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Theory of mind, emotion recognition and social perception in individuals at clinical high risk for psychosis: Findings from the NAPLS-2 cohort

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A B S T R A C T
Social cognition, the mental operations that underlie social interactions, is a major construct to investigate in schizophrenia. Impairments in social cognition are present before the onset of psychosis, and even in unaffected first-degree relatives, suggesting that social cognition may be a trait marker of the illness. In a large cohort of individuals at clinical high risk for psychosis (CHR) and healthy controls, three domains of social cognition (theory of mind, facial emotion recognition and social perception) were assessed to clarify which domains are impaired in this population. Six-hundred and seventy-five CHR individuals and 264 controls, who were part of the multi-site North American Prodromal Longitudinal Study, completed The Awareness of Social Inference Test, the Penn Emotion Recognition task, the Penn Emotion Differentiation task, and the Relationship Across Domains, measures of theory of mind, facial emotion recognition, and social perception, respectively. Social cognition was not related to positive and negative symptom severity, but was associated with age and IQ. CHR individuals demonstrated poorer performance on all measures of social cognition. However, after controlling for age and IQ, the group differences remained significant for measures of theory of mind and social perception, but not for facial emotion recognition. Theory of mind and social perception are impaired in individuals at CHR for psychosis. Age and IQ seem to play an important role in the arising of deficits in facial affect recognition. Future studies should examine the stability of social cognition deficits over time and their role, if any, in the development of psychosis.

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1. Introduction

Social cognition can be defined as the mental operations that underlie social interactions. It includes mental state attribution, affect recognition, attributional style and social perception. It is well known that in schizophrenia, deficits in social cognition are seen at all stages of the illness (Green et al., 2012a) and are relatively stable (Horan et al., 2012). There is also evidence showing that impairments in social cognition are present before the onset of psychosis (Green et al., 2012a), and in unaffected first degree relatives, suggesting that social cognition may be a trait marker of the illness (Lavoie et al., 2013). Using modeling techniques, some studies have shown that, in patients with schizophrenia, social cognition is related to both neurocognition and functional outcome, suggesting that social cognition plays a mediational role between them (Addington et al., 2010; Green et al., 2012b; Schmidt et al., 2011).

Recent progress in risk identification methodology has made it possible to identify individuals who are at clinical high risk (CHR) of
developing psychosis based on clinical phenomenology, in particular sub-threshold psychotic symptoms (Addington and Heinssen, 2012). It has been reported that compared to healthy controls, CHR individuals show deficits in social cognition similar to those observed in patients at the first episode of psychosis and patients who have a more chronic course of schizophrenia (Green et al., 2012a; Thompson et al., 2011). These deficits are observed in several domains of social cognition, such as theory of mind (ToM), emotion recognition, social perception and attributional style (Addington and Barbato, 2015).

ToM is the ability to attribute beliefs and intentions to oneself and others. Numerous studies, using a variety of ToM tasks, have shown that ToM is impaired in individuals at CHR (Chung et al., 2008; Green et al., 2012a; Hur et al., 2013; Thompson et al., 2012), although a few studies have not observed impaired ToM (Brüne et al., 2011; Couture et al., 2008; Stanford et al., 2011). In most of these studies, participants were asked to read short stories or cartoons and perform a first or second order mental state attribution, which means inferring the mental state of a character in the story, or inferring the character’s beliefs about another character. However, another important aspect of ToM is the ability to process counterfactual information, for example detecting sarcasm or lies. In everyday social interactions, sarcasm and lie detection entails going beyond the literal meaning of a message by using social cues. The only study to date examining how CHR individuals process counterfactual information reported impaired detection of sarcasm and lies (Green et al., 2012a).

Emotion recognition is the ability to recognize other people’s feelings. Most studies examining emotion recognition in CHR individuals have focused on prosody and facial affect processing. Although the majority of studies observed deficits in emotion recognition in CHR individuals when compared to healthy controls (Addington et al., 2008; Amminger et al., 2012; Comparelli et al., 2013; Green et al., 2012a; Kohler et al., 2014; van Rijn et al., 2011; Wölwer et al., 2012), mixed findings have been reported, with some studies not finding a deficit (Gee et al., 2012; Pinkham et al., 2007; Seiferth et al., 2008; Thompson et al., 2012) and others showing selective deficits in a sub-set of negative emotions (Amminger et al., 2011). Studies that did not find a significant deficit in emotion recognition tended to have smaller samples, typically less than 20 participants.

