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Information Processing and Social Cognitive Problem Solving in Schizophrenia

Assessment of Interrelationships and Changes Over Time

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The relationship between basic information processing and social cognitive problem solving (SCPS) was studied in 31 schizophrenic, 16 depressive, and 31 control subjects. The clinical subjects were assessed twice, during symptom exacerbation and 3 months later, after partial remission. Control subjects were tested during the same time period. Subjects completed a means-ends problem-solving test, an alternative solution generation task, and an information-processing test battery. Results showed that schizophrenic subjects demonstrated significant improvement in a number of information-processing indices over time. No significant changes on the social cognitive problem-solving variables were found. Furthermore, all three groups demonstrated different patterns of relationships between information processing and social cognitive problem solving. Implications for treatment are discussed.
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Individuals with schizophrenia have deficits across a range of information-processing abilities. Such deficits may be present when the individual is not actively symptomatic, prior or subsequent to a psychotic episode (Nuechterlein and Dawson, 1984). In this sense, the deficits are thought to serve as cognitive "markers" for future psychotic episodes. Although there are a number of different approaches for identifying cognitive vulnerability markers for schizophrenia, the most advantageous are longitudinal designs, which monitor information-processing performance in both active and remitted states.

A number of extensions can be made on longitudinal schizophrenia research. First, a psychiatric comparison group is rarely followed longitudinally with the schizophrenia sample, although there are a few exceptions (Harvey et al., 1990; Nuechterlein et al., 1990). A clinical control group would provide critical information about which episodic and vulnerability-linked deficits are peculiar to schizophrenia, and which are characteristic of psychiatric disorders in general. Second, rarely are more than one or two measures of information processing used at any one time. This limits conclusions to only a circumscribed subset of information-processing abilities. Finally, most studies do not take into consideration the multilevel nature of human functioning (Brenner, 1989; Spaulding, 1986). In order to fully understand whether and how changes in information processing influence social performance, multiple levels of functioning need to be considered, including those that address the processing of social information. Presently, very little is known about the relationship between relatively molecular information-processing deficits and impairments in social competence and performance. Clarifying the pattern of interrelationships between social and nonsocial information-processing performance should lead to a better understanding of the mechanisms of schizophrenia and to more comprehensive and effective interventions.

The present study investigated the following issues: a) the nature of residual information processing and social cognitive deficits in schizophrenia and depression; b) the issue of whether residual cognitive deficits are associated with psychopathology in general, or schizophrenia in particular; and c) the relationship between information processing and social cognitive

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problem solving (SCPS) in schizophrenia and depression.

Method

Subjects

Thirty-one Dutch inpatients with schizophrenia, 16 Dutch patients enrolled in a day clinic program with either a major depressive episode (37% of sample), dysthymia (50%) or bipolar disorder-depression (13%), and 31 Dutch medical students participated in the study. At admission to the inpatient unit, schizophrenic patients were assessed with an extended version of the Present State Examination (Wing et al., 1974), conducted by a trained clinical psychologist. For the depressive group, diagnoses were made by their physician and confirmed by a supervising psychiatrist.

Clinical subjects were tested within their first month of treatment. Subjects were retested approximately 3 months after the initial assessment. Individuals with schizophrenia were retested when their progress warranted a transfer from the full-time to day clinic. For the depressed group, the second testing was administered before discharge from their day clinic program.

Twenty-nine of the 31 control subjects (94%), 14 of the 16 depressed subjects (88%), and 27 of the 31 subjects with schizophrenia (87%) were retested. Attrition was due to either refusal of subjects to participate or an inability to contact subjects after the first assessment. After taking into consideration data lost to computer malfunction and/or incomplete data obtained in the first assessment, the final sample sizes were 25 for the control subjects, 14 for the depressed group, and 24 for the group with schizophrenia.

