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Social cognition and paranoia in forensic inpatients with schizophrenia: A cross-sectional study

Running Head: Social cognition and paranoia in forensic patients

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Abstract

Background:
People diagnosed with schizophrenia have difficulties in emotion recognition and theory of mind, and these may contribute to paranoia. The aim of this study was to determine whether this relationship is evident in patients residing in a secure forensic setting.

Method:
Twenty-seven male participants with a diagnosis of schizophrenia and a history of offending behaviour were assessed using The Awareness of Social Inference Test (TASIT), The Ambiguous Intentions Hostility Questionnaire (AIHQ) and The Green et al. Paranoid Thought Scales (G-PTS). Individuals were recruited from two medium secure and one high secure forensic hospital in Scotland.

Results:
Correlation, logistic and multiple regression analyses did not find that emotion recognition and theory of mind were associated with indices of paranoid thinking.

Conclusion:
Social cognition did not appear to be related to indices of paranoia in this forensic sample. Although participants reported low levels of paranoia overall, the results are consistent with recent conclusions that theory of mind impairments are not specifically linked to paranoia in people diagnosed with schizophrenia.

Keywords: Paranoia, hostile attribution bias, emotion recognition, theory of mind, social cognition, mentally disordered offenders.

Word Count: 4544

1. Introduction

People with a diagnosis of schizophrenia are thought to have impairments in various domains of social cognition (Sprong *et al*, 2007), including their ability to accurately perceive and recognise emotions (‘emotion recognition’) and draw inferences about the thoughts, feelings and intentions of others – so-called ‘Theory of Mind’ skills (Frith, 1992; Zalla *et al*., 2006; Craig *et al*., 2004; Herold *et al*., 2002). Meta-analyses have found that the average scores of people with schizophrenia on tests of emotion recognition and ToM ability are between one half and one standard deviation below that of non-clinical participants (Kohler et al., 2009; Sprong *et al*., 2007). Such impairments are thought to have a negative effect on interpersonal and social interactions, and may have wide ranging consequences during the acute and recovery stages of schizophrenia (Couture *et al*. 2006).

Patients with schizophrenia who have engaged in violent offending present forensic mental healthcare services with particular challenges in relation to rehabilitation and recovery. In this population, impairments in social cognition may represent an unmet need which could be implicated in aggressive behaviour, future risk management, interpersonal relationships with staff and peers, and increased paranoia and persecutory delusions (Murphy, 2007; Salvatore *et al.* 2012; Waldheter *et al*. 2005). Indeed, persecutory delusions are one of the most frequently observed positive symptoms of schizophrenia. Although some authors have considered how they might be associated with an increased risk of committing a violent offence (e.g., Bentall and Taylor, 2006), a recent meta-analysis found that the empirical evidence remains surprisingly sparse and equivocal (Witt, van Dorn & Fazel, 2013).

Of course paranoia is not confined to mental illness and is also present in the general population to varying degrees (Freeman, 2007). It can be thought of as dimensional in nature, ranging from frequently occurring yet easily dismissed thoughts to firmly held crystallized persecutory delusions (Couture, Penn & Roberts, 2006; Savla *et al*, 2012; Freeman & Garety, 2014). As with other appraisals, paranoid appraisals represent an individual’s attempt to make sense of their experiences, a process that is influenced by pre-existing beliefs, developmental and life experiences, as well as counterproductive behavioural responses (Morrison, 2001), which may include avoidance, hypervigilance and, in some cases, acts of hostility and aggression. Although making judgements about the hostile intentions of others can be an adaptive strategy for threat avoidance (Salvatore *et al*. 2012), it has also been linked to increased rates of aggression (Combs *et al.* 2009; Coid et al., 2016).

Although related, paranoia and aggression in schizophrenia may involve different patterns of strengths and impairments in social cognition. For example, whereas Harrington *et al*. (2005) found evidence of a specific relationship between ToM difficulties and symptoms of paranoia, Abu-Akel and Abushua’leh (2004) found that *better* ToM skills, albeit in the context of poorer empathy, were associated with greater hostility and violence in schizophrenia. Another study found reduced ToM impairments in patients with schizophrenia who had committed offences, in comparison to those who had not, although both groups displayed impairments when compared to a non-clinical population (Majorek *et al*., 2009). Indeed, whether ToM is actually associated with paranoia remains unclear. For instance, Grieg *et al*. (2004) reported that greater ToM difficulties were related to symptoms of thought disorder and disorganisation, but not paranoia or persecutory delusions specifically. A recent review concluded that although ToM difficulties are consistently found in people with schizophrenia, the association with negative and disorganisation symptoms is stronger than that with persecutory delusions (Garety & Freeman, 2013).

