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Social cognition in psychosis: Multidimensional structure, clinical correlates, and relationship with functional outcome

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ABSTRACT

Social cognitive impairments are common, detectable across a wide range of tasks, and appear to play a key role in explaining poor outcome in schizophrenia and related psychotic disorders. However, little is known about the underlying factor structure of social cognition in people with psychotic disorders due to a lack of exploratory factor analyses using a relatively comprehensive social cognitive assessment battery. In a sample of 85 outpatients with psychosis, we examined the factor structure and clinical/functional correlates of eight indexes derived from five social cognition tasks that span the domains of emotional processing, social perception, attributional style, and Theory of Mind. Exploratory factor analysis revealed three factors with relatively low inter-correlations that explained a total of 54% of the variance: (1) Hostile attributional style, (2) Lower-level social cue detection, and (3) Higher-level inferential and regulatory processes. None of the factors showed significant correlations with negative symptoms. Factor 1 significantly correlated with clinical symptoms (positive, depression-anxiety, agitation) but not functional outcome, whereas Factors 2 and 3 significantly correlated with functional outcome (functional capacity and real-world social and work functioning) but not clinical symptoms. Furthermore, Factor 2 accounted for unique incremental variance in functional capacity, above and beyond non-social neurocognition (measured with MATRICS Consensus Cognitive Battery) and negative symptoms. Results suggest that multiple separable dimensions of social cognition can be identified in psychosis, and these factors show distinct patterns of correlation with clinical features and functional outcome.

1. Introduction

Social cognition has emerged as a high priority topic for research in schizophrenia and related psychotic disorders that may help explain poor outcomes. Social cognition is a broad, multifaceted construct that refers to the cognitive and emotional functions required to understand and predict other people's mental states and behavior (Adolphs, 2009; Ochsner, 2008). Research has documented impairments across a diverse array of social cognitive processes, most commonly emotional processing, social knowledge/perception, attributional style, and Theory of Mind (Green and Horan, 2010). There have been two distinct goals of social cognitive research in schizophrenia: One devoted to understanding the nature of specific clinical symptoms (e.g., relations to paranoia or thought control) and another devoted to social cognition's role in functional outcome. Despite the proliferation of research in this promising area, several fundamental issues remain largely unexplored (Green et al., 2005, 2008).

One question concerns the underlying structure of social cognition in schizophrenia. Although there is a general consensus that social cognition is empirically and neurobiologically separable from (though related to) non-social

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neurocognition (Green et al., 2008; Fett et al., 2011), it is not known whether the social cognitive assessments used in schizophrenia reflect a single factor or a cluster of separable factors. A few studies focusing on a narrow selection of social cognition measures suggest the presence of separable factors. For example, an exploratory factor analysis of neurocognitive and social cognitive measures found that indices of Theory of Mind, attributional bias, and agency detection loaded on three different factors (van Hooren et al., 2008). Another study using confirmatory factor analyses found that a four-factor model provided a good fit to measures of social cognition and social behavior (affect recognition, Theory of Mind, egocentricity, and rapport) (Bell et al., 2009). Along these lines, emotional intelligence shows a multidimensional structure in people with psychotic disorders that differs from healthy control subjects (Eack et al., 2009). The current study aimed to help clarify the basic structure of social cognition by examining performance across a wide range of social cognitive tasks.

A second question concerns social cognition's relation to clinical symptoms and functional outcome. Although understanding clinical symptoms has been one key motivation to study social cognition in schizophrenia, the literature provides a generally mixed picture. While recent modeling studies suggest that social cognition is separable from negative symptoms (Rassovsky et al., 2010; Sergi et al., 2007), some studies report associations with particular social cognitive tests (e.g., Kohler et al., 2010). Relations to positive symptoms (e.g., thought disorder, hallucinations) are similarly inconsistent (Corcoran et al., 2008; Shamay-Tsoory et al., 2007; Woodward et al., 2009), though there has been somewhat greater consistency for associations between attributional style and paranoid delusions or beliefs (Bentall et al., 2001; Combs et al., 2007, 2009; Fornells-Ambrojo and Garety, 2009; Kinderman and Bentall, 1996). Regarding linkages to functional outcome, most studies have focused on emotion and social perception (Couture et al., 2006; Fett et al., 2011). In addition, many studies include a limited assessment of functional outcome and often do not distinguish between functional capacity (what one can do on competence measures) and real-world functioning (what one actually does in the community), which is increasingly recognized as a critical distinction (Bowie et al., 2006). The current study aimed to address these issues by incorporating comprehensive assessments of symptoms and functioning.