Table 1 provides a summary of age, sex, IQ, and medication status for the three groups. A χ^2 analysis revealed no significant differences for sex distribution ($\chi^2 = 5.70$, NS). Diagnosis × demographic status analyses of variance revealed that individuals with schizophrenia were significantly younger ($F = 33.70, p < .001$) and had lower IQs ($F = 14.06, p < .001$) than those in the other two groups. However, because schizophrenia is associated with a lower IQ (Dean et al., 1987) and an earlier onset than depression (American Psychiatric Association, 1987), we decided not to conduct an analysis of covariance. Such an analysis would artificially equate groups on variables where true differences exist in the populations of interest. Furthermore, as pointed out by Dworkin et al. (1991), there are problems with existing methods that attempt to control for group differences such as IQ (Meehl, 1971).

During the initial assessment, 100% of the schizophrenic group were on psychotropic medication, compared with 50% of the depressed group who were on antidepressants. At test 2, these percentages dropped to 96% and 44%, respectively. Furthermore, 52% and 23% of the schizophrenic group were on anticholinergic medication at test 1 and test 2, respectively. Although not frequently described in published articles, anticholinergics may exert an influence on information-processing skills in schizophrenia (Spohn and Strauss, 1989).

TABLE 1
Means and Standard Deviations of Demographic Variables for Control, Depressive, and Schizophrenic Subjects[a]

	Controls		Depressives		Schizophrenics	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Age	26.6	3.3	28.5	4.0	20.6	2.5
IQ	130	7.6	120	12.4	113	13.0
Males	15		5		18	
Females	10		9		6	
CPZ1					858	
CPZ2					676	
DEX1					.93	
DEX2					.79	

[a]Abbreviations used in table: CPZ1, chlorpromazine equivalent test 1 (mg); CPZ2, chlorpromazine equivalent test 2 (mg); DEX1, dexetimide equivalent test 1 (mg); DEX2, dexetimide equivalent test 2 (mg).

Cognitive Assessment

Cognition was assessed with a Dutch version of COGLAB (Spaulding et al., 1989b). COGLAB comprises test paradigms selected from the information-processing psychopathology literature. The complete battery is administered and scored by an Apple II microcomputer. COGLAB discriminates normal subjects from chronic schizophrenic patients with an overlap of less than 20% (Spaulding et al., 1989a). There are five stable factors that account for 60% of the variance in control subjects, whereas one stable factor has been found to account for 30% of the variance in patients. A full description of the procedure for administering and scoring COGLAB can be found in Spaulding et al. (1989b).

The COGLAB tasks produce 10 summary measures of performance: reaction time (RT); reaction time anticipatory errors; size estimation; the Muller-Lyer effect; false alarms total on the continuous performance/span task; hits across the three conditions (*i.e.*, single distractor, array of six distractors, new target, and array of six distractors) on the span task; correct identifications across the three conditions (*i.e.*, no mask, 40 and 80 msec stimulus onset asynchrony [SOA]) on backward masking; redundancy-associated deficit; distraction recovery across the three interstimulus probes (*i.e.*, 3-, 5-, and 8-second preparatory intervals) on RT; and total errors on a version of the Wisconsin Card Sorting Test. Two additional measures were also included in the analyses. These were the decay functions on the span (*i.e.*, condition 1 hits × 2/condition 2 hits + condition

TABLE 2
Means and Standard Deviations of COGLAB Summary Scores and SCPS Measures that Had Significant Pre-, Post, or Group Effects[a]

Task	Time 1			Time 2		
	Controls	Depressives	Schizophrenics	Controls	Depressives	Schizophrenics
RT	263.4* ± 21.9	287.2* ± 51.8	343.5† ± 87.1	257.8* ± 26.6	289.4* ± 62.9	339.3† ± 100.7
RTANT	1.4* ± 1.1	.8* ± .9	3.3† ± 3.2	1.9* ± 1.6	1.2* ± 1.3	3.3† ± 3.8
MSK	50.6* ± 5.9	48.6* ± 6.4	40.5† ± 9.2	53.2*,[b] ± 4.9	49.4* ± 6.2	43.6† ± 8.0
SPAN	28.3 ± 1.6	26.6 ± 2.7	26.6 ± 2.7	28.6 ± 1.3	27.9 ± 1.5	27.6 ± 1.9
MFNC	1.1* ± .1	1.1* ± .2	1.5† ± .7	1.0* ± .1	1.1* ± .2	1.31† ± .3
SORTMOD	10.4* ± 4.5	17.6* ± 10.5	26.1† ± 17.5	9.9 ± 5.1	13.1 ± 6.4	13.4[b] ± 7.0
MEPS	22.3* ± 7.9	16.8* ± 7.8	14.5† ± 7.0	20.6* ± 6.7	18.0* ± 7.9	15.5† ± 7.3
ALT	15.8* ± 5.7	12.2* ± 4.8	9.2† ± 3.1	14.7* ± 5.2	11.0* ± 2.7	9.9† ± 3.6

