	0.10	−0.05	0.17	−0.34[a]	0.22

[a] $p<0.05$.
[b] $p<0.01$.
Correlations meeting Bonferroni criteria for significance are in bold type. Bonferroni-correction was computed for the matrix of social-cognitive and COGLAB tasks by dividing alpha by the number of bivariate correlations: 0.05/20 = 0.002
AFFECT-F = Facial Affect Recognition; SCRIPTS-C = Number of correct adjoining cards in Scripts task; SCRIPTS-T = Time to complete Scripts task; EMPATHY = Empathy task; FALRM = False alarms; CP/SPAN = Continuous Performance/Span of Apprehension; CARDS-T = Total Errors on the Card Sorting Task; RT = Reaction Time; MASK = Backward Masking.

Table 2
Inter-correlations between COGLAB and ward behavior

Ward behavior	COGLAB				
	FALRM	CP/SPAN	CARDS-T	RT	MASK
Adaptive behavior					
NOSIE-SC	−0.21	0.03	**−0.51**[b]	−0.26	0.18
NOSIE-SI	−0.01	0.13	0.11	0.13	0.23
NOSIE-N	−0.14	0.30	−0.31	−0.31	0.29
Maladaptive behavior					
NOSIE-I	0.06	−0.11	0.36[a]	−0.01	−0.11
NOSIE-P	0.23	−0.03	0.31	0.07	0.16
NOSIE-R	−0.11	−0.10	0.36[a]	0.20	−0.16

[a] $p<0.05$.
[b] $p<0.01$.
Correlations meeting Bonferroni criteria for significance are in bold type. Bonferroni-correction was computed for the matrix of COGLAB tasks with adaptive and maladaptive indices on the NOSIE-30: (COGLAB measures with Adaptive NOSIE scales (0.05/15 = $p<0.003$)); (COGLAB measures with Maladaptive NOSIE scales (0.05/15 = $p<0.003$)).
NOSIE-SC = Social Competence; NOSIE-SI = Social Interest; NOSIE-N = Neatness; NOSIE-I = Irritability; NOSIE-P = Psychoticism; NOSIER = Psychomotor Retardation.

sures as the independent variables. Independent variables were entered only if they showed a significant bivariate correlation with the dependent variable (i.e., $p<0.05$, uncorrected). In each equation, the COGLAB measures were forced in on step 1, so that subsequent entry of the social cognitive measure(s) reflects a unique contribution to the variance of the dependent variable.

Only two indices of ward behavior were predicted by both COGLAB and social-cognitive measures: Social Competence and Irritability. Higher social competence was predicted by only fewer errors on the Card Sorting task ($p<0.01$); performance on the facial affect recognition task did not enter the final regression model. However, more Irritability was predicted by greater time to complete the scripts task ($p<0.01$); errors on the Card Sorting task did not remain in the final regression model. Furthermore, in one case, Neatness, only a social cognitive variable (AFFECT-F) was entered into (and remained in) the regression analysis; there were no significant

Table 3
Inter-correlations between social-cognitive variables and ward behavior

NOSIE-30	Social-cognitive measures			
	AFFECT-F	SCRIPTS-T	SCRIPTS-C	EMPATHY
Adaptive behavior				
NOSIE-SC	0.37[b]	−0.31[a]	0.12	−0.02
NOSIE-SI	0.34[b]	−0.19	0.07	0.19
NOSIE-N	**0.54**[c]	−0.26	0.24	0.11
Maladaptive behavior				
NOSIE-I	−0.25	**0.53**[c]	−0.11	0.43[b]
NOSIE-P	0.07	0.00	0.26	0.21
NOSIE-R	−0.30	−0.06	−0.14	−0.24

[a] $p<0.06$.
[b] $p<0.05$.
[c] $p<0.01$.
Correlations meeting Bonferroni criteria for significance are in bold type. Bonferroni-correction was computed for the matrix of social-cognitive tasks with adaptive and maladaptive indices on the NOSIE-30: (social-cognitive measures with Adaptive NOSIE scales ($0.05/12 = p < 0.004$)); (social-cognitive measures with Maladaptive NOSIE scales ($0.05/12 = p < 0.004$)).

bivariate correlations between Neatness and any of the COGLAB variables.

4. Discussion

The results provide fairly strong support for the hypothesis that among inpatients with chronic schizophrenia, deficits in social cognition are associated with impairments in ward behavior. These relationships do not completely overlap with relationships between ward behavior and measures of information processing. This supports the hypothesis that the relationship of social-cognitive deficits with ward behavior does not simply reflect the impact of general cognitive impairment. This is consistent with recent findings of relationships between social cognition and indices of social problem solving (Corrigan and Toomey, 1995).