A third question is whether social cognition has “added value” in explaining functional outcome above and beyond neurocognition and clinical symptoms. Notably, at the level of simple correlations, a recent meta-analysis reported that social cognition has generally stronger relations to functional outcome than does neurocognition (Fett et al., 2011). A few studies have found that social cognition (mainly emotion and social perception) does account for unique variance in outcome above and beyond neurocognition (Horan et al., in press). The current study used a relatively comprehensive social cognitive battery to further address whether social cognition plays a unique role in explaining functional outcome.

The primary goal of this research was to evaluate the factor structure of social cognition in a sample of outpatients with psychotic disorders. We used five different tests that cover the four most commonly investigated domains of social cognition in schizophrenia. Secondary goals were to: (1) examine correlations between the derived factor(s) and neurocognition, symptoms, and functional outcome, and (2) investigate whether the social cognitive factor(s) uniquely account for incremental variance in functional outcome, above and beyond neurocognition and symptoms.

2. Methods

2.1. Participants

Eighty-five outpatients were recruited from the VA Greater Los Angeles Healthcare System (VAGLAHS) and local community mental health centers. Patients met DSM-IV criteria for schizophrenia, schizoaffective disorder, or psychosis NOS (not secondary to substance use disorder) as determined by medical records and consultation with treating psychiatrists. Subjects were clinically stable (no psychiatric hospitalizations in the past 6 months, same antipsychotic medication for past 3 months). Exclusion criteria were current or past neurological disorder (e.g., epilepsy), mental retardation, or substance use disorder within the past month. Antipsychotic medication type and dose were left to the discretion of the treating physician. All participants had the capacity to give informed consent and provided written informed consent after all procedures were fully explained in accordance with procedures approved by the Institutional Review Board at the VAGLAHS. The participants were enrolled in a clinical trial comparing psychosocial interventions for social cognition and neurocognition (Horan et al., submitted); the current study used data from the baseline assessments.

2.2. Social cognitive assessment

(1) Emotional processing was assessed with two tests: (a) The *Facial Emotion Identification Test* (FEIT), in which subjects view 56 digital pictures of faces from the Ekman (2004) picture set and select which emotion is expressed (happy, sad, angry, afraid, surprised, disgusted or neutral). The index of accuracy is the total number of correct items. (b) The *Managing Emotions* subtest of the Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT) (Mayer et al., 2002, 2003) comprises two 2 subscales that examine the regulation of emotions in oneself and in one's relationships with others. These subscales include vignettes of various situations, along with ways to cope with the emotions depicted in these vignettes. Subjects were required to indicate the effectiveness of each solution, ranging from one (very ineffective) to five (very effective). A total score was derived using the MSCEIT General Consensus method.

(2) Social perception was assessed with The Half-Profile of Nonverbal Sensitivity (PONS) (Ambady et al., 1995; Rosenthal et al., 1979). The 110 scenes in this videotape-based measure last two seconds and contain facial expressions, voice intonations, and/or bodily gestures of a Caucasian female. After watching each scene, participants select which of two labels better describes a situation that would generate the social cue(s). The index of accuracy is the total number of correct items.

(3) Attributional style was assessed with The Ambiguous Intentions Hostility Questionnaire (AIHQ) (Combs et al., 2007). This particular measure of attributional style focuses on a person's tendency to over-attribute hostile intentions to others and to respond to others in a hostile manner. Subjects read a series of vignettes describing social situations and answer questions about the intentions of the characters and how subjects themselves would respond to the situation. Following Combs et al. (2007), we examined scores for ambiguous situations only and computed three summary scores: Hostility bias, Aggression bias, and a composite “Blame” score (average of Intentionality, Anger, and Blame item ratings). The Hostility and Aggression bias scores were independently scored by two blinded raters (ICC's for both bias scores were .85+).