The precise relationship between paranoia and emotion recognition in people with schizophrenia also remains unclear. Although a recent meta-analysis found that emotion recognition impairments are moderately associated with symptoms such as hallucinations and delusions (Ventura et al, 2013), other studies have reported either a negative relationship with paranoia (e.g., Williams et al., 2007), a positive relationship (e.g., Chan et al., 2008), and or no relationship at all (e.g., Pinkham et al., 2016). Pinkham et al (2016) concluded that while paranoia is not associated with an impaired capacity to recognise emotions per se, it is associated with an increased bias to infer hostility or anger in others. Although Frommann and colleagues (2013) found that violent patients with psychosis were less likely than non-violent patients to accurately recognise either neutral or fearful facial expressions, whether these impairments also contribute to paranoia in this forensic group of patients has not been investigated. Given both social cognition and paranoia are linked to poorer outcomes and acts of aggression (Couture *et al*. 2006, Waldheter *et al*. 2005), this is a surprising omission. These patients have a number of characteristics, such as increased substance misuse, aggression, anger and symptoms of personality disorder (Ogloff et al., 2015), that make it unclear whether findings obtained from a non-forensic population can be easily applied to them.

The aim of the current study was to address this gap, and determine whether reduced social cognitive functioning is associated with increased paranoia in people with psychosis who have a history of violent offending and are receiving inpatient care for schizophrenia in a secure forensic setting. We set out to test the specific hypotheses that emotion recognition and theory of mind skills account for a significant portion of variance in indices of paranoia in this group, as assessed by self-reported paranoid thoughts and / or a hostile or blaming attributional bias.

2. Methods

2.1.Ethical Approval

This study was given a favourable opinion by NHS Scotland's South East Scotland Research Ethics Committee.

2.2.Design

A within-group cross-sectional design was used to examine whether there was a relationship between social cognition and indices of paranoia. Self-report and observer-rated measures were used.

2.3.Participants

Participants were recruited from one high, and two medium secure forensic hospitals in Scotland which provide multi-disciplinary care for mentally ill offenders. In addition to psychotropic medications all patients are also offered a range of interventions to help them manage their mental health and desist from offending guided by the Scottish Governments Forensic Matrix which provides information on evidence based interventions and a range of treatment protocols (Forensic Network, 2011).

Participants were able to take part if they were male, detained under the Mental Health Act (Care and Treatment) (Scotland) Act 2003 in a secure setting, had a diagnosis of schizophrenia or schizoaffective disorder, aged 18-64 and able to provide informed consent. Participants were excluded if they had a history of traumatic brain injury resulting in loss of consciousness and requiring inpatient hospital care, a diagnosis of Autistic Spectrum Disorder, Schizoid Personality Disorder or Learning Disability.

2.4.Sample size

Calculations carried out using G*Power 3.1.6 (Faul, Erdfelder, Lang & Bucher, 2007) suggested that for multiple regression with three predictor variables it was necessary to recruit 33 participants to detect a medium effect size (ρ=0.3) with statistical power of 0.8 and an alpha level of 0.05.

2.5.Procedure

At each research site Responsible Medical Officers were asked to identify patients who met the inclusion and exclusion criteria and had capacity to consent. A member of the patient's usual care team approached the patient to give them a participant information sheet. If the individual met the criteria and wished to proceed then informed consent was taken by the researcher. Participants then completed the measures in one or two sessions totalling one to two hours in duration. As low levels of literacy are common in this population, measures which required a written response were read to the participants if necessary. All measures were administered in the same or similar order.

2.6.Measures

The following measures were administered:

2.6.1. The Awareness of Social Inference Test

The Awareness of Social Inference Test (TASIT) (McDonald *et al*. 2006) is an ecologically valid tool which measures emotion recognition and theory of mind through the use of video vignettes of everyday social interactions.

