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Large social cognitive impairments characterize homicide offenders with schizophrenia

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ABSTRACT

Schizophrenia is associated with an increased violence risk, particularly homicide. One possible, but scarcely explored, contributor to the increased violence risk is social cognitive impairment. Individuals with schizophrenia show impairments in social cognition that are associated with poor functional outcome. This study examined social cognition among homicide offenders with schizophrenia (HOS), applying validated measures of emotion perception and theory of mind (ToM). Two groups of individuals with schizophrenia were compared, one had committed homicide (HOS, $n = 26$), and the other had no violence history (non-HOS, $n = 28$). Healthy controls (HC, $n = 71$) were included as reference group for one measure. Emotion perception was indexed by the Emotion in Biological Motion (Emotion) and Pictures of Facial Affect (PFA) tests. ToM was assessed with the Hinting Task and Movie for the Assessment of Social Cognition (MASC). The results showed that HOS participants had significantly poorer performance than non-HOS in both emotion perception and ToM. For the MASC test, HOS participants showed large deficits compared to HC (-4 standard deviations). Particularly, HOS participants made a substantial number of undermentalizing errors. The results suggest that emotion perception deficits and a tendency to undermentalize may be important for understanding homicide in schizophrenia.

1. Introduction

Although the majority are not dangerous, some individuals with schizophrenia commit homicide. Schizophrenia is in fact associated with an increased risk of committing violent acts, particularly homicide (Fazel et al., 2009). Attempts to characterize the individuals who commit homicide have been numerous, but the question of why schizophrenia is associated with an elevated homicide risk is still not fully answered (Rund, 2018). Drug abuse, hostile behaviour, non-adherence to treatment and a history of criminal behaviour are factors that have consistently been associated with increased violence risk in psychosis (Witt et al., 2013), but explains only some of the variance. Another possible explanation is that schizophrenia is a social brain disorder (Burns, 2006). Social cognitive deficits are a characteristic of schizophrenia (Green, 2016) and the diagnostic criteria include difficulties in social relations. These features are linked, in that impaired social cognition predicts poor functional outcome (Fett et al., 2011). A relevant hypothesis based on this is that the increased risk of committing homicide may be explained by a reduced ability to understand and relate to others, or that violence risk is associated with larger social cognitive deficits in violent compared to non-violent individuals with schizophrenia. It has recently been suggested that "[*p*]athological aggression can be conceptualized as a disorder of the social brain" (Abu-Akel and Bo, 2018, p. 545). The social brain comprises brain areas that are implied in the ability to navigate socially, including the amygdala and fusiform face area for face perception and temporoparietal junction, temporal pole, precuneus and medial prefrontal cortex for mentalizing (Green et al., 2015). Additionally, recent contributions to explaining violence in schizophrenia have highlighted how cognitive and neurobiological factors may explain why some individuals commit violence (Abu-Akel and Bo, 2018; Sedgwick et al., 2017; Soyka, 2011; Stratton et al., 2018). Social cognition can be considered the behavioural output of the social brain, and there are findings that suggest an incremental validity of social cognition in violence prediction (O' Reilly et al., 2015;

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Waldheter et al., 2005). However, very few studies have investigated social cognition among homicide offenders with schizophrenia (HOS), and only combined with individuals who have committed non-lethal violence.

Social cognition refers to the processing of social information (Green et al., 2015; Penn et al., 1997). Two core domains of social cognition are emotion processing and theory of mind (ToM) (Pinkham, 2014). Emotion processing includes both basic processes such as emotion perception, and more complex processes such as emotion regulation. ToM or mentalizing refers to the ability to make inferences about oneself and others' mental states (Premack and Woodruff, 1978). Both emotion perception and ToM difficulties can lead to faulty social inferences. Incorrectly interpreting the other's emotional expression as anger, failing to perceive a fearful expression, or wrongly attributing hostile intention, could lead to a misplaced violent response to the perceived threat.