(4) Theory of mind was assessed with The Awareness of Social Inference Test (TASIT) – Part 3 (McDonald et al., 2002), a videotape measure that contains 16 scenes depicting lies or sarcasm, with two or three actors appearing in each one. In each scene, a prologue/epilogue or camera edit provides information to the participant about the nature of the conversational exchange. After each scene, participants answer four types of forced-choice (yes/no) questions about the characters' communicative intentions, whether they want the literal or non-literal meaning of their message to be believed, their beliefs and knowledge about the situation, and their emotional state. Summary scores for Lies and Sarcasm were calculated (Kern et al., 2009). The detection of lies can be made by viewing the camera shot or from the prologue/epilogue accompanying each scene, which explicitly reveals the true state of affairs to one of the characters but not the other. To detect sarcasm, this supplemental information is helpful but not sufficient to make an accurate determination; subjects must also attend to and accurately process subtle changes in paralinguistic and other social cues from the characters' conversational exchange.

Higher scores on the social cognitive tasks indicate better performance with the exception of AIHQ. The AIHQ produces bias scores in which higher and lower scores indicate higher or lower levels of bias, respectively, toward attributing hostile intentions and blaming others in ambiguous social situations.

2.3. Neurocognitive assessment

The MATRICS Consensus Cognitive Battery (MCCB) (Nuechterlein and Green, 2006) was used to assess general cognitive performance. It includes tests that assess seven domains of neurocognition including speed of processing, attention/vigilance, working memory, verbal learning, visual learning, reasoning and problem solving, and social cognition (Kern et al., 2008; Nuechterlein et al., 2008). Because the goal of the study was to look at specialized measures of social cognition and neurocognition separately, we used a modified composite score that did not include social cognition domain, but instead was based on the average *T*-scores from the six remaining domains. Higher scores indicate better performance.

2.4. Symptom assessment

(1) Expanded 24-item *Brief Psychiatric Rating Scale* (BPRS) (Lukoff et al., 1986; Overall and Gorham, 1962) was used to evaluate psychiatric symptoms during the previous month. The current study used four subscales: *Positive*, *Negative, Depression-Anxiety*, and *Agitation* (Kopelowicz et al., 2008).

(2) *Scale for the Assessment of Negative Symptoms* (SANS) (Andreasen, 1984) was used to assess negative symptoms during the month preceding the interview: *Affective flattening, Alogia, Anhedonia-Asociality, and Avolition-Apathy*. All BPRS and SANS interviewers were trained to a minimum intraclass correlation coefficient of 0.80 using established procedures (Ventura et al., 1993, 1998) by the Treatment Unit of the VISN 22 MIRECC and participated in an on-going quality assurance program. Higher ratings on the BPRS and SANS indicate more severe levels of symptoms.

2.5. Functional outcome assessment

(1) Functional capacity was assessed using two scales: (a) The *UCSD Performance-based Skills Assessment (UPSA)* (Patterson et al., 2001), which involves role-play tests with props that are administered as simulations of events in the areas of general organization, finance, social/communications, transportation, and household chores. An overall summary score was used. (b) The *Maryland Assessment of Social Competence (MASC*) (Bellack et al., 1994), a measure of subjects' ability to solve common problems in an interpersonal context, consists of four 3-min role play scenarios, including one involving initiating conversation with a casual acquaintance, two involving negotiation and compromise, and one involving standing up for one's rights. The interactions were videotaped and subsequently scored by specially trained and blinded raters. The Overall Effectiveness rating (a composite measure of the ability to maintain focus and achieve the goal of the scenario) was used.

(2) Real-world functioning was assessed with The Community Adjustment Form (Stein and Test, 1980) is a semi-structured interview that evaluates real-word functioning. This measure covers 17 domains of psychosocial functioning and community adjustment. Information derived from the interview was used complete the *Role Functioning Scale (RFS)* for the domains of work functioning, independent living, and social functioning (McPheeters, 1984). The three RFS subscales moderately inter-correlated from .19 to .36; we therefore opted to evaluate them separately rather than compute a composite score. Higher scores on the UPSA, MASC, and RFS indicate better functioning.

