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Memory Functioning and Negative Symptoms as Differential Predictors of Social Problem Solving Skills in Schizophrenia

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Abstract

Background—Neurocognition in general, and memory functioning in particular, as well as symptoms have all been shown to be related to social problem solving (SPS) in schizophrenia. However, few studies have directly compared the relative contribution of neurocognition vs. psychiatric symptoms to the components of SPS.

Method—Sixty outpatients (aged 21 – 65) who met DSM-IV criteria for schizophrenia or schizoaffective disorder were administered a broad battery of memory tests and assessed for severity of positive and negative symptoms as part of a baseline assessment of a study of psychiatric rehabilitation. Multiple regression analyses were used to examine the contribution of memory functioning vs. symptoms on receiving, processing, and sending skill areas of social problem solving ability.

Results—An index of verbal learning was the strongest predictor of processing skills whereas negative symptoms were the strongest predictor of sending skills. Positive symptoms were not related to any of the three skill areas of social problem solving.

Conclusions—Memory functioning and psychiatric symptoms differentially predict selected areas of social problem solving ability in persons with schizophrenia. Consistent with other

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Contributions

Dr. Ventura participated in data analysis, interpreted the results, reviewed the literature, developed the manuscript, edited comments from co-authors, and organized the references. Robert S. Kern is the study Principal Investigator who conceived of the initial study design, was awarded funding to carry out the study, supervised the collection of data, supervised the conduct of the data analysis, and made contributions to the manuscript. Chris Jetton, Ph.D., and Shelley R. Tom, Ph.D., created initial data sets, conducted data analysis, and contributed to the manuscript. All authors have approved the final manuscript.

Conflict of interest

The authors report no conflict of interest

reports, positive symptoms were not related to social problem solving. Consideration of both neurocognition and negative symptoms may be important to the development of rehabilitation interventions in this area of functioning.

Introduction

Some evidence suggests that various forms of social skills are necessary for daily living and might play an intermediate role as a mediator of the relationship between neurocognition and functional outcome (Kurtz and Mueser, 2008). In fact, a variety of social skills training (SST) programs and social cognition training have been developed to treat these impairments in social functioning (Heinssen et al., 2000; Horan et al., 2008). Social problem-solving deficits, which can be considered a subset of the broader category of social skills, are common among individuals who have schizophrenia (Addington and Addington, 2008; Addington and Piskulic, 2011; Vaskinn et al., 2009; Zanello et al., 2006). Models of social problem solving identify three components: receiving, processing, and sending. Previous studies have reported links between neurocognition, particularly verbal learning, and social problem solving in schizophrenia. However, few studies have directly compared the contribution of neurocognition vs. symptoms on these critical components of social problem solving. Given the multidimensional nature of social problem solving, determining how selected components might be differentially related to neurocognition vs. symptoms might prove useful.

Neurocognitive deficits in schizophrenia continue to be of prime interest because of their close ties to skill acquisition and functional outcomes (Green et al., 2000). Of the neurocognitive functions examined in the literature, verbal memory has shown to be a consistent, often replicated predictor of social problem-solving ability. Most studies have examined only selected aspects of memory and so despite a good deal of research in this area, the findings from these studies are mixed. Many studies have examined memory functions and several found that tests of verbal memory (Addington and Addington, 1999, 2000; Corrigan and Toomey, 1995) and visual memory (Addington and Addington, 1999) were in fact related to social problem solving. Other studies, that appeared to be adequately powered, did not find these relationships between social problem solving and verbal memory, or visual organization and visuo-spatial memory (Addington and Addington, 2000; Addington et al., 1998; Bowen et al., 1994; Corrigan and Addis, 1995; Zanello et al., 2006). However, in some of these studies, the neurocognitive batteries were rather limited in terms of the number of memory measures. In other types of studies, memory skills were not comprehensively assessed. These results suggest that it is not entirely clear which domains of verbal memory are fundamental to social problem solving.