Social perception generally refers to the awareness of cues and rules that occur in social situations. There are three studies that have examined social perception in individuals at CHR as compared to healthy controls (Couture et al., 2008; Green et al., 2012a; Thompson et al., 2012), although each of them focused on different aspects of social perception. Findings from the PREDICT study showed that CHR individuals had biased complex social judgements compared to healthy controls (Couture et al., 2008) and to a help-seeking control sample (Healey et al., 2013). Green and colleagues looked at perception of social relationships and demonstrated poorer performance for the CHR group compared to the control group (Green et al., 2012a). Thompson et al. (2012), using the Managing Emotions branch of the Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT; Mayer et al., 2002), did not find that their CHR sample evidenced impairment. Although the Managing Emotions section of the MSCEIT includes questions about perception of social or interpersonal situations, the MSCEIT is usually considered a measure of emotional intelligence, that is, the ability to understand and manage emotions and to problem-solve on the basis of them (Mayer et al., 1999), and therefore may not necessarily measure social perception.

Attributional style is an individual’s tendency when inferring the cause of an event. A few studies have looked at attributional style in CHR individuals (An et al., 2010; DeVylder et al., 2013; Thompson et al., 2013). Although DeVylder and colleagues did not find an attributional bias in individuals at CHR compared to controls, An and colleagues reported a perceived hostility bias and Thompson and colleagues observed a significantly more externalized locus of control for the CHR group compared to controls.

In summary, although there has been a significant increase in the number of studies assessing social cognition in the CHR population, often samples have been small, results have been mixed, and many studies examined only one or two domains. The current study aimed to expand upon previous research by examining, in a large cohort of individuals at CHR for psychosis and healthy controls, whether social cognition is impaired. It has been observed that the majority of individuals who present as being at CHR and who do not make the transition to psychosis continue to have deficits in social function (Addington et al., 2011), plus there is a link between social cognition and social functioning. It would therefore be important to have an improved understanding of these early deficits in social cognition in the CHR population as a whole so that potential treatments at this pre-psychotic phase could be developed. We assessed three well-established areas of social cognition: ToM (including sarcasm and lies detection), facial affect processing and social relationship perception. Based on the previous literature, we expected to observe a poorer performance in all three domains of social cognition in the CHR group compared to the control group.

2. Methods

2.1. Participants

All participants were recruited as part of the multi-site NIMH funded North American Prodrome Longitudinal Study 2 (NAPLS 2) (Addington et al., 2012) which was established to investigate predictors and mechanisms of conversion to psychosis. The NAPLS 2 sample consists of 764 CHR individuals (436 males, 328 females) and 280 controls (141 males, 139 females) recruited from all eight NAPLS 2 sites (University of California Los Angeles, Emory University, Harvard University, Zucker-Hillside Hospital, University of North Carolina, University of California San Diego, University of Calgary, Yale University). All CHR participants were required to meet the Criteria of Prodromal Syndromes (COPS) using the Structured Interview for Prodromal Syndromes (SIPS) (McGlashan et al., 2010). Participants were excluded if they met criteria for any current or lifetime axis I psychotic disorder, had IQ < 70, or had past or current history of a clinically significant central nervous system disorder. Control participants were excluded if they had a first-degree relative with a current or past psychotic disorder. A more detailed description of ascertainment, inclusion and exclusion criteria, and participant details is provided elsewhere (Addington et al., 2012).

2.2. Measures

The Structured Interview for Prodromal Syndromes (SIPS) (McGlashan et al., 2010) was used to determine whether an individual met criteria for the prodromal syndrome. The Scale of Prodromal Symptoms (SOPS) was used to rate the severity of symptoms and consists of 19 items in 4 symptom domains: positive, negative, general, and disorganized.

IQ was assessed with the Vocabulary and Block Design subtests of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999).

