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Colin A. Depp Ph.D. ,   Jennifer Villa B.A. ,
Blaire C. Schembari Ph.D. ,   Philip D. Harvey Ph.D. ,
Amy Pinkham Ph.D.

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Highlights

- Negative social cognitive biases, ratings of more extremely untrustworthy faces, and increased accuracy in recognizing negative affect were associated with suicidal ideation in schizophrenia
- Negative social cognitive bias was associated with the presence of suicidal ideation at two weeks follow up assessment
- Negative biases in processing and interpreting social information may foster suicidal thinking in schizophrenia.

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Social cognition and short-term prediction of suicidal ideation in schizophrenia

Colin A. Depp, Ph.D.[a,b]

Jennifer Villa, B.A.[c]

Blaire C. Schembari, Ph.D.[b]

Philip D. Harvey, Ph.D.[d,e]

Amy Pinkham, Ph.D. [f]

[a] Department of Psychiatry, UC San Diego, La Jolla, CA, United States
[b] VA San Diego Healthcare System, San Diego, CA, United States
[c] Department of Psychology, San Diego State University, San Diego, CA, United States
[d] Research Service, Bruce W. Carter Veterans Affairs (VA) Medical Center, Miami, FL, United States
[e] Department of Psychiatry and Behavioral Sciences, University of Miami Miller School of Medicine, Miami, FL, United States
[f] School of Behavioral and Brain Sciences, The University of Texas at Dallas, Richardson, TX, United States

Corresponding author: Colin A. Depp, Ph.D.

Department of Psychiatry (0664)
University of California San Diego
9500 Gilman Drive
La Jolla, CA 92093-0664
p.858 822 4251
f. 858 534 5475
cdepp@ucsd.edu

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Abstract

Despite recent research acknowledging social cognition as an important feature of interpersonal functioning in schizophrenia, little work has evaluated the role of social cognition in suicidal ideation and behavior in psychosis. In a short-term longitudinal study, we evaluated the association between concurrent and near term suicidal ideation with social cognition, including emotion recognition and related biases (ER-40; BLERT), attribution biases (AIHQ), and evaluations of trustworthiness (trustworthiness task) in a sample of 179 outpatients with schizophrenia or schizoaffective disorder. Adjusting for severity of positive and general mental health symptoms, greater reactivity to extreme stimuli (trustworthiness measure), BLERT negative affect accuracy, and AIHQ Blame Scores were associated with suicidal ideation at baseline. AIHQ Blame Scores also longitudinally predicted the presence of ideation 2 weeks later and were highest among participants with ideation across the two time points. The present findings provide support that biased interpretations, and, concurrently with ideation, reactivity and selective accuracy to negative stimuli, are associated with suicidal ideation in schizophrenia. Further understanding the role of social cognitive ability and biases on suicidal ideation could contribute to the understanding of social cognition as a treatment target in prevention of suicidal behavior in schizophrenia.

Keywords: schizophrenia; psychosis; suicide; social cognition; facial emotion recognition; cognitive bias; neuropsychology

1. Introduction

People with schizophrenia are approximately four times more likely to die by suicide compared to those without a psychotic disorder (Hor & Taylor et al., 2010). The majority of individuals with a psychotic disorder experience active suicidal ideation (Hor & Taylor et al., 2010) and as many as one half exhibit suicidal behavior during their lifetimes (Harvey et al., in press). The dynamics of ideation and behavior in psychotic disorders are somewhat unique from people without psychosis (Hawton et al., 2005), including a stronger association between suicidal ideation and suicide attempts compared to people with mood disorders (Chapman et al., 2015) and the fact that suicide attempts among people with psychosis tend to be more dangerous (Kelleher et al., 2013). The risk factors are also different. For example, in contrast to data in the general population (Sorberg et al., 2013) or mood disorders (Richard-Davantoy et al., 2014), higher cognitive ability is associated with greater risk of suicide in psychosis (Harvey et al., in press; Villa et al., 2018a). Moreover, among people with psychosis, the risk of suicide seems to vary by severity of symptoms; positive symptoms (e.g., paranoia, and hallucinations) are, in some studies, associated with increased suicide risk (Castelein et al., 2015), whereas in others negative symptoms are associated with decreased risk (Harvey et al., in press; Hawton et al., 2005). Therefore, available data indicates several unique aspects of suicidality in psychosis, and there are a number of gaps in understanding the determinants of suicide in this population.