Studies of the associations between facial emotion perception and violence/aggression in schizophrenia have yielded mixed results. Men with a violence history were better at identification of emotions, but were outperformed by non-violent participants when it came to determining the intensity of the emotional expressions (Silver et al., 2005). Another study failed to find significant differences between violent and non-violent schizophrenia participants in facial emotion perception (Demirbuga et al., 2013).

Some studies have focused on specific emotions, particularly negative emotions, and violence. Forensic patients outperformed non-forensic patients in recognition of disgust in one study (Wolfkühler et al., 2012), while another found that criminal behaviour or violence was associated with poorer recognition of fear and anger (Weiss et al., 2006). A correlation between misidentification of emotion and irritability was found by Bilgi et al. (2017). More precisely, sad, surprised or angry faces were interpreted as showing fear.

ToM has previously been examined in forensic patients with schizophrenia in association with violence, aggression and the presence of psychopathic traits. ToM deficits have been associated with violence in schizophrenia (Arborelius et al., 2013; Murphy, 1998, 2006), although one study found better ToM among forensic compared to non-forensic participants with schizophrenia (Majorek et al., 2009). Further, there is a distinction between cognitive and affective ToM, i.e. the ability to infer other people's thoughts or emotions, respectively (Brothers and Ring, 1992; Shamay-Tsoory et al., 2007). Applying this distinction, Abu-Akel and Abushua'leh (2004) found that violent participants with schizophrenia had greater difficulties than non-violent participants on an affective ToM task, but outperformed non-violent participants on cognitive ToM tasks.

Psychopathy and antisocial personality disorder (APD) have consistently been associated with increased violence risk. A selective impairment of affective ToM has been found in forensic patients (non-schizophrenia) with psychopathic traits (Shamay-Tsoory et al., 2010). In another study comparing male offenders with and without APD, an ecologically valid measure of ToM (Movie for the Assessment of Social Cognition; MASC (Dziobek et al., 2006)) was applied. The results showed that offenders with APD performed significantly poorer than the healthy control group, but better than offenders without APD (Newbury-Helps et al., 2017). Offenders with APD also showed larger impairments for affective compared to cognitive ToM.

ToM difficulties can be caused by overmentalizing or undermentalizing (or hyper- and hypomentalizing). Overmentalizing refers to a cognitive style characterized by exaggerated interpretations of others' mind, e.g. to attribute intention when there is none. Undermentalizing, on the other hand, refers to a cognitive style where the mental state of others is not fully understood, or misunderstood. Undermentalizing also applies to instances where no assumptions of the other's mental state are made.

The lack of a uniformed conceptualization of violence could be one explanation for the variability in results that has been found in previous studies (Sedgwick et al., 2017). This is the first study to investigate social cognition in a group of individuals with schizophrenia consisting solely of homicide offenders (HOS group), using a battery of well-validated social cognitive tests. HOS are compared to a group of participants with schizophrenia without a history of violence (non-HOS) and healthy controls (HC). Emotion perception is assessed with tasks conveying emotions through both faces and bodies. In the ToM domain, mentalizing style as well as cognitive and affective ToM, are assessed. We hypothesize that HOS participants will show larger social cognitive impairments than non-HOS, in both the emotion perception and ToM domains.

2. Methods

2.1. Participants

The HOS study is a cross-sectional comparative study. It was conducted at Vestre Viken Hospital Trust in Norway, in collaboration with a number of in- and outpatient units across the country.

Participants were two groups of individuals with a diagnosis of schizophrenia or schizoaffective disorder, and one group of healthy controls (Table 1). The HOS group ($n = 26$) was sentenced to compulsory mental care for homicide or homicide attempt. The non-HOS group ($n = 28$) had no history of interpersonal violence. Recruitment procedures were similar for HOS and non-HOS participants: Diagnostic evaluations were made by clinicians at collaborating units prior to inclusion in the current study and were based on the ICD-10 (World Health Organization, 2004). Participants were excluded if they had insufficient knowledge of the Norwegian language, i.e. were unable to undergo clinical interviews and cognitive assessment in Norwegian. A qualitative evaluation of Norwegian language skills was undertaken before the participant signed informed consent. One HOS, eligible for participation, was excluded due to insufficient comprehension of Norwegian.