[a]Means with different symbols (*, †) differ significantly at $p < .025$. Abbreviations used in tables: RTANT, reaction time anticipatory errors; MSK, backward masking; SPAN, hits on the span task; MFNC, decay function on the masking task; SORTMOD, modified card-sorting task.
[b]Significant pre-post change at $p < .025$.

3 hits) and masking tasks (*i.e.*, number correct condition 1/number correct condition 2), as they reflect deterioration in performance as task demands are increased.

For this study, a procedural change was made in the card-sorting test. The instructions were modified to provide the subjects an explanation of the task and its sorting principles. This was intended to provide a more sensitive test of the disassociation between language and behavior that can occur with frontal lobe impairment. Individuals with frontal lobe impairment can often verbalize task demands, but are unable to use such verbalization to control behavior (Stuss and Benson, 1984). To avoid confusion, results regarding the modified card-sorting task are referred to as SORTMOD in Table 2.

Social Cognitive Problem-Solving Assessment

Means-ends problem solving. One aspect of SCPS, means-ends cognition, was assessed by the means-ends problem-solving task (MEPS; Platt and Spivack, 1975). The MEPS consists of 10 vignettes involving a hypothetical individual. Seven of these vignettes are recommended by Spivack et al. (1985) because three of the 10 vignettes do not involve interpersonal problems. Each vignette consists of a beginning, in which a problem is present, and an ending, in which the problem is resolved. The subject's task is to fill in the middle of the vignette, that is, how the protagonist went about solving the problem. Responses are scored for means (*i.e.*, a discrete behavioral or cognitive step which brings the protagonist closer to the goal), obstacles (*i.e.*, recognition that something may block a particular mean), and time (*i.e.*, taking into consideration that some solutions take time or that there is an optimal time for a particular strategy to be implemented). Spivack et al. (1985) recommend that means, obstacles, and time be summed together to create an overall index of means-ends performance. Therefore, this total served as the index of performance on the MEPS.

Although the MEPS has been criticized as a measure of SCPS in schizophrenia (Bellack et al., 1989), it was selected for use in the study for three reasons. First, it was easily translated into a Dutch version. Second, the study was concerned with social information processing rather than behavioral performance. The MEPS has a long history as a measure of the cognitive aspects of social problem solving. Finally, recent findings from our laboratory suggest that responses to MEPS vignettes are roughly equivalent irrespective of whether subjects responded from their own perspective, or that of a hypothetical individual (Penn et al., in press). This provides evidence against the conclusion that the MEPS is merely a measure of imagination (Bellack et al., 1989).

Alternative solution generation task. Alternative solution generation (ALT) appears earlier in development than means-ends cognition (Kendall and Fischler, 1984; Spivack and Shure, 1982, for reviews). Furthermore, whereas means-ends cognition is considered a problem of transformation, alternative solution generation is an important component in resolving problems of arrangement (see Bellack et al., 1989, for further discussion of these issues). Therefore, means-ends cognition and alternative solution generation seem to measure related, but different, SCPS abilities.

The ends of three MEPS vignettes were deleted to create the stimuli for the alternative solution-generating task. Subjects were only given the beginning of the problem situation. The subjects were instructed to generate as many different solutions as possible to the problem situations. Responses were scored for the total number of independent solutions (*i.e.*, solutions with nonoverlapping themes) generated by subjects.

Procedure

During the initial assessment, subjects were given a short form of the Groninger Intelligence Test (Luteijn and Van der Ploeg, 1982). This was followed by assessment of the subject's current level of psychopathology.