- Part 1: The Emotion Evaluation Test assesses emotion recognition and is comprised of 28 vignettes portraying seven emotions; happy, sad, surprised, angry, revolted, fear or neutral. Participants choose the emotions they feel best represent that of the actor in the vignette.
- Part 2 (TASIT 2): The Social Inference Test - Minimal measures understanding of social inference using sincere, sarcastic and paradoxical sarcasm exchanges in 15 vignettes. No additional cues or information are provided to the viewer to help in their interpretation.
- Part 3 (TASIT 3): The Social Inference Test - Enriched comprises 16 vignettes to measure a participant's ability to use contextual cues to distinguish a lie from sarcasm. The viewer is provided with additional information which reveals the actors true intentions by means of a visual cue or prologue.

Following parts 2 & 3 participants answer four questions about what the person was doing to the other person; what they were trying to say, what they were thinking and what they were feeling with a 'yes', 'no' or 'don't know' response. Reliability estimates for the TASIT range from 0.62 – 0.83 for alternate forms and 0.74 – 0.88 for test re-test (McDonald *et al*., 2006). Construct validity has been demonstrated by high correlations (*p*=.37-.70) between all parts of the TASIT and the Ekman and Freisen series of faces (Ekman & Freisen, 1976). The TASIT has been used in samples with schizotypy (Jahshan & Sergi, 2007) and schizophrenia (Kern *et al*., 2009 and Kosmidis *et al.,* 2008).

2.6.2. The Ambiguous Intentions Hostility Questionnaire

The Ambiguous Intentions Hostility Questionnaire (AIHQ) (Combs *et al*., 2007) measures hostility, blame and aggression in ambiguous situations where social cues are not clear. The measure has been used in recent research with a similar population (An *et al*., 2010 and Waldheter *et al*., 2005). The AIHQ is a 15-item vignette questionnaire where participants rate ambiguous, intentional or accidental scenarios. The first question requires participants to describe why the person in the vignette may have acted in that way towards them. Their answer is scored by the rater on a hostility index providing a hostility bias score. Scenarios are then rated, by the participant, on a Likert scale for perceived intentionality, from 1- 'definitely no' to 6-'definitely yes'; how angry it would make them, from 1 – 'not at all' to 5 – 'very angry' and how much they apportioned blame to the other person, from 1 – 'not at all' to 'very much'. The scores for intention, anger and blame are collapsed into a single score of blame bias. The participant notes how they would respond to the situation and the answer is then scored for aggressive bias. For each group of scenarios [intentional (5), ambiguous (5) and accidental (5)] the participant has a hostility, blame and aggression bias score. Both hostility and blame scores for ambiguous situations have individually demonstrated a strong relationship with measures of paranoia (Combs *et al*. 2007). These scores were therefore used as an additional index of paranoia. The AIHQ has demonstrated good levels of internal consistency (alpha = .84 -.86) and inter-rater reliability (intra-class correlation range: .97-.99) in a sample of 322 undergraduate students (Combs *et al*., 2007). Two researchers independently rated a selection (25%) of the completed questionnaires. Inter-rater agreement was high (Cohen's Kappa, 0.97).

2.6.3. The Green et al. Paranoid Thought Scales

The Green *et al*. Paranoid Thought Scales (G-PTS) (Green *et al*., 2008) was used to measure paranoid thoughts within the sample. The scale was developed to assess the full continuum of paranoia, from non-clinical ideation to delusional levels of paranoia as seen in clinical practice. The measure is comprised of two 16-item scales assessing social reference relevant to paranoia, and paranoia. The second scale, part B, focuses on ideas of persecution and is comprised of four subscales of conviction, pre-occupation, distress and paranoid thoughts. The scale can be used as two separate scales or together. Part B was selected for use in this study as it measures attributions of intended harm which are central to paranoia (Freeman, 2007). The self-report scale was read out to participants if required, each question is answered on a Likert scale from 'not at all' to 'totally'. The scale displayed good internal consistency (Cronbach's a = .70 - .95) and test-retest reliability (intra-class correlation .81) on a sample of 353 university staff and students and 50 individuals with a current persecutory delusion (Green *et al*., 2008).