2.6. Statistical analysis

Analyses were conducted in three stages: (1) The structure of the eight social cognitive indexes was assessed through correlational analyses followed by an exploratory factor analysis. We used the Maximum Likelihood extraction method because, in general, it provides better estimates than other approaches (Fabrigar et al., 1999). We selected the number of factors using the scree test, which is superior to other commonly used methods of determining the number of factors (Velicer and Jackson, 1990). We chose an oblique rotation algorithm since we expected that any factors identified would likely be inter-correlated (rather than orthogonal); the individual variables from the social cognitive tests are believed to tap an over-arching social cognition dimension. (2) Correlates of the underlying dimensions derived from the factor analysis were examined. Indexes were assigned to no more than one factor based on the strength of their loadings. Factor scores were computed by first converting each social cognitive index to a z-score and then calculating the average of the z-scored indexes that corresponded to each factor. These factor scores were then correlated with measures of neurocognition, symptoms, and functional outcome. (3) The incremental validity of social cognition in predicting functional outcome was examined with regression analyses, focusing only on the social cognitive factor scores and specific functional outcome measures that demonstrated significant inter-correlations. Multiple regression analyses examined whether the social cognitive factor scores predicted significant incremental variance (R^2) in outcome after accounting for neurocognition and any symptoms that showed significant correlations to the relevant factors. All tests were two-tailed and results were regarded as significant below the 5% level of probability.

3. Results

3.1. Sample characteristics and descriptive statistics

Demographic and clinical variables are presented in Table 1. This sample was chronically ill and predominantly male. Symptom levels were generally in the low to moderate range. Table 2 displays descriptive statistics for each of the social cognitive, neurocognitive, and functional outcome variables. Mean scores resemble those found in prior studies of stabilized outpatient samples (e.g., Horan et al., 2009; Roberts and Penn, 2009).

Table 1
Demographic and clinical characteristics ($N=85$).

	%	*M* (SD)
Age		48.50 (8.6)
Education		
Participant		12.88 (1.84)
Father		12.85 (3.4)
Mother		12.48 (3.6)
Age of onset		22.26 (8.36)
Duration of illness		25.96 (10.85)
Sex (male)	89.4	
Ethnicity		
White	30.6	
Latino	12.9	
Asian	2.4	
Black	52.9	
Other	1.2	
Diagnosis		
Schizophrenia	68.2	
Schizoaffective	22.4	
Psychosis NOS	9.4	
Symptoms		
BPRS Positive		1.92 (0.75)
BPRS Depression-Anxiety		1.98 (0.81)
BPRS Negative		2.0 (0.91)
BPRS Agitation		1.24 (0.37)
BPRS Total		1.78 (0.42)
SANS Affect		1.83 (1.29)
SANS Alogia		0.65 (0.98)
SANS Apathy		3.05 (1.03)
SANS Anhedonia		2.62 (1.13)
SANS Total		1.58 (0.07)

Notes: BPRS = Brief Psychiatric Rating Scale; SANS = Scale for the Assessment of Negative Symptoms.

Table 2
Descriptive statistics for the social cognitive, neurocognitive, and functional outcome measures ($n=85$).

	Mean	SD
FEIT	39.79	7.02
PONS	76.41	7.29
AIHQ Hostility	1.80	.53
AIHQ Aggression	1.85	.52
AIHQ Blame	2.97	.96
TASIT Lies	24.58	4.07
TASIT Sarcasm	20.94	5.90
MSCEIT- ME	38.61	10.20
Modified MCCB	37.74	7.39
UPSA	73.97	10.52
MASC	3.30	.78
RFS Work	1.94	1.37
RFS Independent living	4.15	1.60
RFS Social	3.61	1.89

Notes: FEIT = Facial Emotion Identification Test; PONS = Half-Profile of Nonverbal Sensitivity; AIHQ = Ambiguous Intentions Hostility Questionnaire – Aggression, Hostility and Blame scores, respectively; TASIT = The Awareness of Social Inference Test; MSCEIT ME = Mayer–Salovey–Caruso Emotional Intelligence Test – Managing Emotions branch; MCCB = MATRICS Consensus Cognitive Battery – modified composite score; UPSA = UCSD Performance-Based Skills Assessment; MASC = Maryland Assessment of Social Competence; RFS = Role Functioning Scale.