Outside of schizophrenia, there is an increasing emphasis on interpersonal appraisals and dysfunction as determinants of suicidal thoughts and behavior (Olié et al., 2015; Richard-Devantoy et al., 2014; Szanto et al., 2012; Szanto et al., 2014). The interpersonal-psychological theory posits that the psychological experiences of thwarted belongingness and perceptions of

burdensomeness to others, coupled with diminished aversion to death, lead to suicidal behavior (Van Orden et al., 2010). In a recent theoretical model of suicide in schizophrenia, negative social appraisals, including perceptions of social defeat and exclusion, are posited mechanisms of suicidality (Owen et al., 2017). Despite the wealth of data on social cognitive ability and social skill deficits in schizophrenia (Green et al., 2008; Penn et al., 2008), little work has evaluated social cognitive correlates of suicidal thinking in psychosis.

A few studies have evaluated the association of measures of social cognition with suicidal ideation and behavior. A recent study found an association between lower scores on the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) and suicidal ideation (along with positive symptom severity) in schizophrenia (Comparelli et al., 2018). Poorer performance on a false belief task predicted suicide attempts in first-episode patients (again, in conjunction with severity of positive symptoms) (Canal-Rivero et al., 2017). In addition, misperceiving neutral emotion faces as angry was associated with negative interpersonal appraisals that were associated with history of active suicide ideation and attempts, despite no association between overall emotion recognition performance and histories of ideation or behavior (Villa et al., 2018b). Misperception of neutral faces for angry has also been demonstrated among patients with more severe paranoia (Pinkham et al., 2016). In contrast, negative symptoms moderated the association between suicidal ideation and social role functioning, with greater experiential negative symptoms associated with diminished association between suicidal ideation and social dysfunction (Jahn et al., 2016). Turning to social participation, in a study employing ecological momentary assessment (Depp et al., 2016), we found that patients with schizophrenia with current ideation engaged in a similar *quantity* of interactions as patients without ideation but

appraised those interactions more negatively, particularly when alone, and overestimated how much time they spent alone.

Taken together, there appears to be some support for social cognitive ability (e.g., accuracy in theory of mind tasks) and negative social cognitive bias (e.g., more extreme negative appraisals of interactions or stimuli) as associated with suicidal thinking/behavior, in tandem with positive symptoms. These associations seem to be somewhat independent from indicators of social participation. Disentangling the relative impact of social cognitive ability and biases on suicidal ideation would potentially enable a sharper focus on the potential for social cognition as a treatment target in suicide prevention, in particular if isolated from potential artefactual associations between ideation and symptoms (particularly positive symptoms).

In this paper, we extend prior work in a short-term longitudinal study evaluating the association between concurrent and near term suicidal ideation and three measures of social cognition. We focused on measures of social cognition that provided indicators of both overall performance/ability and negative biases in processing social information, including selective accuracy to negative stimuli and negative emotion biases in affect recognition (ER-40; BLERT), attribution biases, as measured by the Ambiguous Intentions Hostility Questionnaire (AIHQ), and ratings of trustworthiness (via the trustworthiness task). We evaluated these associations with a wide range of potential demographic, clinical (diagnosis, medications), and symptom (positive and negative symptoms, general psychopathology) covariates that were previously found to be associated, positively and negatively, with suicidal ideation. We hypothesized that social cognitive biases and impaired performance on social cognitive and social competence indices would be concurrently associated with suicidal ideation at baseline and predict subsequent persistence or development of ideation, adjusting for covariates.