We assessed three well-established areas of social cognition, namely ToM, facial affect processing and social perception, using measures that have now been deemed appropriate for this population, as suggested by the RAND panel (Pinkham et al., 2014). Furthermore, we chose a range of measures that may have particular relevance for social interactions. In particular, we used a recently developed measure of relationship perception, given that vulnerability to psychosis had previously been linked to maladaptive ways of understanding and implementing social relationships (Allen et al., 2005). Theory of mind (ToM) was assessed using the Social Inference subscale of The Awareness of Social Inference Test (TASIT; McDonald et al., 2003a,b); facial affect processing was assessed with the Penn Emotion Recognition task (ER40; Gur et al., 2002) and the Penn Emotion Differentiation task (EDF40; Kohler et al.,...
between the members, which can be classi
cand are equivalent and undifferentiated. The second model is called Au-
are based on the idea that the individuals have something in common
participants can answer
about what the characters are thinking, doing, feeling and saying. Partic-
can answer “yes”, “no” or “don’t know”. For each scene, the max-
imum score is four, yielding a maximum score of 64 as well as sub-
cores for Lies and Sarcasm. The TASIT is an audiovisual measure with
good psychometric properties (McDonald et al., 2006) and high ecolog-
ical validity (McDonald et al., 2004). Although it was initially developed
for use with patients with traumatic brain injury, its efficacy in detecting
ToM deficits has been proven with both schizophrenia patients
(Cassetta and Goghari, 2014; Green et al., 2012a; Kern et al., 2009; Sparks et al.,
2010) and individuals at CHR (Green et al., 2012a).

To assess facial affect processing, two well-established computerized
tasks, the ER40 and the EDF40, were used. In these tasks, pictures
representing facial expressions are shown in color. There are an equal
number of male and female faces, and four races are represented
(Caucasian, African–American, Asian and Hispanic). In the ER40, one face
at a time is shown and participants have to choose the emotion that is rep-
resented from a list of five possibilities (anger, fear, neutral, happy and
sad), shown on the right side of the screen. In the EDF40, two faces are
shown and participants are asked to indicate which one shows an emotion
(either happiness or sadness) more intensely. For the ER40 task, there are
a total score ranging from 0 to 40, and individual sub-scores for happy,
sad, angry, fearful and neutral facial expressions. For the EDF40 task,
there are a total score ranging from 0 to 40, and two sub-scores for
happy and sad facial expressions. Both of these tasks have been previ-
ously used with schizophrenia patients (Goghari and Sponheim, 2013;
Silver et al., 2004; Weiss et al., 2007) and individuals at CHR (Kohler
et al., 2014).

The RAD is a measure of competence in relationship perception. The
full version of the RAD has 25 vignettes and 75 items. For the purpose
of this study, we used the RAD-45 items, an abbreviated version of the RAD.
The RAD-45 contains 15 vignettes each involving two characters whose
interpersonal behaviors are consistent with one of the four relational
models (Fiske, 1991, 2004). According to the relational model theory,
people base their relationships on four implicit relationship models that
regulate social behavior in several different domains of social life.
Relationships conformance to the first model, named Communal Sharing,
are based on the idea that the individuals have something in common
and are equivalent and undifferentiated. The second model is called Au-
thority Ranking and refers to relationships where there is a hierarchy be-
tween the members, which can be classified into “decision makers” and
“followers”. The third model is called Equality Matching and is based on
relationships involving a one-to-one distribution of efforts and resources
between members. In the fourth model, called Market Pricing, relation-
ships are based on ratios and rates, and members are focused on proportion-
ality based on their contribution to a certain activity or business. In
the RAD, each vignette is followed by three statements that describe in-
teractions between the same two characters in different situations, with
each statement representing one of the relational models. Participants
are asked to use the information they have learned from the vignette
to judge (answering yes/no) whether the behaviors described in each
statement are likely to occur. Performance is measured as the total num-
ber of correct responses (ranging from 0 to 45) and four sub-scores, one
for each relational model named above. The RAD has good psychometric
properties and was specifically developed and validated to assess per-
ception of relationships in individuals with schizophrenia (Sergi et al.,
2009) based on evidence showing a link between poor use of relation-
ship models and vulnerability to psychosis (Allen et al., 2005).

2.3. Procedures

All sites recruited both CHR individuals and healthy controls. The study was approved by the Institutional Review Boards of all eight
NAPLS 2 sites. Informed consent was obtained from those who met
criteria and were judged fully competent to give consent. Parental con-
sent was obtained from parents/guardians of minors. Participants were
assigned a clinical rater who conducted all the semi-structured inter-
views. Raters were experienced research clinicians. Gold standard
post-training agreement on determining the prodromal diagnoses was
excellent (kappa = 0.90) (Addington et al., 2012). Social cognition as-
sessments were conducted at all sites by research assistants and post-
doctoral fellows trained by J. Addington. All data in this study were col-
lected at the initial assessment of the NAPLS 2 project.