3.2. Correlational and factor analysis of the social cognitive measures

Table 3 presents the correlations among the eight social cognitive indexes. The magnitude of correlations was highly variable, ranging from −.09 to .64. Scores on the AIHQ showed minimal correlations with other measures. There was also a notable absence of significant correlation between the Sarcasm and Lies indexes from the TASIT.

In a factor analysis of these eight indexes (Table 4), the eigenvalue-greater-than-one rule and screen plot converged on a three-factor solution that accounted for 53.6% of the total variance. All the AIHQ indexes loaded on the first factor, which was labeled "Hostile attributional style". Factor 2 comprised Facial Emotion Identification, PONS, and TASIT Lie scores. These tasks share a relatively low level reliance on perceiving cues and understanding information directly presented to subjects in the task stimuli, and the factor was labeled "Lower-level social cue detection". The third factor comprised TASIT Sarcasm and MSCEIT Managing emotions, which require relatively high-level processes involved in incorporating and utilizing socio-emotional information and knowledge that is not directly present in the stimuli. This factor was labeled, "Higher-level inferential and regulatory processing". The factors weakly intercorrelated: Factor 1 correlated −.07 with Factor 2 and .08 with Factor 3. Factor 2 correlated .26 with Factor 3.

3.3. Correlations with neurocognition, symptoms, and functional outcome

Correlations between the three social cognitive factor scores and the other study measures are shown in Table 5.

Table 3
Correlations among the social cognitive measures.

	FEIT	PONS	AIHQ Hostility	AIHQ Aggression	AIHQ Blame	TASIT Lies	TASIT Sarcasm	MSCEIT ME
FEIT	1							
PONS	.64***	1						
AIHQ Hostility	−.16	−.15	1					
AIHQ Aggression	.07	.04	.31**	1				
AIHQ Blame	−.09	−.08	.60***	.52***	1			
TASIT Lies	.43***	.44***	−.09	.01	.03	1		
TASIT Sarcasm	.27*	.25*	.20	−.11	.09	.17	1	
MSCEIT − ME	.35***	.28*	.12	−.06	−.04	.31**	.41***	1

Notes: FEIT = Facial Emotion Identification Test; PONS = Half-Profile of Nonverbal Sensitivity; AIHQ = Ambiguous Intentions Hostility Questionnaire – Aggression, Hostility and Blame scores, respectively; TASIT = The Awareness of Social Inference Test; MSCEIT ME = Mayer–Salovey–Caruso Emotional Intelligence Test – Managing Emotions branch.
*$p<0.05$; ** $p<0.01$; *** $p<0.001$.

There were some commonalities across the factors: None of the factors showed any correlations with negative symptoms, either assessed with the BPRS or the SANS. The factors, however, showed different patterns in other respects. Higher scores on Factor 1 (i.e., greater tendency to attribute hostility and blame to others) showed significant correlations with clinical symptoms (positive, depression-anxiety, and agitation on the BPRS) but not with functional capacity or real-world functioning. In contrast, Factors 2 and 3 showed the opposite pattern: no significant associations with clinical symptoms, but several significant relationships to functional capacity and real-world functioning. Another difference is that, although each social cognitive factor significantly correlated with the modified MCCB composite, the magnitude was significantly larger for Factor 2 compared to either Factor 1 or Factor 3 (both p values < .05, using Steiger's Z). Similarly, Factor 2 tended to show larger correlations with functional capacity compared to the other factors, but the comparisons only reached significance for the contrast of Factor 2 versus Factor 1 on the UPSA ($p<.01$).