2. Method

2.1. Participants

Data from this study were derived from a psychometric evaluation of social cognitive instruments in schizophrenia, the Social Cognition Psychometric Evaluation (SCOPE) study. Details on the recruitment, procedures, and primary outcomes from this study are reported elsewhere (Pinkham et al., 2015). We included data from all 179 participants with schizophrenia or schizoaffective disorder in this study. Participants were recruited from two sites: Southern Methodist University (SMU) and The University of Miami Miller School of Medicine (UM). SMU patients were recruited from Metrocare Services, a nonprofit mental health services provider organization in Dallas County, TX, and other area clinics. UM patient recruitment occurred at the Miami VA Medical Center and the Jackson Memorial Hospital-University of Miami Medical Center. Due to the focus on suicidal ideation in this study, we did not include data from healthy control subjects from the SCOPE study.

To be eligible to participate in the study, patients must have met DSM-IV criteria for schizophrenia or schizoaffective disorder, which was confirmed by the Mini International Neuropsychiatric Interview (Sheehan et al., 1998) and Structured Clinical Interview for DSM-IV Disorders psychosis module (First et al., 2002). Patients were required to be on a stable medication regimen for a minimum of six weeks with no dose changes for a minimum of two weeks as well as no prior hospitalizations within the last two months. Participants were excluded if they had: (i) presence or history of pervasive developmental disorder or mental retardation (defined as IQ < 70) by DSM-IV criteria, (ii) presence or history of medical or neurological disorders that may affect brain function (e.g., seizures, central nervous system tumors, or loss of

consciousness for 15 min or more), (iii) presence of sensory limitation including visual (e.g., blindness, glaucoma, vision uncorrectable to 20/40) or hearing impairments that interfere with assessment, (iv) no proficiency in English, (v) presence of substance abuse in the past month, and (vi) presence of substance dependence not in remission for the past 6 month. The study did not exclude participants on the basis of current or past suicidal ideation or behavior. This study was approved by the Human Research Protections Program at The University of Texas at Dallas and at the University of Miami.

2.2. Procedures

All participants completed a baseline visit and a retest assessment conducted approximately two weeks after the initial visit (mean interval= 16.2, SD= 4.3 days). At visit 1, all participants provided informed consent and completed the social cognitive and functional outcome measures. The order of these task blocks was counterbalanced, and within the social cognitive battery, the order of individual tasks was also counterbalanced. Visit 1 included diagnostic assessment and an evaluation of symptom severity using the Positive and Negative Syndrome Scale (Kay et al., 1987) in addition to assessment of suicide ideation (Beck Depression Inventory: Item 9). At visit 2, symptom severity was reassessed in patients, and all participants completed and repeated the social cognitive measures in the same order as their first visit. The SCOPE study included a number of measures of social cognition, but here we focused on measures that allowed investigation of both performance and potential biases pertinent to negative emotions/attributions. Therefore, other measures such as theory of mind tasks were not included.

2.3. Measures

2.3.1. Beck Depression Inventory (BDI)

The measure of suicidal ideation employed in this study derived from the BDI-2 (Beck et al., 1961). Item 9 was used to assess suicide ideation, with the responses ranging from 0 to 3: 0 reading "I don't have any thoughts of killing myself, "1 reading "I have thoughts of killing myself, but I would not carry them out", 2 reading "I would like to kill myself," and 3 reading "I would kill myself if I had the chance." Scores were dichotomized for the analyses given positively skewed distribution of responses and therefore represented either the presence (scores of 1-3) or absence (scores of 0) of suicidal ideation.

2.3.2. Social Cognition

We selected measures from a larger battery of social cognition measures evaluated in the Social Cognition Psychometric Evaluation (SCOPE study; Pinkham et al., 2015). Our focus in this study was on the distinction between social cognitive capacity, or the ability to correctly identify socially relevant stimuli, and negative social cognitive biases, or a tendency for misperception, exaggerated response, or differential accuracy for negative social information. Accordingly, we selected from a broader list of measures included in the SCOPE study only those that produced indices of negative bias (as a sole indicator or in addition to correct or incorrect responses). We selected BLERT and ER-40 because they each provide a rating of accuracy for negative emotional stimuli (vs. positive or neutral affective expressions) but do so via different channels of information. Specifically, the ER-40 utilizes static photos whereas the BLERT uses dynamic emotional displays that combine both visual and prosodic cues. Additionally, although similar to each other in the generation ratings of different affect, the BLERT and ER-40 are somewhat divergent in correlation with functional outcome (Pinkham et al., 2015) and address somewhat unique affective categories. The Trustworthiness Task and AIHQ do not provide indicators of