For the group with schizophrenia, this was done with the Psychiatric Assessment Scale (Krawiecka et al., 1977), which was conducted by a clinical psychologist blind to the results of the Present State Examination. The depressed group received the Zung (Zung, 1965), while the nonclinical control group was administered the SCL-90 (Derogatis, 1977). Subjects then completed the two SCPS tasks (responses were tape recorded) and COGLAB. The second assessment was identical to the first, with the exception of the intellectual assessment, which was omitted.

Results

Interrater reliability

One of the investigators (A. J. W. V.) and a research assistant blind to the hypotheses of the study served as raters for the subjects' responses on the MEPS and the alternative solution generation task. To train, raters read the MEPS manual, discussed criteria, listened to practice tapes, transcribed responses, and reached a consensus. Interrater reliability was determined for a sample of 20 subjects randomly chosen from all groups. This yielded Pearson correlation coefficients of .80 for both tasks.

Symptomatology Over Time

Each of the three measures of symptomatology (Psychiatric Assessment Scale, Zung, and SCL-90) were subjected to the repeated-measures analysis of variance. Both the schizophrenia and depression groups demonstrated a significant drop in symptomatology by the second testing ($F[1,22] = 22.64$, $p < .0001$ and $F[1,13] = 8.78$, $p < .012$,[4] respectively). For the nonclinical controls, there were no significant differences in the SCL-90 between the two testings ($F[1,23] = .70$, NS).

Changes Over Time in Information Processing and SCPS

To control for family-wise error, an initial 3 × 2 (group × pre-post) mixed-model multivariate analysis of variance with repeated-measures on pre-post was conducted across all measures of COGLAB and SCPS. This analysis yielded a significant group × pre-post interaction ($F[2,88] = 2.13$, $p < .01$). After this analysis, each of the dependent measures was subjected to mixed-model analyses of variance. Reported below are those measures that demonstrated significant group, group × pre-post, and group × pre-post × condition effects.

Significant differences among information processing and SCPS scores for the three groups at time 1 and time 2 are summarized in Table 2. Group difference main effects emerged for reaction time ($F[2,59] = 9.85$, $p < .0001$), reaction time release ($F[2,60] = 10.26$, $p < .001$), decay on backward masking ($F[2,59] = 8.69$, $p < .001$), total hits on span of apprehension ($F[2,60] = 4.08$, $p < .025$) and backward masking ($F[2,60] = 15.47$, $p < .001$), MEPS ($F[2,58] = 6.13$, $p < .005$), and ALT ($F[2,58] = 12.14$, $p < .001$). For all variables, the pattern was the same: The group with schizophrenia performed the poorest, demonstrating the slowest RT, the largest number of RT anticipatory errors, the fewest hits on span and backward masking tasks, the most decay on backward masking, the lowest total on the MEPS task, and the fewest solutions generated, whereas the control group performed best. Furthermore, post-hoc analyses (least significant difference with alpha set to .025 to control for family-wise error) revealed that the group with schizophrenia differed significantly from both groups on measures of reaction time anticipatory release and backward masking, and from only the control group on the measures of RT, backward masking decay, and SCPS.

A significant group × pre-post interaction was found on the modified card sort for total errors ($F[2,60] = 8.24$, $p < .001$). Post hoc analyses revealed that although groups differed significantly from one another at test 1 ($F[2,62] = 10.13$, $p < .0005$; controls had the fewest errors and schizophrenics had the most), there were no significant differences at test 2 ($F[2,60] = 2.24$, NS). This finding is a result of the significant pre-post improvement by the group with schizophrenia ($F[1,23] = 17.29$, $p < .0001$). By the second assessment, performance by the group with schizophrenia had reached the level of that of the control group.

Because four of the 10 COGLAB measures produce data in multiple conditions (*i.e.*, masking, vigilance, vigilance false alarms, and RT distraction recovery), important information regarding differential group response across conditions may be obscured by analyzing only summary scores. Therefore, mixed-model analyses of variance were conducted on the four measures across each of their conditions. Significant group × condition × pre-post interactions were found for both vigilance/span ($F[4,120] = 2.59$, $p < .04$) and masking ($F[4,120] = 7.58$, $p < .001$).