Studies have examined the role of positive and negative symptoms as measured using the PANSS, BPRS, or SANS on the components of social problem solving in schizophrenia using correlational analyses. There has been some support for a relationship between positive symptoms and AIPSS performance, particularly for Receiving and Processing skills. In contrast, fewer studies showed a significant relationship between positive symptoms and Sending skills (Ikebuchi, 2007; Üçok et al., 2006; Zanello et al., 2006). In contrast, the reported relationship between negative symptoms and social skills including

social problem solving is larger and generally more consistent yielding effect sizes ranging from medium to large (Addington and Addington, 1999, 2000; Bellack et al., 1994; Corrigan and Toomey, 1995; Ikebuchi, 2007; Ventura et al., 2009; Yamashita et al., 2005). Ikebuchi (2007) using structural equation modeling concluded that social problem solving was associated with neurocognition, social cognition, disorganization, and negative symptoms. But the relative strength of the contribution of these variables differed depending on whether one was considering receiving, processing, or sending skills. Üçok et al. (2006) using multivariate analyses found that positive symptoms were inversely associated with social problem solving. In general, relatively few studies have directly compared (in the same sample) neurocognition to symptoms as predictors of the individual components of social problem solving in schizophrenia.

We hypothesized that various forms of declarative and non-declarative memory and negative symptoms in schizophrenia patients are related to the domains of social problem solving including, receiving, processing, and sending. Receiving and processing of social problems might be enhanced by better recall of previous problem situations, including recall of the nature of the problem and evaluation of the success of those prior attempted solutions. Negative symptoms, rather than positive, would be associated with social problem solving because they are associated with interpersonal withdrawal and lack of a response needed for implementation of a solution.

METHOD

Subjects

The study included 60 outpatients (aged 21 – 65) who met DSM-IV criteria for schizophrenia or schizoaffective disorder. Psychiatric diagnosis was determined following administration of the Structured Clinical Interview for DSM-IV (SCID-I/P) (First et al., 2001) by an interviewer trained within the diagnostic and psychiatric symptom training program at the UCLA Clinical Research Center for the Treatment and Rehabilitation of Schizophrenia. A minimum overall kappa of .75 (and .75 kappa sensitivity and .75 specificity) for all symptom and algorithm decisions was required for certification (Ventura et al., 1998). Final determination of psychiatric diagnosis was made following case review by the study PI using all available information (interview, medical records, informants, etc.). The outpatients were clinically stable (no psychiatric hospitalizations in the past six months, same antipsychotic medication for the past three months). Exclusion criteria included evidence of current or past neurological disorder (e.g., epilepsy), history of head trauma with loss of consciousness exceeding one hour, mental retardation, inability to understand spoken or written English, and substance dependence within the past three months. Table 1 presents the sample characteristics.

Procedures

All participants received, shortly after study entry, assessments of psychiatric symptoms, memory functioning, and social problem-solving ability. The memory battery was divided into three approximately equal parts with order of administration counter-balanced across participants to reduce order effects on memory performance. All participants received the

memory and social problem-solving assessments in a single session with breaks provided between battery components and between the memory and social problem-solving assessments. Symptoms were assessed on a separate day within a two-week window of the memory and social problem-solving assessment. The length of time to complete the entire memory battery was approximately 1.5 to 2.0 hours; the social problem-solving assessment required approximately 45 – 60 minutes; symptom assessment required approximately 30 – 40 minutes. The individual measures which comprised the three assessments are described below.

Symptom Assessment—Psychiatric symptoms were assessed using the 24-item Brief Psychiatric Rating Scale (BPRS; Ventura et al. 1993), a semi-structured interview for rating the presence and severity of psychiatric symptoms. Signs and symptoms are rated along a severity and impairment in functioning dimension using a seven-point rating scale with anchors (higher scores reflect greater severity of symptoms). The BPRS was administered by raters trained to reliability standards at the UCLA Clinical Research Center. Raters were trained to a minimum Intraclass Correlation Coefficient (ICC) of .80 and participated in a quality assurance program (Ventura et al., 1993). For the present study, the dependent measures of interest were summary scores for positive symptoms Reality Distortion sum of auditory hallucinations, unusual thought content, and conceptual disorganization, and Negative Symptoms sum of emotional withdrawal, motor retardation, and blunted affect.

Memory Assessment—The following areas of explicit and implicit memory functioning were assessed using the methods described below.

Explicit Memory: Verbal learning – Verbal learning was assessed using the logical memory subtest from the Wechsler Memory Scale – III (Wechsler, 1987).The logical memory subtest includes two brief paragraphs that are read aloud to the participant and recall is assessed after each one. To assess verbal learning, the second story is reread and recall is assessed a second time. The dependent variable was a total score combining recall scores for both administrations of the second story.