2.4. Statistical analysis

Demographic variables were compared between the two groups
using the Student’s t-test and Chi-square test. The Spearman rank-
order correlation coefficient was used to assess, within each group,
the correlation between measures of social cognition, as well as the cor-
relation of social cognition with clinical symptoms, and age. To account
for multiple comparisons, Bonferroni correction was applied. The distri-
bution of the social cognition data was negatively skewed. For all vari-
ables results of the Shapiro–Wilk test were statistically significant at
the p-level of 0.0001. Skewness and Kurtosis were statistically signifi-
cant for most of the variables. Our attempts to transform the data to
symmetry were not successful. Therefore Mann–Whitney U test was
initially used to test for differences in social cognition between the
CHR group and the control group. To account for the skewed data, for
which means are not an adequate measure of central tendency because
of their sensitivity to outliers, median regression models were used to
assess the difference in social cognition between the CHR group and
the control group controlling for age, as well as the differences between
the CHR group and the control group controlling for IQ. Median regres-
sion is a statistical method for modeling the relation between a set of
predictor variables and the conditional median of the response variable
(Koenker and Bassett, 1978), yielding estimates that are more robust
against outliers in the response measurements, relative to the ordinary
least squares regression.

3. Results

The sample of participants in NAPLS 2 that completed the social cog-
nition assessments included 675 CHR individuals (389 males and 286
females) and 264 controls (136 males and 128 females). Control partic-
ips were slightly older and had significantly more years of education
than CHR participants. IQ was higher in the control group (Median =
111, SD = 14.10; U = 61557) compared to the CHR group (Median =
105, SD = 15.28, p < 0.0001). The characteristics of the sample are summarized in Table 1.

In both groups, the total scores of all measures of social cognition
were inter-related and there were significant positive correlations be-
tween social cognition and age and between social cognition and IQ
(Table 2). We examined the associations of social cognition with the
SOPS total positive symptoms and total negative symptoms. There
were no significant correlations between any of the social cognition
measures and symptoms.

Results of the initial comparisons between groups are shown in
Table 3. Median regression models were used to further explore the sig-
nificant group differences controlling for age and controlling for IQ. The
observed in other studies using the same measures (McDonald et al., 2003b; Kohler et al., 2014), suggesting that there may have been a ceiling effect for these measures. Similar distribution of the data was observed in both the CHF group and the healthy control group. Nevertheless, the results of our group comparisons showed a poorer performance for the CHF group compared to controls in all measures of social cognition, possibly indicating that although a proportion of the CHF individuals perform well in social cognition tasks, there may be a sub-group of CHF individuals who have poorer social cognition. Furthermore, despite the ceiling effect, the measures used appear to be sensitive enough to highlight small group differences. Although, when we controlled for age and then for IQ, group differences in ToM and social perception remained significant but there were no longer significant group differences in facial affect recognition.

The observed deficit in ToM ability, as shown by a lower total score on the TASIT, confirms previous evidence that individuals at CHF have difficulties with mental states attribution (Bora and Pantelis, 2013; Chung et al., 2008; Green et al., 2012a; Hur et al., 2013). This result remained significant even after controlling for age, and IQ. Moreover, our study supports the work of Green et al. (2012a), demonstrating that CHF individuals show poor processing of counterfactual information. Specifically, the group differences in sarcasm detection remained significant after controlling for age and for IQ, suggesting that impairment in processing counterfactual information starts early in the course of psychosis and may be considered as an indicator of vulnerability. It may be that deficits in sarcasm detection impede social interaction and the establishment of peer-relationships, thus impacting social functioning. Nevertheless, the small effects sizes observed in the current study may indicate that these deficits are less severe in this population than they are in individuals with an established psychotic illness, supporting evidence that the performance of CHF individuals in ToM falls in between that of first-episode patients and of healthy controls (Bora and Pantelis, 2013).

