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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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Abstract

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 psychosis. Its detection and treatment intervention is of paramount importance as it would enable prevention of early stages of illness. Research in CHR demonstrates the importance of markers for prediction of psychosis as they can be used for early intervention.
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 counter-factual 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., 2012).
and 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 (i.e., sarcasm). After each scene, participants answer questions
something that is contrary to the actual meaning he or she wishes to
she believes (i.e., a lie), and in the other half the main speaker says
the main speaker conveys a message that is contrary to what he or
veryday conversations and use lies and sarcasm. In half of the vignettes
scenes, enriched with contextual cues, where actors are engaged in ev-
properties and was speci-
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 repre-
jected 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-
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 conforming 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-
Demographic variables were compared between the two groups
the sample of participants in NAPLS 2 that completed the social cogni-
tions included 675 CHR individuals (389 males and 286 females) and 264 controls (136 males and 128 females). Control particip-
ts 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 sam-
Table 3. Median regression models were used to further explore the sig-
3. Results
The sample of participants in NAPLS 2 that completed the social cogni-
tions assessed included 675 CHR individuals and 264 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-
ments 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-
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 distribu-
the social cognition data was negatively skewed. For all vari-
ables results of the Shapiro–Wilks test were statistically significant at the p-level of 0.0001. Skewness and Kurtosis were statistically signi-
cificant for most of the variables. Our attempts to transform the data to symmety 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.
results of the analysis controlling for age showed that there were significant differences in medians between the CHR group and the control group in TASIT total, TASIT Sarcasm, TASIT Lies, RAD total, Communal, and Equality. The groups no longer differed in the ER40 and the EDF40. The results of the median regression controlling for IQ showed that there were significant differences in medians between the CHR group and the control group in TASIT total, TASIT Sarcasm, RAD total, and RAD Authority. The groups no longer differed in TASIT Lies, the ER40, the EDF, and RAD Communal and Equality. See Tables 4 and 5.

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., 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 CHR group and the healthy control group. Nevertheless, the results of our group comparisons showed a poorer performance for the CHR group compared to controls in all measures of social cognition, possibly indicating that although a proportion of the CHR individuals perform well in social cognition tasks, there may be a sub-group of CHR 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 performance for the CHR group compared to controls in all measures of social cognition 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 CHR 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 CHR 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
no longer significantly differed once age was considered in the model, particularly when most previous studies are reporting such differences. However, even amongst the studies cited above that observed deficits in facial emotion recognition after controlling for age, results are mixed with regard to individual emotions that may be affected. It has been suggested that facial affect processing can vary significantly during the adolescence period due to continuous and non-linear development of the specific brain regions involved in facial affect processing (Blakemore, 2008; Burnett et al., 2011), and therefore high variability might be expected when assessing facial emotion processing in adolescence, which could result in mixed findings when comparing outcomes across studies. Similarly, the group differences in facial emotion recognition were no longer significant after controlling for IQ. To date, only two studies considered the influence of IQ on emotion recognition, and they had different results. The first (Thompson et al., 2012) found no differences between CHR and healthy controls, whereas the second (Amminger et al., 2011) found impaired recognition of fear and sadness in their at-risk group. Based on our results it is possible that, for individuals at CHR, IQ has an impact on facial affect recognition, however, given the limited number of studies that looked at the relationship between IQ and facial affect recognition, a definite statement cannot be made at this stage. In our study the effect sizes for group differences in facial affect recognition were small, perhaps because the CHR participants were demonstrating only mild impairment or because some were performing at a normal level. This fits with previous work (Addington et al., 2008), demonstrating that on facial affect recognition CHR individuals performed better than schizophrenia patients and worse than controls, but without significantly differing from either.

Social perception was impaired in the CHR group, confirming findings from previous studies (Couture et al., 2008; Green et al., 2012a; Healey et al., 2013). It is worth noting that social perception assessments typically consider the awareness of cues that occur in social situations (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 understanding of social relationships, as assessed by the RAD, and our results are supported 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 relationships 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 evidence for a relationship between social cognition and symptoms is mixed, and this could at least in part be due to the use of different measures 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
Estimated medians of social cognition measures with adjustments for age.