2.7.Data Analysis

Data were analysed using SPSS Version 22. All variables were checked for normality through visual inspection of the data, the Kolmogorov-Smirnov test, skewness and kurtosis tests. Variables which did not meet the assumption of normality were analysed using non-parametric statistical tests. Correlations between variables were calculated, and logistic and boot-strapped linear regression were used to examine the study hypotheses. Regression analysis were conducted using the enter method. Emotion recognition was entered into the first block and theory of mind (parts 2 and 3) into the second block in all regression analyses. Standardised effect sizes (Cohen's d) and their associated 95% confidence intervals were also computed for differences in social cognition between participants reporting no paranoia and participants reporting at least subclinical paranoia. No participant data were excluded; all data from all consenting participants was included in each analysis.

3. Results

3.1.Sample characteristics

As shown in Table 1, we recruited 27 participants (mean age 37.6 years, SD 11.16; range 22-55). Sixteen were recruited from a high-security hospital and 11 were recruited from two medium-secure units. All participants were male, all had a diagnosis of paranoid schizophrenia and all had a history of offending. The mean length of time since initial diagnosis of schizophrenia was 10.81 years (SD 5.88; range 1-24 years). Prior to admission, the majority (78%, N=21) had used alcohol or drugs. A history of violence prior to the index offence was present in 70% (N=19) of the sample, and the most common index offence in the sample was culpable homicide (48%, N=13).

Table 1 also provides mean social cognition and paranoia scores for the sample. The total possible score for Part 1 of the TASIT (emotion recognition) is 28. In this sample the mean score was 20.26 (SD = 4.53). This is equivalent to the lower 5% of a university undergraduate normative sample, indicating abnormally low scores (McDonald *et al*., 2002). Part 2 tests the ability of participants to determine the actor’s intention and meaning in sincere and sarcastic exchanges. The total possible score is 60 and the mean score in the sample was 42.30 (SD = 10.60). Part 3 assesses the ability to distinguish lies and sarcasm; the total possible score is 64 and the mean score for this sample was 44.19 (SD = 14.02). Performance on the measure of theory of mind parts 2 and 3 was also in the lower 5% of the university sample. In Sparks *et al.* (2010) a sample of outpatients with a diagnosis of schizophrenia performed at a similar level to this sample in all three parts of the TASIT. Only the GPTS paranoid thoughts scale and TASIT Part 3 data did not satisfy the criterion of being normally distributed.

In Green *et al*. (2008), the mean GPTS paranoia score for a non-clinical sample was 22.1 (SD = 9.2) and 55.4 (SD = 15.7) for people with persecutory delusions, whereas in this study it was 26.11 (SD 14.02). Noting that the minimum score on the GPTS scale is 16 and that levels of paranoia in the current sample were similar to the non-clinical sample used in Green *et al*. (2008), it would seem the current sample reported low levels of paranoia. This is supported by consideration of AIHQ scores, which were lower in this group than in a study of 322 undergraduate students, where a mean hostile attributional bias score of 2.5 (0.68) and a mean blaming attributional bias of 3.0 (0.67) was reported (Combs *et al*., 2007).

3.2.Are emotion recognition and theory of mind skills associated with paranoia?

Correlations between the variables are reported in Table 2. Contrary to the study hypothesis, no significant correlations were evident between the social cognition and paranoia variables. Unexpectedly there was also no correlation between GPTS and AIHQ scores, or between emotion recognition and theory of mind scores. Correlations between AIHQ subscales were large and significant, as were correlations between the TASIT subscales.

3.3. Do emotion recognition and theory of mind skills predict presence of at least subclinical paranoid thoughts?

Two thirds of the sample scored zero (i.e., a score of 16) or close to zero on the GPTS. The data was therefore dichotomised into (a) absent or very low paranoid thoughts (group 0; N=18) and (b) at least subclinical paranoid thoughts (group 1; N=9), and analysed using logistic regression (see Table 4). Subclinical paranoia was defined here as a score of at least 31 on the GPTS, which is equivalent to 1 standard deviation above the mean score reported by Green *et al* for their non-clinical sample (mean 22.1, SD 9.2).