Probing the interaction for vigilance revealed group differences for the second condition (*i.e.*, initial 6-digit array) for both test 1 ($F[2,60] = 3.91$, $p < .03$) and test 2 ($F[2,60] = 3.87$, $p < .03$); the interaction was accounted for by the pre-post improvement by the depressed group in the second condition. This led to nonsignificant differences being present between the control and depressed groups at time 2.

[4]According to criteria determined by Barrett et al. (1978), six patients in the depressed group experienced remission of symptoms, two went from moderately to mildly depressed, two patients' symptomatology was in the remitted range for both assessments, and four patients' level of symptomatology stayed in the same range.

Probing the interaction for backward masking revealed group differences at the 80-msec condition for both time 1 ($F[2,60] = 11.69$, $p < .0001$) and time 2 ($F[2,60] = 9.50$, $p < .0003$). Group differences also emerged at 40 msec for both testings ($F[2,60] = 8.55$, $p < .0005$; $F[2,60] = 10.71$, $p < .0001$). In both conditions, controls had the highest hit rate and schizophrenics had the lowest. Post hoc analyses revealed significant pre-post improvement for the schizophrenia group at the 80-msec SOA ($F[1,23] = 4.82$, $p < .04$) and for the control group at the 40 msec SOA ($F[1,24] = 8.13$, $p < .01$). At time 1, the group with schizophrenia was significantly poorer than the other two groups at the 80-msec SOA. At time 2, there were no differences between schizophrenic and depressive groups, but both groups were still poorer than controls.

Interrelationships Between Information Processing and SCPS: Cross-Sectional

The relationship among COGLAB summary scores, MEPS, and ALT performance across the three groups and for both testings was determined using Pearson correlations. To control for family-wise error, alpha was set at .01.

For the control group at both time 1 and time 2, there were no significant relationships between SCPS and information processing. For the depressed group at time 1, a better performance on the MEPS was associated with more total hits on the backward masking task ($r = .62$). More alternative solutions were associated with more total hits (.65) and less decay on the masking task (.62). At time 2, there were no significant correlations. As symptomatology subsides, the sensitivity of information-processing tasks among depressives approaches that of the normative sample.[5]

For the schizophrenia group at time 1, better performance on the MEPS was not associated with any measures of information processing. However, more alternative solutions were associated with more total False Alarms (.50) on the span task. The correlation between alternative solutions and number of false alarms increased as task demands increased (*i.e.*, −.14, .29, and .54), with the relationship being significant at condition 3 (*i.e.*, 6-digit array, new target). This pattern was paralleled for hit rate across the three vigilance conditions (*i.e.*, .01, .20, and .34) and was not evident for the other groups.

At time 2, better performance on the MEPS was also associated with more total false alarms (.51). As with alternative solutions at time 1, the relationship between SCPS and false alarms increased, as did task demands (*i.e.*, .13, .43, and .48), although the pattern between SCPS and hit rate was not as consistent (*i.e.*, .00, .42, and .18). For the alternative solution task, there were no significant relationships with information processing, a finding that is similar to that of depressives at time 2.

Interrelationships Between Information Processing and SCPS: Longitudinal

The longitudinal relationship COGLAB summary scores and MEPS and ALT performances across the three groups were examined by computing correlations between residualized change scores (alpha set at .01). For controls, there were no significant relationships between information processing and SCPS change scores. Among depressed subjects, the only significant correlation was between increase in generation of alternative solutions over time and a decrease in distractibility on RT ($r = -.62$, $p < .01$). For the schizophrenia group, an increase in MEPS performance was significantly associated with an increase in total false alarms ($r = .55$, $p < .01$). Furthermore, the relationship between improved MEPS performance and decrease in errors on the modified card sort approached significance ($r = -.48$, $p < .012$). Change in alternative solution generation was not significantly associated with change in any of the information-processing measures.