accuracy, but the Trustworthiness Task provides indicators of exaggerated response to normatively rated trustworthy and untrustworthy faces and the AIHQ provides a rating of several biases, including the tendency to blame others and assume intentionality.

Ambiguous Intentions Hostility Questionnaire (AIHQ)

The AIHQ (Combs et al., 2007) is a measure of hostile social-cognitive attributional biases (hostility, blame, intention, anger, and aggression). We used the abbreviated version with only the ambiguous scenarios – in this measure, participants are asked to read five hypothetical negative, social situations reflecting ambiguous causes, to imagine the scenario happening to them, and to rate the following using Likert scale ratings: how much the character is to blame for the event (AIHQ-bs subscale) (1 "not at all" to 5 "very much"), if they believe the character did it on purpose (AIHQ-is subscale, intentionality bias) (1 "definitely no" to 6 "definitely yes"), and how much anger they would experience in that situation (AIHQ-ab subscale, anger bias) (1 "not angry at all" to 5 "very angry"). In addition, participants provide open-ended responses scored by independent raters according to the extent to which participants interpreted the situation in a hostile manner (AIHQ-HB subscale, Hostility Bias) (1 "not at at all hostile" to 6 "very hostile") and the extent to which they report aggression in their description of how they would respond to the situation (AIHQ-AB subscale, Aggression Bias) (1 "not at all aggressive" to 6 "very aggressive"). An overall Blame Score (BS) is computed by averaging Likert ratings across the five scenarios to the intentional, anger, and blame items and summing the 3 averages (range = 3–16). Higher scores reflect a more hostile and negative attributional style. Analyses focused on this Blame Score and its constituents and not the coded responses to the open-ended questions (i.e. the AIHQ-HB and AIHQ-AB) given the lower levels of psychometric reliability and validity on those two indices (Buck et al., 2016; Buck et al., 2017).

Bell Lysaker Emotion Recognition Task (BLERT)

The BLERT (Bryson et al., 1997) assesses the ability to identify seven emotional states correctly, including: happiness, sadness, fear, disgust, surprise, anger, or no emotion. Participants are asked to view 21, 10-second video clips which include a male actor providing dynamic facial, vocal-tonal, and upper-body movement cues. Participants are then asked to identify the expressed emotion. The total accuracy score as well as accuracy for positive and negative emotions were used.

Penn Emotion Recognition Task (ER-40)

The ER-40 was used to assess facial emotion recognition via computerized assessment (Kohler et al., 2003). The ER-40 consists of 40 color photographs of faces expressing the basic emotions of fear, anger, happiness, and sadness, as well as neutral expressions. There are four female faces and four male faces for each emotion. Participants are shown each of the faces at random and asked to identify the emotion expressed. For the present study, we assessed overall accuracy, as well as accuracy of responses to negative and positive emotion faces and the rate of incorrect responses to neutral faces, as in Pinkham et al. (2011) and Villa et al. (2018b).

Trustworthiness Task

The Trustworthiness Task (Adolphs et al., 1998) assesses participants' ability to make complex social judgments of trustworthiness from facial images. Participants rated 42 faces for trustworthiness on a scale from −3 (untrustworthy) to 3 (trustworthy). Faces were presented in grayscale and represented ethnically diverse males and females. The average rating across all faces was examined as well as ratings of trustworthiness for faces that can be considered extremely trustworthy or untrustworthy based on normative ratings derived from the healthy

control participants in Pinkham et al. (2015), who were demographically matched to the patient sample.