At time of inclusion, all participants received antipsychotic medication (Table 1). Medication Defined Daily Dose (DDD) was calculated for each participant according to World Health Organization (WHO) guidelines (WHO Collaborating Centre for Drug Statistics Methodology, 2017). Information on participants' background, including illness history and violence history (presence/absence depending on group), was available from medical records and participants' treating clinicians.

Participants were initially informed of the study by their treating clinician, who also presented the possibility of receiving further information by the first author. All participants gave written informed consent prior to assessments. The study was approved by the Regional Committee for Medical and Health Research Ethics (REC South East 2015/713).

The healthy control group (HC) consisted of 71 individuals who participated in the TOP study at the NORMENT K.G. Jebsen Centre for Psychosis Research at Oslo University Hospital, Norway (Vaskinn et al., 2018). Individuals randomly selected from national statistical records of Oslo and neighbouring counties were invited to participate by letter. HC were screened for symptoms of severe mental illness using the Primary Care Evaluation of Mental disorders (PRIME- MD) (Spitzer et al., 1994). Additional exclusion criteria were severe somatic disorders, head trauma, drug abuse or IQ scores under 70 as indicated by the Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 2007).

2.2. Measures

Symptoms were assessed with the Positive and Negative Syndrome Scale (PANSS) (Table 1) (Kay et al., 1987). Symptom scores are based on a validated five-factor PANSS model which includes positive, negative, disorganized, excited and depressed symptoms (Langeveld et al.,

Table 1
Demography and clinical data, results of *t*-tests (two groups) and ANOVAs (three groups).

	HOS, $n = 26$	Non-HOS, $n = 28$	HC, $n = 71$	Tukey
Age**	38.2 (7.3)	36.7 (10.1)	29.3 (7.7)	HOS, non-HOS > HC
Sex, male**	25 (96%)	25 (89%)	42 (59%)	HOS, non-HOS > HC
Education, years**	9.6 (2.2)	11.1 (1.6)	14.2 (2.1)	HOS < non-HOS < HC
IQ**, [a]	87.0 (16.7)	98.0 (15.8)	110.7 (10.8)	HOS < non-HOS < HC
Illness duration, years	15.7 (6.7)	13.7 (10.1)[b]	–	
Diagnosis	23 schizophrenia 3 schizoaffective	25 schizophrenia 1 schizoaffective	–	
Medication, DDD*, [c]	1.84 (0.80)	1.36 (0.64)	–	
Time since offense, years	6.5	–	–	
Norwegian native language*	15 (57.7%)	24 (85.7%)	–	
Inpatients**	16 (61.5%)	3 (10.7%)	–	
PANSS positive (min-max 4–28)	7.2 (4.1)	7.5 (4.7)	–	
PANSS negative (min-max 6–42)	10.2 (5.2)	8.1 (2.8)	–	
PANSS disorganized (min-max 3–21)	5.7 (2.0)	4.8 (1.7)	–	
PANSS excited (min-max 4–28)**	5.1 (1.5)	4.2 (0.5)	–	
PANSS depressed (min-max 3–21)	6.3 (3.6)	7.0 (2.8)	–	

* $p < 0.05$.
** $p < 0.01$.
[a] Based on vocabulary and matrix reasoning from Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 2007).
[b] $N = 27$
[c] DDD = Defined Daily Dose (WHO Collaborating Centre for Drug Statistics Methodology, 2017).

2013; Wallwork et al., 2012).