3.4. Incremental validity analyses

Factors 2 and 3 were carried forward into two incremental validity analysis because of their significant relationships to functional capacity (UPSA, MASC) and real-world functioning (RFS Work, RFS Social) in the previous correlational analysis. We evaluated whether neurocognitive and symptom levels (SANS, BPRS) significantly correlated with these functional outcome variables and should therefore also be included in the incremental validity analyses. Modified MCCB scores significantly correlated with UPSA ($r=.54$, $p<.01$), MASC ($r=.26$, $p<.05$), and Work functioning ($r=.25$, $p<.05$). SANS total scores significantly correlated with UPSA ($r=-.23$, $p<.05$), MASC ($r=-.38$, $p<.01$), Independent living ($r=-.30$, $p<.01$), and Social functioning ($r=-.51$, $p<.01$). BPRS total scores were not significantly correlated with any of the functional outcome measures (all r's<.20). MCCB and SANS totals scores were therefore included in the following incremental validity analyses.

Two sets of multiple regression analyses were conducted – one set for Factor 2 and another for Factor 3. In these analyses, each functional outcome index served as the dependent variable with three blocks of predictor variables entered in the following order: Block 1 = modified MCCB; Block 2 = SANS; Block 3 = Either Factor 2 or Factor 3. Results for the Factor 2 analyses are shown in Table 6. For the UPSA, after

Table 4
Factor analysis of the social cognitive measures.

	Factor 1	Factor 2	Factor 3
FEIT	−.07	**.80**	.26
PONS	−.06	**.80**	.23
AIHQ Hostility	**.65**	−.20	.35
AIHQ Aggression	**.64**	.07	−.14
AIHQ Blame	**.88**	−.08	.12
TASIT Lies	.03	**.56**	.25
TASIT Sarcasm	.05	.28	**.68**
MSCEIT – ME	−.04	.38	**.57**

Notes: Items assigned to each factor appear in bold. FEIT = Facial Emotion Identification Test; PONS = Half-Profile of Nonverbal Sensitivity; AIHQ = Ambiguous Intentions Hostility Questionnaire; TASIT = The Awareness of Social Inference Test; MSCEIT ME = Mayer–Salovey–Caruso Emotional Intelligence Test – Managing Emotions branch.

Table 5
Correlations between social cognitive factors and neurocognition, symptoms, and functional outcome.

	Factor 1	Factor 2	Factor 3
Neurocognition			
Modified MCCB	.22*	.51***	.29**
Symptoms			
BPRS Positive	.28*	.04	.09
BPRS Depression-Anxiety	.30**	.06	.07
BPRS Negative	−.02	.17	−.15
BPRS Agitation	.22*	−.16	.17
BPRS Total	.37**	.03	.07
SANS Affect	−.08	.11	−.14
SANS Alogia	.01	−.12	−.18
SANS Apathy	.03	−.21	−.20
SANS Anhedonia	.05	−.18	.09
SANS Total	.02	−.05	−.20
Functional outcome			
UPSA	.11	.52***	.34**
MASC	.10	.38**	.29*
RFS Work	.05	.26*	.21
RFS Independent living	−.07	.09	.10
RFS Social	−.12	.24*	.25*

Notes: MCCB = MATRICS Consensus Cognitive Battery – modified composite score; BPRS = Brief Psychiatric Rating Scale; SANS = Scale for the Assessment of Negative Symptoms; UPSA = UCSD Performance-Based Skills Assessment; MASC = Maryland Assessment of Social Competence; RFS = Role Functioning Scale.
* $p<0.05$; ** $p<0.01$; *** $p<0.001$.

accounting for neurocognition and negative symptoms Factor 2 accounted for an additional 8% (R^2 change) of the variance, which was statistically significant. Similarly, for the MASC, Factor 2 accounted for a significant additional 9% of the variance. Factor 2 did not account for significant incremental variance in RFS Work or Social functioning, though there was a non-significant trend for Social functioning ($p = .067$).

Results for Factor 3 are presented in Table 7. After accounting for neurocognition and negative symptoms, Factor 3 did not contribute significant incremental variance for any of the functional outcome variables. There was a trend-level finding for the MASC ($p = .077$).

4. Discussion

Exploratory factor analysis of variables from five tests covering a wide range of social cognitive processes yielded three interpretable and weakly intercorrelated factors in outpatients with psychosis. The factors demonstrated evidence of external validity in their differential patterns of correlation with neurocognitive, clinical symptom, and functional outcome measures. The Hostile attributional style factor significantly correlated with clinical symptoms (positive, depression/anxiety, agitation) but not functional outcome, whereas The Lower-level social cue detection and Higher-level inferential and regulatory processes factors significantly correlated with functional outcome (functional capacity and real-world social and work functioning) but not clinical symptoms. Furthermore, aspects of social cognition had added value in predicting functional capacity above and beyond non-social neurocognition and symptoms. A multidimensional conceptualization of social cognition can provide a useful organizational and guiding framework for this rapidly growing area of research in psychosis.