2.3.6. Positive and Negative Syndrome Scale (PANSS)

Clinical symptoms were rated using the PANSS (Kay et al., 1987). The PANSS consists of 30-items assessing seven positive items, seven negative items, and 16 general psychopathology symptoms items. The items are rated on a 7-point severity scale ranging from 1-(absent) to 7-(extreme). Positive and negative scale scores may range from 7 to 49, and the general scale ranging from 16 to 112, with higher scores indicating greater symptom severity.

2.3.7. Wide Range Achievement Test (WRAT-3)

For the purposes of the current study, the reading subscale (i.e., number of words pronounced aloud correctly) of the WRAT-3 (Weickert et al., 2000) was administered as a measure of premorbid IQ. Raw scores were converted to standard scores with higher scores reflecting higher achievement.

2.4. Statistical analyses:

Analyses proceed in stages. We first evaluated the distribution of scores at Time 1 and Time 2 on the BDI-2 Suicide Item. We then evaluated potential covariates by evaluating significant associations between baseline ideation and demographic, clinical, and symptom variables with GLM, using alpha level of 0.05 as a criterion. In multivariate models we evaluated the association between baseline ideation and baseline social cognitive variables, including covariates. We calculated effect sizes (Cohen's *d*) for each of the comparisons. We then evaluated the association between significant baseline social cognitive variables and Time 2 suicidal ideation using hierarchical logistic regressions, entering baseline covariates in the first

block and social cognitive measures in the second block. Specification of logistic regressions were checked via Hosmer-Lemeshow tests. Finally, because the suicide item derived from the BDI, it was difficult to disentangle from depression in general (BDI Total), and we evaluated associations among persons who exceeded the threshold for clinically significant depressive symptoms (BDI Total $\geq$ 14) in sensitivity analyses.

3. Results

3.1. Sample characteristics (Table 1)

The sample was, on average, more likely to be male (65.4%), middle-aged ($M = 42.1$ years, SD = 12.3), African American (52.5%), and have an average of 12 years of education. The sample was slightly more likely to have a diagnosis of schizophrenia (53.1%) than schizoaffective disorder.

3.2. Suicidal ideation and associations

Among the 179 participants, 43 (24.0%) reported suicidal thoughts at baseline on BDI item 9 (39 rated a 1, three rated a 2, and one rated a 3). The rate was 19.9% at follow up among the 171 who completed that assessment (30 rated a 1, two rated a 2, and two rated a 3). A total of 28 participants reported ideation at both time points (16.3%) and 27 (15.7%) reported ideation in only one time-point.

Baseline suicidal ideation was positively associated with higher scores on the PANSS General Symptoms subscale and PANSS Positive Syndrome subscale; these significant associations were evident at the follow up assessment as well. Ideation was not associated with any demographic variables (age, gender, ethnicity, education), diagnosis (schizophrenia or schizoaffective disorder), or medication type (atypical vs. typical). Furthermore, suicidal

ideation was not associated with PANSS Negative Syndrome subscale scores or WRAT-3 Scores. Accordingly, PANSS General and PANSS Positive Subscales were incorporated as covariates in subsequent multi-variate models.

3.3 Concurrent associations between social cognition and suicidal ideation

As seen in Table 2, AIHQ Overall Blame Score was higher among participants with suicidal ideation, including PANSS General and PANSS Positive as covariates (Cohen's *d*= 0.433). Among the three subcomponents of the overall AIHQ Blame Score, only the specific tendency to blame others was significant, in the direction of higher scores among persons with suicidal ideation (Cohen's *d*= 0.599). In the Trustworthiness Task, overall task performance did not differ by current ideation status. However, participants with current ideation provided greater ratings of untrustworthiness than participants without ideation for those faces that were identified via normative data as the most untrustworthy (Cohen's *d*= 0.390). Groups did not differ on normatively ambiguous/extremely trustworthy faces. On the BLERT Task, the group with current ideation were more accurate in rating negative affect (Cohen's *d*= 0.441), but did not differ on total performance or positive affect. None of the indicators derived from the ER-40 were significant (overall accuracy, accuracy for happy, neutral, or negative faces).