We initially observed poorer facial emotion recognition in CHF individuals compared to controls, supporting previous literature (Addington et al., 2008; Amminger et al., 2011; Comparelli et al., 2013; Kohler et al., 2014). The group differences in our study were no longer significant after controlling for age, a result only found in one previous study (Thompson et al., 2012). It is not clear why our groups

### Table 2

<table>
<thead>
<tr>
<th>Measure</th>
<th>TASIT</th>
<th>ER40</th>
<th>EDF40</th>
<th>RAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF</td>
<td>0.22*</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>EDF40</td>
<td>0.27*</td>
<td>0.17*</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>RAD</td>
<td>0.52*</td>
<td>0.16*</td>
<td>0.37*</td>
<td>–</td>
</tr>
<tr>
<td>AGE</td>
<td>0.21*</td>
<td>0.00</td>
<td>0.24*</td>
<td>0.27*</td>
</tr>
<tr>
<td>IQ</td>
<td>0.45*</td>
<td>0.11*</td>
<td>0.40*</td>
<td>0.55*</td>
</tr>
<tr>
<td>Controls</td>
<td>0.25*</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>EDF40</td>
<td>0.39*</td>
<td>0.13</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>RAD</td>
<td>0.41*</td>
<td>0.18</td>
<td>0.33*</td>
<td>–</td>
</tr>
<tr>
<td>AGE</td>
<td>0.38*</td>
<td>0.17</td>
<td>0.17*</td>
<td>0.26*</td>
</tr>
<tr>
<td>IQ</td>
<td>0.31*</td>
<td>0.11*</td>
<td>0.42</td>
<td>0.46*</td>
</tr>
</tbody>
</table>

* p < 0.001.

### Table 3

<table>
<thead>
<tr>
<th>Measure</th>
<th>Group Mean (SD)</th>
<th>Range*</th>
<th>Mann-Whitney U</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>TASIT total</td>
<td>52.34 (6.11)</td>
<td>54.79 (5.30)</td>
<td>–</td>
<td>65065.50**</td>
</tr>
<tr>
<td>Chern</td>
<td>26.66 (3.81)</td>
<td>27.93 (3.14)</td>
<td>–</td>
<td>68408.00**</td>
</tr>
<tr>
<td>Sarcasm</td>
<td>25.68 (3.93)</td>
<td>26.87 (3.84)</td>
<td>–</td>
<td>69805.00**</td>
</tr>
<tr>
<td>ER40 total</td>
<td>32.79 (3.54)</td>
<td>33.67 (2.79)</td>
<td>–</td>
<td>73849.50**</td>
</tr>
<tr>
<td>Angry</td>
<td>5.00 (1.45)</td>
<td>5.03 (1.40)</td>
<td>–</td>
<td>85429.50</td>
</tr>
<tr>
<td>Fearful</td>
<td>6.81 (1.33)</td>
<td>6.91 (1.26)</td>
<td>–</td>
<td>81984.50</td>
</tr>
<tr>
<td>Neutral</td>
<td>6.94 (1.71)</td>
<td>7.22 (1.25)</td>
<td>–</td>
<td>81619.00</td>
</tr>
<tr>
<td>Happy</td>
<td>7.68 (0.73)</td>
<td>7.78 (0.48)</td>
<td>–</td>
<td>81979.00</td>
</tr>
<tr>
<td>Sad</td>
<td>6.36 (1.39)</td>
<td>6.73 (1.18)</td>
<td>–</td>
<td>72965.00**</td>
</tr>
<tr>
<td>EDF40 total</td>
<td>24.29 (6.01)</td>
<td>25.97 (5.22)</td>
<td>–</td>
<td>73011.50**</td>
</tr>
<tr>
<td>Happy</td>
<td>10.98 (3.73)</td>
<td>11.96 (3.57)</td>
<td>–</td>
<td>73983.50**</td>
</tr>
<tr>
<td>Sad</td>
<td>13.31 (2.90)</td>
<td>14.01 (2.43)</td>
<td>–</td>
<td>75175.00**</td>
</tr>
<tr>
<td>RAD total</td>
<td>31.68 (5.30)</td>
<td>33.95 (4.48)</td>
<td>–</td>
<td>63276.00**</td>
</tr>
<tr>
<td>Communal</td>
<td>8.98 (2.00)</td>
<td>9.58 (1.86)</td>
<td>–</td>
<td>70381.00**</td>
</tr>
<tr>
<td>Authority</td>
<td>9.35 (2.19)</td>
<td>10.32 (1.59)</td>
<td>–</td>
<td>62304.00**</td>
</tr>
<tr>
<td>Equality</td>
<td>7.48 (1.70)</td>
<td>8.01 (1.65)</td>
<td>–</td>
<td>71397.00**</td>
</tr>
<tr>
<td>Market</td>
<td>5.86 (1.68)</td>
<td>6.04 (1.63)</td>
<td>–</td>
<td>79510.50</td>
</tr>
</tbody>
</table>

* p < 0.01, ** p < 0.001.