This is the first study, to our knowledge, to conduct an exploratory factor analysis on social cognitive domains that are commonly studied in major psychopathology. The three Hostile attributional style indexes (AIHQ Hostility, Aggression and Blame) loaded on the first factor, which showed little to no correlation with the other social cognitive variables. The second factor was labeled "Lower-level social cue detection"

Table 6
Regression analyses for incremental prediction of functional outcome: Factor 2 (Lower-level social cue detection).

Dependent variable	Predictor	R^2	R^2 change	F change
UPSA	MCCB	.29		32.07***
	SANS	.32	.03	3.75†
	Factor 2	.40	.08	10.74**
MASC	MCCB	.06		4.79*
	SANS	.19	.13	11.19***
	Factor 2	.27	.09	8.40**
RFS Work	MCCB	.07		5.90*
	SANS	.09	.03	2.20
	Factor 2	.11	.01	1.27
RFS Social	MCCB	.03		2.56
	SANS	.28	.25	27.52***
	Factor 2	.31	.03	3.45†

Notes: UPSA = UCSD Performance-Based Skills Assessment; MASC = Maryland Assessment of Social Competence; RFS = Role Functioning Scale; MCCB = MATRICS Consensus Cognitive Battery – modified composite score; SANS = Scale for the Assessment of Negative Symptoms.
*$p<0.05$; ** $p<0.01$; *** $p<0.001$; †$p<.10$.

Table 7
Regression analyses for incremental prediction of functional outcome: Factor 3 (higher-level inferential and regulatory processes).

Dependent variable	Predictor	R^2	R^2 change	F change
UPSA	MCCB	.29		32.07***
	SANS	.32	.03	3.75†
	Factor 3	.35	.03	3.21†
MASC	MCCB	.06		4.79*
	SANS	.19	.13	11.19***
	Factor 3	.21	.03	2.41
RFS Work	MCCB	.07		5.90*
	SANS	.09	.03	2.20
	Factor 3	.11	.01	1.25
RFS Social	MCCB	.03		2.56
	SANS	.28	.25	27.52***
	Factor 3	.29	.01	1.59

Notes: UPSA = UCSD Performance-Based Skills Assessment; MASC = Maryland Assessment of Social Competence; RFS = Role Functioning Scale; MCCB = MATRICS Consensus Cognitive Battery – modified composite score; SANS = Scale for the Assessment of Negative Symptoms.
*$p<0.05$; ** $p<0.01$; *** $p<0.001$; †$p<.10$.

reflecting basic emotion detection skills (recognition of emotions in faces), low level of cognitive processing (interpretation of non-verbal information transmitted by others), and first order mental representation (detection of lies) (Peskin, 1996; Sullivan et al., 1995). This factor showed the highest correction with neurocognition. The third factor was labeled "Higher-level inferential and regulatory processing" and was reflected in more refined emotional skills (ability to manage subjective emotional states), higher social cognitive functions and second order mental representation (detection of sarcasm) (Winner and Leekman, 1991; Happe, 1993). These findings support the value of considering social cognition as a multidimensional construct with hierarchically distinct lower-level and higher-level abilities (Ochsner, 2008).

Our results also showed that detection of lies and sarcasm loaded on separate factors. Several studies of school-age children have demonstrated that comprehension of deceit and irony (e.g., sarcasm) are qualitatively distinct abilities (Bara et al., 1999; Bosco and Bucciarelli, 2008; Lee and Katz, 1998). Comprehension of lies/deceit is acquired before sarcasm/irony and is based on a less complex inferential chain (Bucciarelli et al., 2003; Winner et al., 1988). We found that detection of sarcasm and managing emotions loaded on the same factor, suggesting that comprehension of sarcasm requires refined emotional skills such as empathic appreciation of the listener's emotional state (Shamay-Tsoory et al., 2005). This distinction between lies and sarcasm may have been enhanced by the way that the TASIT evaluates detection of lies – it provides all of the information about deceit in the scene and does not require much inference. A more subtle test of lie detection may have yielded a different factor structure.