3.4. Longitudinal associations

Focusing on the significant variables in the cross-sectional analyses (Table 3), Baseline AIHQ Blame Scores were associated with Time 2 suicidal ideation, again adjusting for PANSS Positive and General subscales. The total variance accounted for in subsequent SI scores for the model including AIHQ-BS, PANSS subscales was Nagelkerke $r2$= 0.16. The AUC was 0.718 (sd=0.49, p<0.001). In contrast, Baseline Trustworthiness Ratings of Extremely Untrustworthy Faces or BLERT Negative Affect ratings were not associated with follow up suicidal ideation.

Evaluating the person-averaged AIHQ scores collapsed across the two points, participants who endorsed SI at both time points had the highest AIHQ Blame score ($F(2,165)= 4.5$, $p= .013$; $n= 27$, $M= 10.0$, $SD= 2.6$), significantly different from the group with no endorsement of suicide ideation (Bonferroni corrected $p= .014$; $n= 123$, $M= 8.2$, $SD= 2.6$;). The group with endorsement on only one occasion ($n= 20$, $M= 9.2$, $SD= 3.1$) did not differ from the other two groups in pairwise analyses.

3.5. Sensitivity analyses

We repeated analyses with a modified BDI total score that did not include the BDI suicide item as a covariate in place of PANSS General and PANSS positive. None of the significant associations identified above were significant when BDI total score was included in the model. Given the method bias introduced by scale overlap between the BDI suicide item and total score, we evaluated the association between suicide ideation and social cognition among the subset of participants with clinically significant levels of depression on the BDI (Total ≥ 14, $n= 85$). We found that AIHQ Blame Score was no longer (although marginally) significant in association with baseline ideation ($F(1,80)= 3.8$, $p= .055$) but remained significant in predicting Time 2 suicide ideation scores [est= 0.196, s.e.= 0.091, $p= 0.015$, OR: 1.2 (1.02-1.45)]. Baseline Trustworthiness Extreme Faces ratings were more negative in patients with current ideation ($F(1,80)= 6.6$, $p= .012$) but, as in the entire sample, not associated with Time 2 ideation. The BLERT Negative Affect rating score was not significant for Time 1 or Time 2 ideation.

4. Discussion

In this investigation of social cognition and suicidal ideation in schizophrenia, results support links between concurrent suicidal ideation and negative attribution biases, reactivity to more negative stimuli, and, on the BLERT, selectively enhanced accuracy in negative (vs.

positive) affect recognition. These associations persisted after adjusting for positive and general severity of psychopathology. Hyper-attribution of blame to others predicted the presence of ideation after a short interval and was most pronounced among participants with consistent presence of ideation across the two time points. In contrast, other indicators were not associated with follow up ideation. To date, the influence of positive symptoms has been a focus in investigations of social cognition and suicidal thinking, and our findings indicate that depressive symptoms also exert a strong influence on biases toward negative stimuli and interpretations of interpersonal scenarios.

There are several limitations of this work, which is among only a few studies to evaluate social cognition and suicide in psychosis. Foremost, our study evaluated the association of current suicidal thinking and past or prospective suicidal behavior were not assessed. Some may argue that suicidal thoughts are clinically insignificant compared to prediction of suicidal behavior, but there is a particularly strong link between ideation and behavior in schizophrenia (Chapman et al., 2015), and so understanding the determinants of suicidal thoughts is especially important in this group. Moreover, the assessment of suicidal thinking was completed through a single item (BDI item 9) and not a comprehensive suicide assessment such as the Columbia Suicide Severity Rating Scale (Posner et al., 2011). There is evidence from prior work regarding the validity of single item ratings of suicidal ideation in predicting attempts, but to our knowledge, these have not specifically been replicated in schizophrenia (Louzon et al., 2016; Simon et al., 2013). Moreover, the majority of participants were experiencing low levels of ideation and so future prospective, stratified studies evaluating persons with active intent would greatly add to this research. The follow up period was, on average, two weeks, and about 50% of participants who endorsed suicidal ideation at baseline also endorsed ideation at follow up.