Working memory – working memory was assessed using the Letter-Number Sequencing subtest from the Wechsler Memory Scale – III (Wechsler, 1987). The dependent measure was the total raw score based on the number of correctly completed trials.

Semantic memory – semantic memory was assessed using a category fluency task. Participants were asked to produce as many animal names and grocery items that they could in separate one minute trials. The dependent measure was the total number of acceptable responses across conditions within the allotted time.

Remote memory – remote memory was assessed using a revised version of the tests developed by M. Alpert and her colleagues (Beatty, 1988). The battery included two test components: a) participants were asked to identify pictures of persons famous in each decade from the 1940's to 1980's, and b) to answer public events questions from each of these decades. The dependent measure was a composite that was the mean of the standardized scores for each condition.

Implicit Memory: Procedural memory – procedural memory was assessed using the Pursuit Rotor task. Participants were asked to track a lit target area that moves in a clockwise direction on a turntable using a stylus with a light sensitive tip. For this study, the speed of the target was set at 45 rpm for all study participants (Kern et al., 1997). The test was administered in six blocks of four trials with each trial lasting 20 seconds. The dependent measure was a difference score for time-on-target between blocks 6 and 1.

Priming – priming was measured using a word stem-completion task based on stems and completion frequencies established by Graf and Williams (1987). Materials included two 40-item word lists (List A and B) and two corresponding lists of 40 three-letter stems (Stem Lists A and B). Each stem list included 18 targets (stems corresponding to words from the 40-item word list), 18 “other list” targets (stems belonging to words from the other word list), and 4 stems that did not correspond to words from either list. The mean Standard Frequency Index (SFI) for the primed and non-primed words for the two lists fell in the upper 40s indicating common usage *The American Heritage Word Frequency Book* (Carroll et al., 1971), and the two lists were comparable in this regard (List A: mean SFI = 47.0, sd = 9.8; List B: mean SFI = 49.5, sd = 7.0).

Administration of word lists A and B were counterbalanced across study participants. Administration included the following procedures. Participants were initially presented one of the 40-item word lists and asked to rate the degree of “pleasantness” of each word. Immediately following the ratings, participants were then presented the corresponding list of 40 three-letter word stems (e.g., bro___) and asked to write down the first word they could think of that would correctly complete each stem. The dependent measure was a percent score reflecting the difference between target hits and baseline completion expectancies established from a group of healthy community residents (Kern et al., 2010).

Social Problem-Solving Assessment—Assessment of Interpersonal Problem-Solving Skills (AIPSS) (Donahoe et al., 1990) - The AIPSS is a measure that uses videotaped vignettes to assess the social skills of schizophrenia patients. The AIPSS measures a subject's ability to recognize an interpersonal social problem (“receiving”), to derive a solution to the problem (“processing”), and to enact a solution (“sending”) in a role-played simulation test (Wallace, 1980). The AIPSS is based on the conceptual model that successful social problem solving includes receiving, processing, and sending skills. In this model, the first step in the social problem solving process is recognizing the existence of a problem which requires skills of problem identification and description. The ability to describe both the goal and the obstacle is problem description. Together, problem identification and problem description make up receiving skills. The second step requires that various alternatives must be identified, the consequences considered, and the best alternative chosen, described as processing skills. The third step, the solution must be enacted. Sending skills consist of both content and performance skills. The receiving-processing-sending (RPS) model is thought to be sequential in that competent performance at one stage depends on competent performance at earlier stages (Wallace, 1980).

This previously validated videotape measure of social problem-solving ability in schizophrenia involves presentation of 13 scenes of persons interacting with one another in a

variety of everyday social situations. Ten of the scenes depict a social conflict (e.g., roommate disagreements, being ignored by a store clerk); three do not. For scoring purposes, participant responses were recorded via verbatim transcripts and the role-play exercises were videotaped. Transcripts and videotapes were scored by two raters trained by the PI with competency criteria set at a kappa = 0.90. Interrater reliability with the PI after training yielded kappa scores of 0.96 and 0.93 for the two raters, respectively, and were comparable with previous levels of inter-rater reliability on this measure (Toomey et al., 1997). The dependent measures of interest were summary scores for receiving, processing, and sending skills. See reference below.