Emotion perception was indexed by two measures: Emotion in Biological Motion (EmoBio) (Heberlein et al., 2004) assesses emotion perception through body language. It is based on the point-light displays (PLD) technique, or point-light walkers, where a person is filmed in a dark room with lights connected to major joints of the body. Only the outline of the person can be seen. Participants were shown 22 short movie clips on a computer screen, each with a point-light walker presenting happy, fearful, angry, sad or neutral emotion. The participant is asked to tick the box belonging to the chosen answer on a response sheet. We used the proportional scoring method described in previous studies, where full credit is given to correct answers and partial credit to partially correct answers (Couture et al., 2010; Vaskinn et al., 2016). An average score for all emotions (22 movie clips) was used in the analyses, as well as scores for each specific emotion.

The Pictures of Facial Affect (PFA) test (Frommann et al., 2003) consists of 28 pictures of faces, each conveying an emotion: Happiness, sadness, surprise, anger, disgust and neutral emotion. The test taker is asked to choose which emotion describes the facial expression. Each picture is scored as correct/incorrect, giving a maximum total score of 28 points (100%). Separate scores for each emotion can also be calculated.

ToM was also measured with two tests: Hinting Task consists of 10 short stories that are read out loud by the test administrator (Corcoran et al., 1995). Each story presents a conversation between two characters where one makes a hinting statement. The test-taker is asked to explain the underlying intention/message in the character's statement. If the test-taker is unable to explain this intention, more information is provided, and the test-taker gets a second chance to explain. Two points are awarded for an accurate response at the first attempt; one point for a correct response at the second attempt. Zero points are given if the test taker cannot explain the hint or has an inadequate explanation. Maximum score on the Hinting Task is 20 points.

Movie for the Assessment of Social Cognition (MASC) is an ecologically valid measure of ToM (Dziobek et al., 2006). A 15-minute video is played, showing four characters meeting for dinner on a Saturday night. The video is paused several times. For each pause, the test taker is asked to answer a question about either thoughts, intentions or beliefs of a character. The questions are in a multiple choice response format. Each of the four response options corresponds to a mentalizing style: Correct ToM (MASCtom), undermentalizing (MASCless), overmentalizing (MASCexc) and no ToM (MASCno), the latter specifying instances when no assumptions about the other's mental state have been made. This scoring method therefore allows for more detailed information than traditional correct/incorrect response formats. The test administrator registers the test taker's answers on a response sheet. Scores for cognitive (MASCcog) and affective (MASCaff) ToM can be calculated. The assignment of items to either the affective or the cognitive scale has previously been inconsistent, but we have applied the categorization recently described by Vaskinn et al., (2018). In the current study we present total score, error types and cognitive/affective ToM scores.

2.3. Statistics

All statistical analyses were conducted using The Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, version 25) (IBM Corp,2016).

We applied a series of univariate analyses of variance (ANOVAs) to examine group differences. First, the overall scores of the four social cognitive tests were entered as dependent variables, and group was entered as independent variable. If the overall analysis yielded a statistically significant result, the same analysis was repeated with subscores of that specific test as dependent variables. HOS and non-HOS participants were compared on all research variables. Additionally, for the MASC test, the two schizophrenia groups were also compared to HC. Comparisons of three groups that yielded statistically significant results were followed by post-hoc tests (Tukey's HSD) to determine which groups differed from the others.

Alpha level was set at 0.05. Cohen's d provides the effect size for the difference between HOS and non-HOS participants. For the analyses conducted on three groups we also report an additional effect size measure, partial eta squared, which describes the overall strength of group differences between three groups. We decided not to correct for multiple comparisons because of the small sample size in the HOS and non-HOS groups and the risk of committing type II errors.

3. Results

The results of a series of univariate ANOVAs are shown in Table 2. We detected a significant effect of group on overall EmoBio performance, with non-HOS participants performing better than the HOS group. Follow-up comparisons of specific emotions did not yield significant results.