A number of salient findings from the study should be underscored. First, this is the first study, to our knowledge, which has assessed the relationship of social cognition with naturally occurring social behavior on the ward. This allows us to make more definitive conclusions about how social cognition relates to schizophrenia patients' day-to-day functioning. Second, only one previous study (Mueser et al., in press) has investigated the ecological validity of the affect perception task of Ekman and Friesen (1976). Interestingly, both our study and Mueser et al. found that affect perception was related to grooming/hygiene on the ward. Thus, perception of others' facial affect may have implications for patients' self-perception.

The last major finding that deserves mention is the absence of an overall significant relationship between information processing measures and ward behavior. This finding may be explained in a number of different ways. For example, the finding parallels work demonstrating a weak association between traditional cognitive measures and 'real-world performance' among non-clinical samples (Sternberg et al., 1995). In this sense, cognition and ward behavior among schizophrenia patients may represent fairly orthogonal domains of functioning. Relatedly, perhaps the effects of cognition on ward behavior are mediated by other factors (e.g., social cognition), thus reducing the strength of its' relationship with ward behavior. Therefore, cognition may have a significant *indirect* rather than direct relationship with ward behavior. An alternative hypothesis is that a significant relationship exists between cognition and ward behavior, but a limited range of measures were utilized. For example, the cognitive measure which had the most consistent relationship with ward behavior was performance on the computer version of the Card Sorting task. Perhaps including a greater range of tasks which assess complex information processing (such as assessed by the Card Sorting task) may have produced a significant overall relationship between cognitive and social domains. These hypotheses need to be evaluated in future research.

All of the social-cognitive measures in this study lend themselves fairly directly to therapeutic applications. It is not difficult to imagine a task which would selectively exercise and perhaps strengthen the processes associated with affect perception, recognition of social scripts, and empathic skills. If the relationships in this study turn out to be causal, with impaired social cognition contributing to impaired social functioning, therapeutic modification of social cognition should be beneficial. In this context, the present findings provide justification for more extensive study of social cognition in disabling psychiatric conditions.

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References

Baldessarini, R.J. (1985) Chemotherapy in Psychiatry: Principles and Practice. Harvard University Press, Cambridge, MA.

Bellack, A.S., Sayers, M., Mueser, K.T. and Bennett, M. (1994) Evaluation of social problem solving in schizophrenia. J. Abnorm. Psychol. 103, 371–378.

Bentall, R.P., Kinderman, P. and Kaney, S. (1994) The self, attributional processes and abnormal beliefs: towards a model of persecutory delusions. Behav. Res. Ther. 32, 331-341.

Cohen, J. and Cohen, P. (1983) Applied Multiple Regression/Correlational Analysis for the Behavioral Sciences, 2nd edn. Lawrence Erlbaum Associates, Hillsdale.

Corrigan, P.W. and Toomey, R. (1995) Interpersonal problem solving and information processing deficits in schizophrenia. Schizophr. Bull. 21, 395–403.

Corrigan, P.W., Wallace, C.J. and Green, M.F. (1992) Deficits in social schemata in schizophrenia. Schizophr. Res. 8, 129–135.

Corrigan, P.W., Wallace, C.J., Schade, M.L. and Green, M.F. (1994) Learning medication self-management skills in schizophrenia: relationships with cognitive deficits and psychiatric symptoms. Behav. Ther. 25, 5–15.

Cutting, J. and Murphy, D. (1990) Impaired ability of schizophrenics, relative to manics or depressives, to appreciate social knowledge about their culture. Br. J. Psychiatry 157, 355–358.

Davis, M.H. (1983) Measuring individual differences in empathy: evidence for a multidimensional approach. J. Pers. Soc. Psychol. 44, 113–126.

Ekman P. and Friesen W.V. (1975) Mentioned in text but not in reference list.

Ekman, P. and Friesen, W.V. (1976) Pictures of Facial Affect. Consulting Psychologists Press, Inc., Palo Alto.

Gillis, J.S. (1969) Schizophrenic thinking in a probabilistic situation. Psychol. Rec. 19, 211–224.

Gjerde, P.F. (1983) Attentional capacity dysfunction and arousal in schizophrenia. Psychol. Bull. 93, 57–72.

Hogan, R. (1969) Development of an empathy scale. J. Consul. Clin. Psychol. 33, 307–316.

Holyoak, K.J. and Gordon, P.C. (1984) Information processing and social cognition. In: Wyer, R.S. and Srull, T.K. (eds) Handbook of Social Cognition. Lawrence Erlbaum, Hillsdale, NJ, pp. 39–70.

Honigfeld, R., Roderic, D. and Klett, J.C. (1966) NOSIE-30: a treatment sensitive ward behavior scale. Psychol. Rep. 19, 180–182.