Statistical Analyses

The primary analyses were designed to address the question of whether memory functioning or symptoms better explain the variance in each of the three skill areas of social problem solving ability. To reduce the number of variables drawn from the memory battery, composites were derived for explicit and implicit memory by standardizing the dependent variables from the corresponding tests within each domain and taking the mean of those scores. Initially, we examined memory functioning and symptoms separately to measure the total amount of variance explained by these putative predictors of social problem solving ability. Separate regression analyses were performed with explicit and implicit memory entered as independent variables in one set of analyses for each skill area and positive and negative symptoms entered in the second set. We then examined the amount of variance explained by memory functioning vs. symptoms for each skill area of social problem solving ability. Using hierarchical regression analyses, we directly compared memory functioning vs. symptoms on each skill area. To control for the influence of demographics, age and gender were entered first in block 1 using simultaneous entry, then in block 2 variables for explicit and implicit memory and positive and negative symptoms were entered using the stepwise method. For significant findings involving memory, follow-up analyses were conducted by examining individual areas of memory functioning to see which domain(s) accounted for the most variance.

Results

Hierarchical regression analyses were used to compare memory functioning vs. symptoms on social problem solving ability controlling for age and gender (Table 2). For receiving skills, no independent variables met criteria for entry. That is, neither memory functioning nor psychiatric symptoms explained an appreciable amount of variance in this skill area to be considered for the purposes of comparison. For processing skills, only explicit memory entered the stepwise model. This variable explained an additional 9.6% of the variance over and above that explained by demographics alone. Follow-up analyses of the domains comprising explicit memory showed that verbal learning (WMS-III logical memory) was the primary contributor ($\beta = .334$; $t = 2.66$; $p = .01$). For sending skills, only negative symptoms entered the stepwise model explaining an additional 12.4% of the variance over and above demographics.

Memory functioning (explicit plus implicit) explained 3.7% of the variance in receiving skills, 11.1% of the variance in processing skills, and 11.0% of the variance in sending skills. Symptoms (positive and negative) explained 2.4% of the variance in receiving skills, 8.3% of the variance in processing skills, and 13.1% of the variance in sending skills.

Discussion

We examined neurocognitive functioning (various forms of memory) and clinical variables (positive and negative symptoms) in relationship to three skill areas of social problem solving. Overall, we found a differential pattern of predictive strength depending on the skill area being examined. An index of verbal learning was associated with processing skills, negative symptoms predicted sending skills, and neither memory nor symptoms predicted receiving skills. These findings suggest that the skill areas that underlie social problem solving ability might be differentially determined by memory and negative symptoms. Regarding symptom correlates, positive symptoms were not significantly associated with any of the three domains of social problem solving. Our results share some similarities and differences with previous reports on the relationship between symptoms and social problem solving ability in schizophrenia (Addington and Addington, 1999, 2000; Zanello et al., 2006). Social deficits in schizophrenia are not just related to neurocognitive functioning but negative symptoms might also play a role.

Previous research has clearly shown that schizophrenia patients, at different illness severity levels and stages of illness (recent onset vs. chronic), have social problem solving deficits as measured by the Assessment of Interpersonal Problem Solving Skills (Addington and Addington, 2008; Stålberg et al., 2008; Vaskinn et al., 2009). Our findings are consistent with those previous reports that found verbal memory to be a key determinant of social problem solving (Addington and Addington, 1999, 2000; Addington et al., 1998). However, not all studies found an association with memory (Zanello et al., 2006). One implication is that specific components of memory such as verbal learning are related to specific components of social problem solving in schizophrenia patients, but not others, e.g., receiving or sending skills. These findings suggest that memory for prior social problem solving situations might be involved in the processing of current social problems that require consideration of consequences, selection of an alternative, and identification of various alternatives.

Even though patients might have good memory skills that provide a mechanism by which to generate plausible solutions to social problems, symptoms seem to play a prominent role in other skill areas of social problem solving. Positive symptoms have been shown to be related to receiving skills, whereas negative symptoms have been shown to be related to all three skill areas (Addington and Addington, 2000; Üçok et al., 2006; Zanello et al., 2006). As hypothesized, we found evidence that negative symptoms are related to sending skills. That association might results in an interference with the patient's ability to enact a problem solving action. Negative symptoms might limit what components of social problem solving a patient can communicate during the implementation phase of a generating a solution. These relationships with symptoms suggest that even when a patient's strategies for solving

social problems are reasonable ones, the presence of negative symptoms might interfere with successful execution and consequently, a desired outcome in the real world.