These subsamples were too small to evaluate within person changes in AIHQ scores in the transition from and away from present suicidal thinking. The lack of differences between schizophrenia and schizoaffective disorder should be interpreted with caution, and future research with more detailed assessments of suicide risk and history may reveal important differences. Finally, the sample was comprised of outpatients only, and participants with substance use disorders were not included. Therefore, our findings do not generalize to more acutely ill or dually diagnosed patients.

With these important limitations in mind, our study adds to the limited understanding of the social cognitive underpinnings of suicidal thinking in schizophrenia (Van Heeringen & Mann, 2014). The strongest and most predictive association with suicidal thinking was for negative attribution biases. More extreme ratings of untrustworthy faces and accuracy for negative affect recognition (evident on the BLERT but not the ER40) were concurrently associated with ideation but not with subsequent ideation. Mistaking neutral affect for angry was not found to be associated with current ideation; however, in prior work this indicator was associated with negative interpersonal beliefs that relate to suicidal ideation but not past ideation or history of attempt (Villa et al., 2018b).

The mechanisms by which biased interpretations could foster suicidal thinking deserve further study. It may be that biases increase perceptions of isolation and related beliefs that are linked with suicidal thinking (e.g., thwarted belongingness, burdensomeness). It may also be that existing suicidal thoughts are exacerbated or sustained by selective attention to negative social stimuli leading to perceived lack of available support from other people. The relative influence of depressive symptoms and negative cognitions about the self, compared to negative cognitions about others which might be more aligned with paranoia (Freeman & Garety, 2014)

also deserve future study, as they might be aligned with suicidal thinking. For future research, a stratified prospective sample with individuals experiencing a wider range of severity of suicidal thoughts could help identify the phenomenology of biases as they vary within patients over time alongside levels of ideation and/or the transition from ideation to suicidal behavior.

In gauging the clinical significance of these findings, we note that the strength of the individual associations between social cognition and ideation would be insufficient to accurately predict suicidal thinking in applied settings, consistent with the limitations identified in the vast literature on individual risk factors for suicide (Franklin et al., 2017). Instead, the potential value of these results is in understanding social cognitive biases as potential component processes that may help account for the increase in overall risk for suicidal thoughts and behavior in psychotic disorders. Social cognitive biases are convergent between hallmark aspects of psychosis, such as paranoia and hallucinations, and constructs in contemporary theories of the determinants of suicide that focus on interpersonal processes. Moreover, social cognitive biases can be measured objectively, which may facilitate research to disentangle artefactual influences such as depressed mood that impact subjective self-report measures on suicide-related constructs. Additionally, given that a number of psychotherapeutic approaches have been associated with reductions in social cognitive biases (Roberts et al., 2014), there may be a role of social cognition interventions in suicide prevention in schizophrenia.

Another area for future research would be the developmental process by which social cognitive biases evolve, including whether biases are exacerbated in states (e.g., paranoia) and during phases of the illness from prodromal to first episode to chronic. It would be important to better understand when and how social cognitive biases emerge and how they relate to theoretical constructs proposed as mediators of the transition from suicidal thoughts to behavior,

including social defeat (Selten et al., 2013) and demoralization (Pompili et al., 2009). Moreover, it would be important to understand how social cognitive biases might impact communication of suicide intention (Pompili et al., 2016) and potentially create barriers to help-seeking behavior. There is evidence from a recent meta-analysis (Chapman et al., 2015) and longitudinal research (Kelleher et al., 2013) that the conversion from suicidal ideation to behavior is more rapid and likely in psychosis (Kelleher et al., 2013), and the role of social cognitive biases in this process may be an informative avenue for suicide prevention.