The data satisfied the assumptions of logistic regression; there was no evidence of multicollinearity, tolerance values were over 0.1 and VIF was less than 10. The Hosmer and Lemeshow statistic was not significant (p=.280) indicating linearity between the continuous predictors and the logit of the outcome variable. Emotion recognition did not make a significant contribution to the prediction of paranoia status, β=-.000, p=.998. The addition of theory of mind, as measured by the TASIT 2 & 3, did not significantly change the model and neither variable predicted paranoia, β=-.028, p=.585 and β=.014, p=.869. The Chi-squared statistic was non-significant indicating that adding social cognition variables to the model had no effect on the fit, $\chi 2$= 8.64, p=.280. Effect sizes for group differences on these variables were all negligible in magnitude and / or non-significant (see Table 3)

An additional logistic regression was carried out, but this time defining subclinical paranoia as a score of 31+ on the GPTS and/or a score of 3+ on the AIHQ hostile attribution subscale and/or a score of 3+ on the AIHQ blaming attribution subscale (see Table 6). There were therefore 15 participants in the non-paranoid group, with the rest (N=12) demonstrating at least subclinical paranoia on at least one of these outcomes.

The data again satisfied the assumptions of logistic regression, with no evidence of multicollinearity, tolerance values of over 0.1 and VIF less than 10. The Hosmer and Lemeshow statistic was not significant (p=.508). Emotion recognition did not make a significant contribution to the prediction of paranoia status, β=-.064, p=.538. The addition of theory of mind, as measured by the TASIT 2 and 3, did not significantly change the model and neither variable predicted paranoia, β=-.103, p=.084 and β=.068, p=.355. The Chi-squared statistic was non-significant indicating that adding social cognition variables to the model had no effect on the fit, $\chi 2$= 4.135, p=.247. Group differences were small and non-significant for emotion recognition and one of the theory of mind tasks (TASIT 3), but a moderate to large difference which approached statistical significance was observed for the other (TASIT 2; p=.09). See Tables 5 and 6.

3.4. Do emotion recognition and theory of mind skills predict increased hostile or blaming attributional biases?

Two bootstrapped linear regressions were conducted with AIHQ hostile attribution bias and AIHQ blaming bias as the continuous outcome variables and emotion recognition and theory of mind as predictor variables.

The data in both linear regression models satisfied the assumptions of linear regression except for homoscedasticity (see Tables 7 and 8). There was evidence of heteroscedasticity in the visual plots, therefore bootstrapping was applied in each case. Emotion recognition did not make a significant contribution to the prediction of hostile attributional bias (β=-.006, *p*=.760). Model 1 accounted for 0.1% (R^2 = .001) of the variance in hostile attribution bias. The addition of theory of mind, as measured by the TASIT 2 & 3, did not significantly change the model and neither variable predicted paranoia, β=-.039, *p*=.129 and β=.037, *p*=.158. The addition of TASIT 2 & 3 resulted in an additional 20% (^R^2 = .201, *p*=.076) of the variance in hostile attribution bias. The overall model accounted for 20% of the variance in hostile attribution bias.

Emotion recognition also failed to make a significant contribution to the prediction of blaming attributional bias, β=-.021, *p*=.582, accounting for 1.1% (R^2 = .011) of the variance. The addition of theory of mind, as measured by the TASIT 2 & 3, did not significantly change the model and neither variable predicted paranoia, β=-.035, *p*=.292 and β=.019, *p*=.647. The addition of TASIT 2 & 3 resulted in an additional 11% (^R^2 = .107, *p*=.268) of the variance. The overall model accounted for 12% of the variance in blaming attributional bias.

4. Discussion

Building on previous research (Frith & Corcoran 1996, Sprong *et al.,* 2007, Randall *et al.,* 2003, Craig *et al.,* 2004, Harrington *et al.,* 2005, Mehl *et al.,* 2010), the purpose of this study was to examine if difficulties in emotion recognition and theory of mind account for a significant proportion of variance in indices of paranoia in schizophrenia. Unlike previous studies, our participants were all forensic patients who had committed an offence (culpable homicide in almost half the sample), and were currently receiving secure inpatient care. Understanding the causes of paranoia in this group is essential for both effective rehabilitation and the assessment and management of future risk. Although contrary to what we predicted, our results were consistent with Garety and Freeman's recent conclusion (2014) that theory of mind and emotion recognition are unlikely to play a clinically significant role in paranoia and persecutory delusions.