<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</td>
<td>56</td>
<td>−2.0 (−3.08, −0.92)</td>
</tr>
<tr>
<td>Lies</td>
<td>27</td>
<td>29</td>
<td>−1.36 (−1.99, −0.74)</td>
</tr>
<tr>
<td>Sarcasm</td>
<td>26</td>
<td>28</td>
<td>−0.82 (−1.44, −0.19)</td>
</tr>
<tr>
<td>ER40 total</td>
<td>33</td>
<td>34</td>
<td>−1.0 (−2.08, 0.08)</td>
</tr>
<tr>
<td>Sad</td>
<td>7</td>
<td>7</td>
<td>0.00 (−5.34 × 10⁻⁸, 5.34 × 10⁻⁸)</td>
</tr>
<tr>
<td>ED40 total</td>
<td>25</td>
<td>26</td>
<td>−0.33 (−1.09, 0.42)</td>
</tr>
<tr>
<td>Sad</td>
<td>14</td>
<td>14</td>
<td>−0.10 (−0.53, 0.33)</td>
</tr>
<tr>
<td>Happy</td>
<td>11</td>
<td>12</td>
<td>−0.58 (−1.35, 0.18)</td>
</tr>
<tr>
<td>RAD total</td>
<td>32</td>
<td>35</td>
<td>−2.0 (−2.69, −1.31)</td>
</tr>
<tr>
<td>Communal</td>
<td>9</td>
<td>10</td>
<td>−0.62 (−0.91, 0.33)</td>
</tr>
<tr>
<td>Authority</td>
<td>10</td>
<td>11</td>
<td>−0.67 (−1.05, −0.29)</td>
</tr>
<tr>
<td>Equality</td>
<td>7</td>
<td>8</td>
<td>−0.57 (−0.94, −0.21)</td>
</tr>
</tbody>
</table>

Table 5
Estimated medians of social cognition measures with adjustments for IQ.

<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</td>
<td>56</td>
<td>−1.00 (−1.97, −0.031)</td>
</tr>
<tr>
<td>Lies</td>
<td>27</td>
<td>29</td>
<td>−0.62 (−1.24, 0.01)</td>
</tr>
<tr>
<td>Sarcasm</td>
<td>26</td>
<td>28</td>
<td>−0.83 (−1.41, −0.25)</td>
</tr>
<tr>
<td>ER40 total</td>
<td>33</td>
<td>34</td>
<td>−0.49 (−1.03, 0.05)</td>
</tr>
<tr>
<td>Sad</td>
<td>7</td>
<td>7</td>
<td>0.00 (−5.34 × 10⁻⁸, 5.34 × 10⁻⁸)</td>
</tr>
<tr>
<td>ED40 total</td>
<td>25</td>
<td>26</td>
<td>−0.11 (−1.11, 0.89)</td>
</tr>
<tr>
<td>Sad</td>
<td>14</td>
<td>14</td>
<td>−0.18 (−0.36, 0.73)</td>
</tr>
<tr>
<td>Happy</td>
<td>11</td>
<td>12</td>
<td>−0.38 (−0.99, 0.23)</td>
</tr>
<tr>
<td>RAD total</td>
<td>32</td>
<td>35</td>
<td>−0.91 (−1.75, −0.06)</td>
</tr>
<tr>
<td>Communal</td>
<td>9</td>
<td>10</td>
<td>−0.20 (−0.57, 0.17)</td>
</tr>
<tr>
<td>Authority</td>
<td>10</td>
<td>11</td>
<td>−0.39 (−0.65, −0.13)</td>
</tr>
<tr>
<td>Equality</td>
<td>7</td>
<td>8</td>
<td>−0.15 (−0.47, −0.16)</td>
</tr>
</tbody>
</table>
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Contributors