Table 2
Social cognition across groups and tests. Mean scores and standard deviations. Results of ANOVAs.

Variable (range)	HOS $n = 26$	Non-HOS $n = 28$	HC $n = 71$	Statistic	Partial eta squared[a]	Cohen's d[b]
EmoBio total (0–1)	0.65 (0.15)	0.74 (0.15)	–	$F_{(1, 49)} = 4.27$ $p = 0.04$	–	0.60
Happiness (0–1)	0.72 (0.24)	0.82 (0.19)	–	$F_{(1, 52)} = 2.88$ $p = 0.10$	–	0.46
Sadness (0–1)	0.70 (0.25)	0.75 (0.23)	–	$F_{(1, 52)} = 0.57$ $p = 0.46$	–	0.21
Fear (0–1)	0.48 (0.32)	0.61 (0.29)	–	$F_{(1, 50)} = 2.26$ $p = 0.14$	–	0.43
Anger (0–1)	0.61 (0.19)	0.66 (0.18)	–	$F_{(1, 50)} = 0.95$ $p = 0.34$	–	0.27
Neutral (0–1)	0.68 (0.29)	0.79 (0.20)	–	$F_{(1, 52)} = 2.53$ $p = 0.12$	–	0.44
PFA total (0–100%)	66.54 (13.49)	70.25 (14.55)	–	$F_{(1, 52)} = 0.94$ $p = 0.34$	–	0.26
Hinting task total (0–20)	14.69 (3.66)	16.04 (2.29)	–	$F_{(1, 52)} = 2.66$ $p = 0.11$	–	0.44
MASCtom correct (0–45)	20.58 (8.79)	27.64 (7.63)	35.14 (4.05)	$F_{(2, 122)} = 56.60$ $p < 0.01$	0.48	0.86
MASCexc errors (0–45)	5.85 (3.02)	5.86 (2.56)	4.39 (2.81)	$F_{(2, 122)} = 4.15$ $p = 0.02$	0.06	0.00
MASCless errors (0–45)	11.85 (5.47)	7.21 (4.22)	3.85 (1.99)	$F_{(2, 122)} = 50.69$ $p < 0.01$	0.45	0.96
MASCno errors (0–45)	6.15 (3.97)	5.36 (6.30)	1.59 (1.40)	$F_{(2, 122)} = 20.42$ $p < 0.01$	0.25	0.15
MASCaff correct (0–18)	8.08 (3.33)	10.79 (3.19)	13.55 (1.93)	$F_{(2, 122)} = 45.44$ $p < 0.01$	0.43	0.83
MASCcog correct (0–26)	12.42 (5.86)	16.64 (4.96)	21.28 (2.68)	$F_{(2, 122)} = 48.29$ $p < 0.01$	0.44	0.78

[a] Effect size for three groups.
[b] Effect size for two groups: HOS vs. non-HOS.

HOS and non-HOS did not show statistically significant differences in performance on the PFA or the Hinting Task.

HOS, non-HOS and HC performed significantly different on the MASC test as indicated by MASCtot. HC outperformed non-HOS and HOS, and non-HOS outperformed HOS. Both group comparisons were statistically significant. The same pattern of results was found for MASCless, MASCaff and MASCcog. For MASCexc, the overall analysis of three groups was statistically significant, but specific group comparisons did not reach statistical significance. However, the difference between HC and non-HOS ($p = 0.054$) and between HC and HOS ($p = 0.065$) approached significance, with HC performing better than the clinical groups. Further, the overall analysis of three groups was also statistically significant for MASCno. Here, the difference was driven by HC significantly outperforming both clinical groups, but HOS and non-HOS participants did not perform significantly different from each other.

Because there were significant group differences in IQ, and the fact that social and non-social cognition to some degree overlap (Green et al., 2015), we conducted follow-up ANCOVAs entering IQ as a covariate in significant social cognitive comparisons. The results showed that the groups no longer differed significantly on EmoBio total score when IQ was entered as a covariate, $F(1, 48) = 1.50$, $p = 0.23$, partial $\eta^2 = 0.03$.