There is of course clear evidence that both these social cognition domains are significantly impaired in non-affective psychosis (Kohler *et al*., 2009; Bora & Pantelis, 2013), and the poor performance of participants in our sample was consistent with this. There is also evidence that the severity of these impairments are positively correlated with overall psychotic symptom severity (Ventura *et al*., 2013), that both are present before the onset of psychosis (Piskulic *et al.,* 2016; Addington *et al.,* 2012; Corcoran *et al.*, 2015; Bora & Pantelis, 2013), and that both persist despite antipsychotic treatment (Addington & Addington, 1998; Bora & Pantelis, 2013). Although this is consistent with these impairments having some form of causal role in psychosis, experimental evidence indicates that interventions which specifically address facial affect impairments have no effect on positive or negative symptoms (Bordon, O'Rourke & Hutton, submitted). Unfortunately effects on social functioning have not been reported, and there is also no clear evidence that interventions that focus *only* on improving theory of mind lead to improvements in these domains (Kurtz & Richardson, 2012).

One possibility is that impairments in facial affect recognition and theory of mind ability create a general vulnerability to psychotic symptoms, perhaps as a consequence and cause of social defeat. Recent integrative models of psychosis have proposed that repeated social defeat causes the dopamine neurotransmitter system, thought to be responsible for allocating importance, or 'salience', to stimuli, to become both sensitised and dysregulated (Selten *et al.*, 2013; Howes & Murray, 2014). This disruption is thought to cause individuals to experience normally innocuous stimuli as having a sense of undue importance. This experience may then trigger a search for meaning which, depending on the presence of particular cognitive biases and pre-existing schemata, may conclude with the adoption of a delusional appraisal (Garety *et al.*, 2001). This general theory helps to explain a range of epidemiological, biological and psychological findings including, we suggest, the presence of impairments in social cognition. There is good evidence that social cognition is impaired in children who experience social defeat in the form of early adversity (Pollak & Kistler, 2002) or relational bullying from peers (Woods *et al.*, 2009), and poor emotion recognition is also evident in migrants (Hwa-Froelich, Matsuo & Becker, 2014; Derntl et al., 2009; Beaupré & Hess, 2006), a group that experiences both heightened social defeat and a significantly increased risk of psychosis.

Limitations

Our aim was to examine whether variance in social cognitive capacity accounted for variance in paranoia in a forensic setting, not to replicate the very well-established finding that this capacity is significantly impaired in people with psychosis (Kolher et al., 2009). Nonetheless the absence of a non-psychotic control group limits the extent to which we can draw conclusions about the specific pattern of impairments in our sample. Research in forensic mental health is often hampered by small sample sizes, and our study was no exception. Our original aim was to recruit 33 participants within the allocated time period for the study. Unfortunately recruitment in this setting was slower than anticipated, so we had a slightly smaller sample (N=27) and therefore reduced power. This limits the validity of the conclusions that we can draw and future studies should ensure they have sufficient power to detect effects of theoretical and / or clinical significance. The current study only examined the relationship between social cognition and subclinical paranoia in psychosis. It did not examine whether social cognition is related to persecutory delusions or more severe paranoia in this group. Whether the low levels of paranoia reported by participants reflected their actual subjective state is somewhat unclear. It is possible that responses were biased by participants' knowledge of what might be 'institutionally-desirable'. We did not anticipate this, and therefore did not attempt to measure or control for this. If the AIHQ and GPTS are not sensitive to individual differences in this population, then future studies in this setting might consider using a symptom-focused clinical interview to supplement the assessment of paranoia. They may also benefit from testing whether duration or degree of institutionalisation is a significant moderator of any observed effects. Although number of past hospitalisations does not appear to correlate with social cognition, there is evidence from previous studies that inpatients with psychosis have greater impairments in social cognition than outpatients (Kolher et al., 2009).

Our participants were similar in profile to participants in previous studies of social cognition in forensic patients (Pinkham et al; 2016; Frommann et al., 2013; Luckhaus et al., 2013).

They had longstanding difficulties, with a mean duration of illness of almost 11 years (SD 5.88 years), were male, and were aged between 25 to 55 years old (mean age 38). Although age, but not duration of illness or gender, has been shown to be significantly associated with impairments in social cognition in psychosis (Kohler et al., 2009), whether any of these variables have an effect on the relationship between social cognition and paranoia has not been examined. Future studies might usefully examine the effect of these patient characteristics, as well as examine the potential effects of substance misuse, and type, dose and duration of psychoactive medication.