This range refers to the minimum and maximum score that can be obtained in each measure or sub-score.

### 4. Discussion

This is one of the first studies to assess multiple domains of social cognition in a large cohort of individuals at clinical high risk for psychosis (CHR) and healthy controls. Specifically, this study assessed ToM, facial emotion perception and social perception.

The social cognition data were negatively skewed, a result that has been observed in other studies using the same measures (McDonald et al., 2013; Chung et al., 2008; Green et al., 2012a; Hur et al., 2013). This result remained significant even after controlling for age, and IQ. Moreover, our study supports the work of Green et al. (2012a), demonstrating that CHF individuals show poor processing of counterfactual information. Specifically, the group differences in sarcasm detection remained significant after controlling for age and for IQ, suggesting that impairment in processing counterfactual information starts early in the course of psychosis and may be considered as an indicator of vulnerability. It may be that deficits in sarcasm detection impede social interaction and the establishment of peer-relationships, thus impacting social functioning. Nevertheless, the small effects sizes observed in the current study may indicate that these deficits are less severe in this population than they are in individuals with an established psychotic illness, supporting evidence that the performance of CHF individuals in ToM falls in between that of first-episode patients and of healthy controls (Bora and Pantelis, 2013).
but without signifi- 
cantly better than schizophrenia patients and worse than controls, 
demonstrating that on facial affect recognition CHR individuals per- 
demonstrating only mild impairment or because some were performing 
recognition were small, perhaps because the CHR participants were 
stage. In our study the effect sizes for group differences in facial affect 
were no longer signifi-

Social perception was impaired in the CHR group, confirming find- 
ings from previous studies (Couture et al., 2008; Green et al., 2012a; 
Healey et al., 2013). It is worth noting that social perception assess- 
ments typically consider the awareness of cues that occur in social situa-
tions (Addington et al., 2006); however, studies to date assessing social 
perception in CHR individuals have typically considered only one aspect of social perception. In this study, we have examined the under-
standing of social relationships, as assessed by the RAD, and our results are sup-
ported by two other studies that demonstrated poor performance on the 
RAD for both schizophrenia (Green et al., 2012a; Sergi et al., 2009) 
and CHR samples (Green et al., 2012a). Furthermore, after controlling 
for IQ, we observed group differences in RAD Authority. Interestingly, 
in the RAD, the Authority Ranking relationship model refers to relation-
ships where there is a hierarchy between the members. Inappropriate 
use of this relationship model has been found to be associated with 
psychosis proneness (Allen et al., 2005) and schizotypal personality 
(Haslam et al., 2002), in support of our findings.

Finally, there were no relationships between symptoms and social 
cognition, which is similar to several prior reports (Couture et al., 
2008; Stanford et al., 2011; Yong et al., 2014), although a link between 
symptom progression and social cognition has been reported (Allott 
et al., 2014; Healey et al., 2013; Kim et al., 2011). In the literature, the evi-
dence for a relationship between social cognition and symptoms is 
mixed, and this could at least in part be due to the use of different me-
asures to assess both symptoms and social cognition. It is interesting to 
note that no relationship was observed in previous studies that used 
the SOPS to assess symptoms (Couture et al., 2008; Stanford et al., 
2011; Yong et al., 2014).