Table 1: Sample Characteristics at Baseline

	M (*SD*) or %	Range
Age	42.1(12.3)	18-69
Gender (% Female)	34.6%	---
Ethnicity		---
Caucasian	42.5%	
African American	52.5%	
American Indian/Native Alaskan	0.6%	
Asian	2.2%	
Other	2.2%	
Education	12.7(2.1)	6-20
Diagnosis		---
Schizophrenia	53.1%	
Schizoaffective	46.4%	
Medication (%Atypical)	69.8%	---
WRAT 3	93.7(15.9)	45-122
PANSS Positive	16.1(5.8)	7-34
PANSS Negative	13.7(5.3)	7-29
PANSS General	30.8(8.0)	16-51

Note: WRAT 3: Wide Range Achievement Test; PANSS: Positive and Negative Syndrome Scale

Table 2. Baseline and Follow Up Concurrent Associations between Suicidal Ideation and Social Cognition Measures

Measure	SI (*n*= 42)	No SI (*n*=136)	Significance Tests	*p*-value	Cohen's *d*
	Mean (*SD*)	Mean (*SD*)	*F*(df)		
Ambiguous Intentions Hostility Questionnaire (AIHQ)					
AIHQ Overall Blame Score	9.7 (2.6)	8.5 (2.8)	4.6 (174)	**0.033**	.43
AIHQ Intentionality	3.6 (1.0)	3.3 (1.2)	2.5 (174)	0.169	.27
AIHQ Aggression	2.8 (1.0)	2.5 (1.0)	2.4 (174)	0.126	.30
AIHQ Blame	3.3 (1.0)	2.7 (1.0)	8.1 (174)	**0.006**	.60
Bell Lysaker Emotion Recognition Task (BLERT)					
BLERT Total Correct	13.9 (3.5)	12.9 (4.0)	36.0 (174)	0.122	.26
BLERT Positive Correct	4.5 (1.3)	4.5 (1.1)	<0.01 (174)	0.882	.01
BLERT Negative Correct	7.6 (2.1)	6.5 (2.8)	37.4 (174)	**0.022**	.44
Trustworthiness Task					
Trustworthiness Overall	-0.2 (1.2)	-0.0 (1.1)	0.1 (174)	0.780	.17
Ambiguous Faces	-0.2 (1.2)	-0.1 (1.2)	<0.01 (174)	0.854	.10
Extremely Untrustworthy Faces	-1.5 (1.0)	-1.1 (1.2)	4.2 (174)	**0.042**	.39
Extremely Trustworthy	0.8 (1.5)	0.9 (1.4)	0.1 (174)	0.716	.08
Penn Emotion Recognition Task (ER-40)					
ER-40 Overall	30.5 (4.1)	29.2 (5.7)	1.5 (174)	0.223	.21
ER-40 Happy	7.8 (0.4)	7.7 (0.9)	1.0 (173)	0.322	.19
ER-40 Neutral	5.6 (2.2)	5.4 (2.5)	0.1 (173)	0.706	.07
ER-40 Negative	17.2 (2.9)	16.2 (1)	1.5 (173)	0.222	.29

Note: Adjusted for PANSS General/PANSS Positive; Cohen's d common metrics are small (0.2), medium (0.5) and large (0.8) effects sizes

Table 3. Prediction of Follow Up Suicidal Ideation

	Estimate (*SE*)	*p*-value	Odds Ratio (CI:)
AIHQ Blame Score			
Baseline AIHQ Blame Score	0.185 (0.072)	**0.010**	1.203 (1.045-1.386)
Baseline PANSS Positive	0.014 (0.047)	0.770	1.014 (0.924-1.113)
Baseline PANSS General	0.075 (0.034)	0.028	1.078 (1.008-1.152)
BLERT Negative Affect Correct			
Baseline BLERT Negative Affect	0.088 (0.081)	0.276	1.092 (0.932-1.279)
Baseline PANSS Positive	0.010 (0.046)	0.823	1.010 (0.923-1.106)
Baseline PANSS General	0.078 (0.034)	**0.022**	1.081 (1.012-1.155)
Untrustworthiness Extreme Score			
Baseline Untrustworthiness Extreme Score	-0.218 (0.181)	0.229	0.804 (0.564-1.147)
Baseline PANSS Positive	0.008 (0.046)	0.857	1.008 (0.921-1.104)
Baseline PANSS General	0.078 (0.034)	**0.021**	1.081 (1.012-1.156)

Note: PANSS Positive and PANSS General entered in the first step

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