Discussion

The results from the present study address three areas of inquiry in the role of information processing in schizophrenia. First, residual deficits in young patients with schizophrenia tend to be associated more with molecular than molar processing skills in the cognitive domain, and with means-ends thinking and generative thought in the social cognitive domain. Second, from a purely statistical point of view, residual deficits are unique to schizophrenia, as the depressive group at time 2 did not differ significantly from control subjects on any of the measures. However, the pattern of findings across measures (*i.e.*, the consistently lower performance of depressives relative to controls) suggests that stable residual deficits do occur in a nonschizophrenic psychiatric group. Third, depressive and schizophrenic groups differed with respect to the type of information-processing skills that contributed to social problem-solving ability.

In measures of molecular information processing (*i.e.*, reaction time, reaction time release, backward masking, vigilance), the group with schizophrenia demonstrated significant impairment after symptom reduc-

[5]One concern was that the decrease in correlations could be due to a decrease in variance. Therefore, all correlations that decreased from time 1 to time 2 were systematically evaluated for the nature of the reduction. This revealed that variances did *not* decrease across assessments. The decrease in correlations is due to a change in the relationship of the constructs measured, rather than a statistical change.

tion. These findings complement those reported in previous research concerning residual information-processing deficits in remitted schizophrenics (Asarnow and MacCrimmon, 1978; Nuechterlein et al., 1986; Saccuzzo and Braff, 1981). However, by the second assessment, the performance by the group with schizophrenia on a measure of more complex information processing, the modified card sort, was indistinguishable from that of controls. Taken together, these findings suggest that the most persistent cognitive deficits in schizophrenia are associated more with molecular, rather than molar, information-processing skills.

It may be hypothesized that improvement in the modified card-sorting performance by the group with schizophrenia is due to an improved ability to utilize verbal information when symptoms are reduced. This is likely associated with reduction in positive symptoms, which, when present, are associated with increased distractibility (Cornblatt et al., 1985). Because of the modification in the task instructions (*i.e.*, providing the rules at the beginning of the task), it cannot be concluded with confidence that the group with schizophrenia improved in conceptual abilities. Therefore, the stability of conceptual deficits as a function of improvement in clinical status still needs to be examined.

The group with schizophrenia did not improve or change its position relative to control groups with respect to social cognitive problem solving. This finding suggests that impairment in SCPS may represent a stable, vulnerability-linked deficit area, rather than one that is sensitive to the episodic quality of the disorder. This is consistent with recent findings that deficits in social problem solving among remitted schizophrenics differentiates individuals who relapse from those who do not (Sullivan et al., 1990).

The depressives did not statistically differ from controls on any measures of information processing or SCPS by the second assessment. However, the pattern of findings across tasks indicates that the depressed group consistently performed worse than controls. Knight (1984) argues that this type of finding provides convincing evidence about the nature of group differences with respect to a given set of processes. Therefore, the current findings suggest that residual cognitive and social cognitive deficits *are* present in psychopathology in general, but are more profound in schizophrenia.

The three groups differed with respect to the extent and pattern of information-processing skills that contributed to SCPS. For the control group, there was no significant relationship between information processing and SCPS at either test 1 or 2. This finding complements that of Corrigan et al. (1992), who reported a lack of relationship between measures of simple information processing and social problem solving in a normative sample. The lack of relationship in the present study was due partially to range restriction, as subjects' performance peaked on a number of information-processing measures (*e.g.*, the first condition in vigilance and backward masking). For those measures in which neither ceiling nor cellar occurs (*e.g.*, reaction time), two hypotheses about the lack of relationship with SCPS may be entertained. First, there could be functional autonomy between performance in the cognitive and social cognitive domains. This would be consistent with findings indicating that functioning in the cognitive domain is not necessarily associated with functioning in the social domain (Dworkin et al., 1991; reviewed by Penn, 1991). Second, an information-processing battery may be best suited to assess performance for deviant, rather than normative, functioning. This is known as the "twisted pear" phenomenon (Fisher, 1959): A test is most predictive of functioning for scores indicative of pathology or impairment. Therefore, COGLAB type tasks may be best predictive of social problem-solving ability for those individuals or groups who demonstrate the most impairment in information processing.