4.1.Conclusion

Impaired social cognition in schizophrenia has been linked to reduced quality of life, relapse, unemployment (Couture *et al*., 2006) and increased violence severity (Waldheter *et al*. 2005) . Although the present study did not find a relationship between social cognition and subclinical paranoia in a forensic setting, the impairments that were observed may have other consequences for rehabilitation, recovery and independent living, and there is evidence that difficulties with social relationships, hostility and aggression can be ameliorated following social and cognitive training (Combs *et al*., 2007). Future longitudinal studies may help to establish whether patients' social cognition on admission to secure hospital is predictive of social functioning or incidences of aggression during their hospital stay. Randomised controlled trials within a forensic setting are also required to establish the effects on violence and social functioning of interventions which specifically address affect recognition or theory of mind.

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Table 1. Sample Characteristics

	N (%)	Mean (SD)	Median (Range)
Demographic, illness and offending-related information.			
Age (years)	-	37.6 (11.16)	35 (24-55)
Duration since diagnosis received (years)	-	10.81 (5.88)	10 (1-24)
Substance misuse	21 (78%)	-	-
Alcohol misuse	4 (15%)	-	-
Drug misuse	6 (22%)	-	-
Alcohol and drug misuse	11 (41%)	-	-
History of violence prior to index offence	19 (70%)	-	-
Index offence (IO) of culpable homicide	13 (48%)	-	-
IO of attempted murder	4 (15%)	-	-
IO of sexual assault	3 (11%)	-	-
IO of assault	3 (11%)	-	-
IO other violent offence	4 (15%)	-	-
Overall social cognition and paranoia scores			
TASIT Part 1 – Emotion Recognition	-	20.26 (4.53)	21 (17)
TASIT Part 2 – Social Inference (minimal)	-	42.30 (10.60)	42.30 (32)
TASIT Part 3 – Social inference (enriched)	-	44.19 (8.15)	44.00 (31)
AIHQ Hostility Ambiguous	-	1.66 (0.70)	1.60 (3.60)
AIHQ Blame Ambiguous	-	2.12 (0.90)	2.02 (3.70)
GPTS paranoia subscale	-	26.11 (14.02)	18 (47)

Table 2. Correlation matrix for all variables included in the analyses.

	AIHQ Hostility ambiguous	AIHQ Blame Ambiguous	GPTS Paranoid thoughts scale	TASIT Emotion recognition	TASIT 2
AIHQ Blame ambiguous	.534**	-	-	-	-
GPTS Paranoid thoughts scale (non-parametric)	.127	.178	-	-	-
TASIT Emotion recognition	.066	-.104	-.138	-	-
TASIT part 2	-.345	-.314	-.037	.153	-
TASIT part 3 (non-parametric)	.101	-.101	-.011	.193	.616**

*. Correlation is significant at the 0.05 level **. Correlation is significant at the 0.01 level
For non-parametric variables Spearman's correlations are shown, for all other variables Pearson's correlations are shown.

Table 3. Mean scores and effect sizes for comparisons of lower (<31) and higher scoring (>31) groups on GTPS.

	GPTS Paranoid thought scale				
	Non-paranoid (score <31) n=18		Subclinical paranoia (score >31) n=9		
	Mean (SD)	Median (range)	Mean (SD)	Median (range)	Effect size, *d* (95% CI)
Emotion Recognition	20.28 (5.05)	20 (10-27)	20.22 (3.53)	21 (12-24)	0.01 (-0.79, 0.81)
TASIT 2	43.05 (11.88)	43.5 (27-59)	40.81 (7.86)	42.3 (32-52)	0.21 (-0.59, 1.01)
TASIT 3	44.39 (7.37)	46 (33-54)	43.80 (10)	43 (27-58)	0.07 (-0.73, 0.87)

Table 4. Logistic model of predictors of paranoid thoughts as measured by a score of 31+ on GTPS, with 95% bias corrected and accelerated confidence intervals. Confidence intervals and standard errors based on 1000 bootstrap samples.