In the current study, only certain aspects of social cognition showed significant relationships with clinical symptoms. No correlations were found between the three social cognitive factors and negative symptoms suggesting that social cognition and negative symptoms are largely separate constructs (Rassovsky et al., 2010; Sergi et al., 2007). Also, some authors have demonstrated that the correlations between social cognition and negative symptoms can be attributed to confounding variables such as intellectual deficits or duration of illness (Langdon et al., 2002; Pousa et al., 2008). Only the Hostile attributional style factor showed significant relations to other types of symptoms. Similar to other studies, higher tendencies to blame and respond with hostility in ambiguous social situations significantly correlated with positive symptoms (e.g., An et al., 2010; Combs et al., 2009; Janssen et al., 2006). These attributional tendencies also showed more general linkages to higher levels of depression/anxiety and agitation. Thus, the social cognitive domain of Hostile attributional style was more closely tied to indicators of clinical symptom state than the other factors and showed no significant relations to any aspect of functional outcome.

The Lower-level social cue detection and Higher-level inferential and regulatory processes factors were distinguished from the Hostile attributional style factor by a different pattern of external correlates, namely, significant relations with both functional capacity and real-world functioning but no significant relations to positive, depression/anxiety, or agitation. These findings converge with growing evidence that various aspects of social cognition show meaningful relations to both competence and performance measures of functional outcome (Couture et al., 2006; Horan et al., in press). This study also explored the associations between functional outcome and social cognition versus neurocognition, another key correlate of functional outcome. Notably, Lower-level social cue detection factor demonstrated a significantly larger correlation with neurocognition than did Higher-level inferential and regulatory processes factor, providing some evidence of differential relations between these social cognitive factors and external variables. In line with prior studies (e.g., Couture et al., 2006; Pan et al., 2009), the Lower-level social cue detection factor accounted for additional variance in functional capacity above and beyond neurocognition and negative symptoms (8% for UPSA and 9% for MASC), demonstrating the "added value" of social cognition. However, we did not find evidence for incremental validity in real-world functioning, although other studies have (Brekke et al., 2005; Poole et al., 2000; Vauth et al., 2004). As discussed in recent integrative models of functional outcome (Bowie et al., 2008; Horan et al., 2010; Rassovsky et al., 2010), neurocognitive and social cognitive competence appear more proximal to functional capacity than to real-world functioning, rendering unique relations to functional capacity simpler to demonstrate. Relations to the more distal outcome of real-world functioning can be more challenging to detect due to the various personal (e.g., motivation, self-efficacy) and socio-environmental (e.g., disability policies, cultural factors) variables that impact how one performs in the community.

The current study provides evidence for the multidimensional structure of social cognition in outpatients with psychosis. These findings should be considered in the context of several methodological factors that may limit generalizability, including a largely VA-based sample (mostly older male patients with a slightly skewed ethnic distribution), enrolling patients with three different clinically-determined psychotic diagnoses, and a lack of control for medication effects. Also, the generally low to moderate level of symptoms in our sample may have limited our ability to detect significant relations to symptoms. Nevertheless, a better understanding of the factor structure of social cognition in schizophrenia was a stated goal of a NIMH consensus meeting on this topic (Green et al., 2008) and has implications for how we interpret findings in this area. As mentioned above, social cognition has been studied in schizophrenia to better understand clinical symptoms and to better understand daily functioning. The results of these analyses suggest that social cognition in general serves both of these purposes, but specific factors serve one or the other. Even the well-documented relationships between social cognition and neurocognition are more characteristic of one factor (lower-level processes) than others, suggesting that Hostile attributional style and Higher-level inferential and regulatory processes factors involve other types of determinants. Hence, these results provide an initial step to help parse and organize this complex and rapidly-developing area.

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Contributors

Dr. Green, Horan, and Kern designed the study and wrote the protocol. Drs. Horan and Mancuso undertook the statistical analysis, and Dr. Mancuso wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest

None.

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