Kay, S., Fiszbein, A. and Opler, L. (1987) The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr. Bull. 13, 261–276.

Kern, R.S., Green, M.F. and Satz, P. (1992) Neuropsychological predictors of skills training for chronic psychiatric patients. Psychiatry Res. 43, 223–230.

Kraemer, M.S., Vogel, V.H., DiJohnson, C., Dewey, D.A., Sheves, P., Cavicchia, S., Little, P., Schmidt, R. and Kimes, I. (1989) Antidepressants in 'depressed' schizophrenic inpatients. Arch. Gen. Psychiatry 46, 922–928.

Levinson, D.F. and Levitt, M. (1987) Schizoaffective mania reconsidered. Am. J. Psychiatry 144, 415–425.

Levinson, D.F. and Mowry, B.J. (1991) Defining the schizophrenia spectrum: issues for genetic linkage studies. Schizophr. Bull. 17, 491–514.

Lysaker, P.H., Bell, M.D., Zito, W.S. and Bioty, S.M. (1995) Social skills at work: deficits and predictors of improvement in schizophrenia. J. Nerv. Ment. Dis. 183, 690-694.

Marlowe, H.A. (1986) Social intelligence: evidence for multidimensionality and construct independence. J. Ed. Psychol. 78, 52–58.

Mattes, J.A. and Nayak, D. (1984) Lithium versus fluphenazine for prophylaxis in mainly schizophrenic schizoaffectives. Biol. Psychiatry 19, 445–449.

Mehrabian, A. and Epstein, N.A. (1972) A measure of emotional empathy. J. Pers. 40, 523–543.

Monti, P.M. and Fingeret, A.L. (1987) Social perception and communication skills among schizophrenics and nonschizophrenics. J. Clin. Psychol. 43, 197–205.

Morrison, R.L., Bellack, A.S. and Mueser, K.T. (1988) Deficits in facial-affect recognition and schizophrenia. Schizophr. Bull. 14, 67–83.

Mueser, K.T., Bellack, A.S., Douglas, M.S. and Wade, J.H. (1991) Prediction of social skill acquisition in schizophrenic and major affective disorder patients from memory and symptomatology. Psychiatry Res. 37, 281–296.

Mueser, K.T., Doonan, R., Penn, D.L., Blanchard, J.J., Bellack, A.S., Nishith, P. and DeLeon, J. (in press). Emotion recognition and social competence in chronic schizophrenia. J. Abnorm. Psychol.

Nuachterlein and Dawson (1984) Mentioned in text but not in reference list.

Ostrom, T.M. (1984) The sovereignty of social cognition. In: Handbook of Social Cognition, Vol. 1. Lawrence Erlbaum, Hillsdale, NJ, pp. 1–37.

Penn, D.L., van der Does, A.J.W., Spaulding, W., Garbin, C., Linszen, D. and Dingemans, P. (1993) Information processing and social-cognitive problem solving in schizophrenia: assessment of inter-relationships and changes over time. J. Nerv. Ment. Dis. 181, 13–20.

Penn, D.L., Mueser, K.T., Spaulding, W.D., Hope, D.A. and Reed, D. (1995) Information processing and social competence in chronic schizophrenia. Schizophr. Bull. 21, 269–281.

Spaulding, W.D. (1978) The relationships of some information processing factors to severely disturbed behavior. J. Nerv. Ment. Dis. 166, 417–428.

Spaulding, W.D., Garbin, C.P. and Crinean, W.J. (1989a) The logical and psychometric prerequisites for cognitive therapy for schizophrenia. Br. J. Psychiatry 155, 69–73.

Spaulding, W.D., Garbin, C.P. and Dras, S.R. (1989b) Cognitive abnormalities in schizophrenic patients and schizotypal college students. J. Nerv. Ment. Dis. 177, 717–728.

Spaulding, W.D., Penn, D.L. and Garbin, C. (in press) Cognitive changes in the course of psychiatric rehabilitation. To appear in: Perris, C., Merlo, M. and Brenner, H.D. (eds) Cognitive Rehabilitation of Schizophrenia. Huber-Hohgrefe, Toronto.

Spitzer, R. and Williams, J. (1985) Structured Clinical Interview for DSMIII-R – Patient Version. New York State Psychiatric Institute, New York.

Sternberg, R.J., Wagner, R.K., Williams, W.M. and Horvath, J.A. (1995) Testing common sense. Am. Psychologist 50, 912-927.

Tabachnick, B.G. and Fidell, L.S. (1989) Using Multivariate Statistics, 2nd edn. Harper and Row, New York.

Taylor, E.H. (1990) The assessment of social intelligence. Psychotherapy 27, 445–457.

Weimer, D.E. (1992) The dimensions of empathy. Unpublished Master's thesis, University of Nebraska-Lincoln.