For the depressed group at time 1, better performance on both measures of SCPS was associated with better performance on the backward masking task (*i.e.*, more total hits). While the specific mechanisms underlying backward masking performance are a matter of debate (Schuck and Lee, 1989), there is general consensus that backward masking measures efficiency during the early stages of visual information processing (reviewed by Nuechterlein and Dawson, 1984). Since depression is associated with both excessive self-focused attention (*e.g.*, Pyszczynski and Greenberg, 1986) and deficits in effortful processes (Wenzlaff et al., 1988), backward masking effects in this population may be mediated by effectiveness in maintaining sustained attention. This is supported by the longitudinal improvement in SCPS being associated with a longitudinal decrease in distractibility. Therefore, it may be hypothesized that better SCPS is associated with more efficient or better utilization of controlled/effortful information processing among individuals who are acutely depressed. At the second assessment, when symptoms had remitted, no relationships were found for the depressed group between SCPS and information processing. This supports the hypothesis that as subjects' clinical status stabilizes, the predictive efficiency of information-processing measures for social problem solving approaches that of normal subjects.

For the group with schizophrenia, better SCPS during symptom exacerbation and remission was associated with an increase in false alarms during the vigilance/span task. The relationship between COGLAB false alarms and SCPS tended to increase as task demands increased. This was paralleled by a similar pattern involving hit rate and SCPS. An increase in hit and false alarm rates has been found to correlate with molar social behavior (Spaulding, in press). Therefore, the liberal response style adopted by individuals with schizophrenia may be measuring significant aspects of social functioning. This is underscored by the consistency which the relationship between response style and SCPS holds across clinical states.[6]

The longitudinal findings have clinical implications for treatment of schizophrenia. When symptoms have remitted, psychiatric rehabilitation should focus cognitive intervention on more molecular levels of information processing. If these deficit areas serve as vulnerability markers for future psychotic episodes, then actively addressing them during remission might prevent relapse. The application of cognitive rehabilitation techniques utilized with the head-injured (*e.g.*, computer tasks for improving attention), might prove to be especially promising in this regard (reviewed by Stuve et al., 1991). Furthermore, individuals with schizophrenia who demonstrate a significant improvement in ability to utilize verbal information (*i.e.*, as assessed by the modified Wisconsin Card Sorting Test) and have a more liberal response style may be most ready for rehabilitative interventions. This is supported by the finding that longitudinal improvement on the modified card sort and an increase in false alarm rate were associated with longitudinal improvement in SCPS. Thus, such cognitive and social cognitive characteristics may be conducive to the acquisition of social information, such as that found in social skills training.

Future research should continue to explore implications of the findings reported above. Specifically, a larger number of social problem-solving measures should be utilized. This will increase the scope of investigation regarding information-processing correlates of social problem-solving ability. Furthermore, a longer follow-up period is advised, so as to ascertain the longitudinal stability of both residual deficits and information processing-social cognitive relationships. Finally, assessment of information processing should be replicated with those tasks that traditionally are administered manually (*e.g.*, Wisconsin Card Sorting Test), because computerized administration might change the parameters of a given task (see Miller et al., 1990, for an example with the span of apprehension task).

As more is learned about the stability of cognitive and social cognitive relationships in remission, interventions can be developed whose comprehensive nature will decrease the chances of future psychotic relapse. The present study represented a first step in this direction.

[6]To support the point that the relationship between response style and SCPS holds across clinical states, residualized change score correlations were conducted between symptoms and information processing and SCPS measures that changed over time. Change in symptoms was not significantly correlated with change in cognitive or social cognitive abilities. Cross-temporal correlations between time 1 false alarms with time 2 MEPS and the Psychiatric Assessment Scale for schizophrenics revealed an increase in relationship between false alarms and MEPS as task demands increased (−.08, .07, and .35), while no clear pattern emerged between false alarms and the Psychiatric Assessment Scale (−.03, .18, and .10). This suggests that the liberal response style in schizophrenics may impact social functioning independent of changes in symptom status.

Conclusions

The results of this study suggest that residual cognitive and social cognitive deficits occur in psychopathology, but are most profound in schizophrenia. The cognitive deficits in schizophrenia tend to be more at the molecular, rather than molar, level of functioning. Social cognitive problem solving is associated with sustained attention among individuals with a mood disorder and with a liberal response style among individuals with schizophrenia.

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