Table 4

<table>
<thead>
<tr>
<th>Measure</th>
<th>CHR n = 675</th>
<th>Controls n = 264</th>
<th>Adjusted difference in medians</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Median</td>
<td>Estimate (95% CI)</td>
</tr>
<tr>
<td>TASIT total</td>
<td>54 (50, 58)</td>
<td>56 (50, 60)</td>
<td>−2.00 (−3.08, −0.92)</td>
</tr>
<tr>
<td>Lies</td>
<td>27 (21, 33)</td>
<td>29 (21, 33)</td>
<td>−1.36 (−1.99, −0.74)</td>
</tr>
<tr>
<td>Sarcasm</td>
<td>26 (21, 31)</td>
<td>28 (21, 31)</td>
<td>−0.82 (−1.44, −0.19)</td>
</tr>
<tr>
<td>ER40 total</td>
<td>33 (29, 36)</td>
<td>34 (29, 36)</td>
<td>−1.00 (−2.08, 0.08)</td>
</tr>
<tr>
<td>Sad</td>
<td>7 (4, 10)</td>
<td>7 (4, 10)</td>
<td>0.00 (−5.34 × 10⁻⁹, 5.34 × 10⁻⁹)</td>
</tr>
<tr>
<td>Happy</td>
<td>11 (7, 15)</td>
<td>12 (7, 15)</td>
<td>−0.33 (−1.09, 0.42)</td>
</tr>
<tr>
<td>RAD total</td>
<td>32 (28, 36)</td>
<td>35 (28, 39)</td>
<td>−2.00 (−2.69, −1.31)</td>
</tr>
<tr>
<td>Communal</td>
<td>9 (6, 12)</td>
<td>10 (6, 13)</td>
<td>−0.62 (−0.91, −0.33)</td>
</tr>
<tr>
<td>Authority</td>
<td>10 (7, 13)</td>
<td>11 (7, 13)</td>
<td>−0.67 (−1.05, −0.29)</td>
</tr>
<tr>
<td>Equality</td>
<td>7 (4, 10)</td>
<td>8 (4, 10)</td>
<td>−0.57 (−0.94, −0.21)</td>
</tr>
</tbody>
</table>

Table 5

<table>
<thead>
<tr>
<th>Measure</th>
<th>CHR n = 675</th>
<th>Controls n = 264</th>
<th>Adjusted difference in medians</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Median</td>
<td>Estimate (95% CI)</td>
</tr>
<tr>
<td>TASIT total</td>
<td>54 (50, 58)</td>
<td>56 (50, 60)</td>
<td>−1.00 (−1.97, −0.031)</td>
</tr>
<tr>
<td>Lies</td>
<td>27 (21, 33)</td>
<td>29 (21, 33)</td>
<td>−0.62 (−1.24, 0.01)</td>
</tr>
<tr>
<td>Sarcasm</td>
<td>26 (21, 31)</td>
<td>28 (21, 31)</td>
<td>−0.83 (−1.41, −0.25)</td>
</tr>
<tr>
<td>ER40 total</td>
<td>33 (29, 36)</td>
<td>34 (29, 36)</td>
<td>−0.49 (−1.03, 0.05)</td>
</tr>
<tr>
<td>Sad</td>
<td>7 (4, 10)</td>
<td>7 (4, 10)</td>
<td>0.00 (−5.34 × 10⁻⁹, 5.34 × 10⁻⁹)</td>
</tr>
<tr>
<td>Happy</td>
<td>11 (7, 15)</td>
<td>12 (7, 15)</td>
<td>−0.11 (−1.11, 0.89)</td>
</tr>
<tr>
<td>RAD total</td>
<td>32 (28, 36)</td>
<td>35 (28, 39)</td>
<td>−0.91 (−1.75, −0.06)</td>
</tr>
<tr>
<td>Communal</td>
<td>9 (6, 12)</td>
<td>10 (6, 13)</td>
<td>−0.20 (−0.57, 0.17)</td>
</tr>
<tr>
<td>Authority</td>
<td>10 (7, 13)</td>
<td>11 (7, 13)</td>
<td>−0.39 (−0.65, −0.13)</td>
</tr>
<tr>
<td>Equality</td>
<td>7 (4, 10)</td>
<td>8 (4, 10)</td>
<td>−0.15 (−0.47, −0.06)</td>
</tr>
</tbody>
</table>
The strengths of our study include a large well-defined sample and the assessment of three domains of social cognition. Limitations of our study include the fact that we used only one measure of social cognition per domain, and that our results are cross-sectional.

In conclusion, we have demonstrated that ToM and social perception are impaired in the CHR population. Since social cognitive deficits implicate social functioning addressing these difficulties at the early stage may have implications for later functioning. Next steps are to examine the stability of social cognition deficits in CHR individuals and to evaluate their predictive relationships with later conversion to psychosis.

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Contributors

Drs. Addington, Cadenhead, Cannon, Cornblatt, McGlashan, Perkins, Seidman, Tsuang, Walker, Woods, Bearden, Mathalon, and Heinsken were responsible for the design of the study and for the supervision of all aspects of data collection. Dr. Barbatto contributed to data collection and supervision of same at the Calvary site, and took the lead on writing the manuscripts with help from Dr. Addington. Dr. Barbatto and Ms. Liu were responsible for data analysis. All authors contributed to and approved the final manuscript.

Conflict of Interest

There are no conflicts of interest for any of the authors with respect to the data in this paper or for the study.

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References