	Beta (β)	95% C.I. Beta	Std. Error	Sig.	Odds Ratio	95% C.I for odds ratio
Emotion Recognition	.000	-.334 to .299	.096	.998	1.000	.828 to 1.209
TASIT 2	-.028	-.276 to .089	.052	.585	.972	.879 to 1.076
TASIT 3	.014	-.212 to .308	.068	.869	1.014	.887 to 1.159
Constant	-.144		2.662	.957		

R^2= χ^2= 8.64, *p*.280. (Hosmer & Lemeshow) .012 (Cox & Snell) .017 (Nagelkerke)

Table 5. Mean scores and effect sizes for comparisons of lower (<31) and higher scoring (31+) groups on GTPS and/or 3+ on hostile attribution bias and/or 3+ on blaming bias.

	GTPS Paranoid thought scale, AIHQ hostile & blaming biases				
	Non-paranoid (Group 0; n=15)		Subclinical paranoia (Group 1; n=12)		
	Mean (SD)	Median (range)	Mean (SD)	Median (range)	Effect size, *d* (95% CI)
Emotion Recognition	20.73 (4.76)	20 (11-27)	19.67 (4.36)	21 (10-24)	0.23 (-0.53, 0.99)
TASIT 2	45.40 (11.65)	51 (27-59)	38.44 (7.98)	34.5 (30-52)	0.68 (-0.10, 1.46)
TASIT 3	44.93 (7.95)	50 (33-54)	43.27 (8.65)	42.5 (27-58)	0.20 (-0.56, 0.96)

Table 6. Logistic model of predictors of paranoid thoughts as measured by a score of 31+ on GTPS and/or 3+ on hostile attribution bias and/or 3+ on blaming bias, with 95% bias corrected and accelerated confidence intervals. Confidence intervals and standard errors based on 1000 bootstrap samples.

	Beta (β)	95% C.I. Beta	Std. Error	Sig.	Odds Ratio	95% C.I for odds ratio
Emotion Recognition	-0.64	-.911 to .308	2.837	.538	.938	.766 to 1.149
TASIT 2	-.103	-1.176 to .019	3.762	.084	.902	.803 to 1.014
TASIT 3	.068	-.144 to 1.035	4.752	.355	1.071	.926 to 1.238
Constant	2.363		90.779	.388	10.622	

R^2= χ^2= 6.28, *p*.508. (Hosmer & Lemeshow) .128 (Cox & Snell) .171 (Nagelkerke)

Table 7. Linear model of predictors of hostile bias, with 95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples.

	B	SE B	B	*p*
Step 1				
Constant	1.548 (.817 to 2.273)	.363		*p*= .003
Emotion recognition	.006 (-.027 to .042)	.018	.038	*p*= .760
Step 2				
Constant	1.674 (.554 to 2.899)	.589		*p*= .035
Emotion recognition	.001 (-.047 to -.054)	.024	.007	*p*= .956
TASIT part 2	-.039 (.100 to .012)	.024	-.586	*p*=.129
TASIT part 3	.037 (-.005 to .105)	.026	.424	*p*=.158

Note. R^2 = .001 for step 1; ^R^2 = .201 (*p*=.076)

Table 8. Linear model of predictors of blaming bias, with 95% bias corrected and accelerated confidence intervals reported in parentheses. Confidence intervals and standard errors based on 1000 bootstrap samples.

	B	SE B	B	*p*
Step 1				
Constant	2.534 (.957 to 3.883)	.763		*p*= .002
Emotion Recognition	-.021 (-.085 to .057)	.036	-.104	*p*= .582
Step 2				
Constant	3.116 (1.313 to 4.999)	.910		*p*= .006
Emotion Recognition	-.018 (-.081 to .094)	.044	-.090	*p*= .637
TASIT part 2	-.035 (-.103 to .008)	.030	-.411	*p*= .292
TASIT part 3	.019 (-.041 to .108)	.039	.019	*p*= .647

Note. R^2 = .011 for step 1; ^R^2 = .107 (*p*=.268)

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Contributors

HB designed the study, carried out it out, analysed and interpreted the results, and prepared drafts of the final manuscript. SOR and LT contributed to the design of the study and supervised the procedures and SOR, LT and PH contributed to the analysis and interpretation of the results and prepared drafts of the final manuscript.

Conflict of interest

The authors report no conflicts of interest.

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