This study has limitations. Although the measurement of memory functioning is comprehensive, broader representation of neurocognitive domains is lacking. For example, an examination of the relationship between neurocognitive domains of attention and executive functioning, as well as selected areas of social cognition, on social problem-solving ability could have provided informative and meaningful results. In addition, there was only one measure of social problem solving, the AIPSS. We did not specifically compare patients to normal controls. However, many studies have shown that schizophrenia patients in all phases of illness have social problem solving deficits. Also, BPRS negative symptoms are mostly based on observation rather than report by observers and so although highly correlated with, might not as comprehensive, as other rating scales. Finally, the analyses are correlational rather than longitudinal so all references to the predictive direction of relationships are is purely theoretical. Despite these limitations, the study results do have important implications for understanding impairments in social problem solving ability in schizophrenia and complement the results from previous investigations in this area.

Putting social problem solving into broader context helps with conceptualizing how domains of social skills and social cognition all relate to each other (Falloon et al., 2007). Knowledge or demonstrated ability in basic social skills would seem to be associated with enhanced social problem solving ability. There are a number of basic social skills, such as, making conversation, being supportive, making good eye contact, asking appropriate questions, asking for help, and appropriate self disclosure, that would facilitate social problem solving. In addition, there are several relevant social cognitive processes that seem to be associated with social problem solving, such as, emotion processing, social cue recognition, attribution, and Theory of Mind (ToM). One might hypothesize that social cognitive skills such as social cue recognition and Tom would be particularly relevant. Understanding these links has implications for interventions because these abilities overlap.

These findings have implications for rehabilitation intervention programs with schizophrenia patients that target social problem solving ability. In fact, processing skills as measured by the AIPSS might be a central element of learning successful solutions to problems that lead to good social functioning. Specifically, verbal learning is likely to be a key consideration of training on processing skills. Consistent with a good deal of previous research, positive symptoms are not a strong determinant of skill acquisition and concern for their influence on training appears minimal (Ventura et al., 2009). However, the presence of negative symptoms appears to be of greater concern and might impede the ability to successfully implement a desired strategy for resolving an interpersonal problem in a social milieu (Kopelowicz et al., 2006). Refining our knowledge about cognitive and symptom predictors of social problem-solving may facilitate deeper understanding of underlying mechanisms of how these processes work while furthering the development of new social skills intervention programs or modifying existing ones.

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Table 1

Sample Demographic and Clinical Characteristics

Variable	Schizophrenia Participants (n = 60) Mean (SD)
Age (yrs.)	43.6 (10.6)
Education (yrs.)	12.1 (3.5)
Gender (M:F)	43:17
Ethnicity (% white)	38.3
Years since 1st hospitalization	16.7 (9.8)
Percent on atypicals	85.0
BPRS[a] total	45.8 (13.6)
BPRS positive	7.9 (4.5)
BPRS negative	6.2 (2.8)

[a]BPRS = Brief Psychiatric Rating Scale

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Table 2

Results of Hierarchical Regression Analyses for Memory vs. Symptoms on Social Problem-Solving Ability

Skill Area	Predictor	Method	β	t-value	p-value	R^2
Processing	Block 1	Enter				0.023
	Age		0.06	0.44	0.66	
	Gender		−0.14	−1.05	−0.30	
	Block 2	Stepwise				0.119
	Age		0.05	0.36	0.72	
	Gender		−0.14	−1.14	0.26	
	Explicit Memory		0.31	2.47	0.02	
Sending	Block 1	Enter				0.019
	Age		0.11	0.84	0.40	
	Gender		−0.08	−0.58	0.56	
	Block 2	Stepwise				0.143
	Age		0.10	0.82	0.42	
	Gender		−0.04	−0.36	0.72	
	Negative Symptoms		−0.35	−2.84	0.01	

Note:: For both the Processing and Sending Skill Areas, Block 2 included the independent variable retained from the stepwise regression plus the independent variables carried forward from Block 1. For Receiving Skills, neither memory nor symptoms met criteria for entry in the stepwise regression.