For the MASC test, however, the groups remained significantly different even after controlling for IQ. This was the case for the total score ($F(2, 121) = 18.18$, $p < 0.01$, partial $\eta^2 = 0.23$) as well as the subscales (MASCno: $F(2, 121) = 5.84$, $p < 0.01$, partial $\eta^2 = 0.09$; MASCless: $F(2, 121) = 18.14$, $p < 0.01$, partial $\eta^2 = 0.23$; MASCaff: $F(2, 121) = 15.47$, $p < 0.01$, partial $\eta^2 = 0.20$; MASCcog ($F(2, 121) = 13.50$, $p < 0.01$, partial $\eta^2 = 0.18$). The only exception was for MASCexc ($F(2, 121) = 0.90$, $p = 0.41$, partial $\eta^2 = 0.02$) where the significant group difference disappeared.

4. Discussion

We found that non-HOS participants performed significantly better than HOS on the overall ability to read emotional expressions from body language, as indexed by the EmoBio test. This difference yielded a medium effect size. There were no significant differences between the groups on individual emotions, unlike previous studies that have indicated an association between violence and impaired perception of negative emotions in schizophrenia (Bilgi et al., 2017; Weiss et al., 2006). A global deficit, i.e. generalized across emotion, in emotion processing is however in line with previous studies that have investigated emotion processing from body language in (non-violent) schizophrenia, indicating that it is not unique for the HOS group. This supports the finding of a general or global emotion perception deficit in HOS, not limited to specific emotions. The group difference was no longer significant after controlling for IQ. We have previously found that lower IQ is associated with homicide in schizophrenia (Engelstad et al., 2018). However, when comparing the EmoBio total scores of our two schizophrenia groups with Norwegian normative data, the performance falls 2.75 (HOS) and 1.63 (non-HOS) standard deviations (SD) below healthy controls (Vaskinn et al., 2016). Regardless of whether group differences are significant or not after controlling for IQ, this indicates substantial impairments among HOS in the ability to recognize emotions from body movement.

Emotional expressions are important social cues, and misinterpretation of emotions could lead to less socially adaptive behaviour such as criminality (Weiss et al., 2006), and potentially also violence. Possibly, poor understanding of social situations because of difficulties with emotion perception could lead to wrongful inferences of other people's intentions (Sedgwick et al., 2017). Further, a consequence of difficulties with emotion perception could involve problems with detection of stress cues in others, and consequentially remove the inhibition response which distress cues normally evoke (Blair et al., 1997). A mechanism involving lack of inhibition in response to stress cues in other people could potentially increase the

chance of a violent offense.

On our emotion perception measure based on facial expressions, we did not detect significant differences between HOS and non-HOS participants. Because the groups did not perform significantly different on the overall test score, follow-up analyses on specific emotions were not undertaken. A contributor to the discrepancy in findings between body language and facial processing of emotion could be the use of different measurement techniques. Processing of PLDs such as the EmoBio task does probably to some extent tap different neural circuits than processing of emotional information from faces. The superior temporal sulcus (STS) has been found to be selectively involved in processing of moving faces and bodies, including PLDs of biological motion (Puce and Perrett, 2003), while the lateral fusiform gyrus (LFG) is particularly connected to processing of faces (Kanwisher et al., 1997).

It is worth noting that although we did not detect statistically significant differences between HOS and non-HOS participants for the PFA test, both schizophrenia groups performed below what would be expected from HC. Previous results have shown that HC have an accuracy of 83% on the PFA (Wolwer et al., 2012), a better performance than the schizophrenia participants in this study. However, the PFA fails to detect, at least in our sample, potentially larger emotion perception deficits associated with violence.

On our first measure of ToM, the Hinting Task, no statistically significant differences between HOS and non-HOS participants were detected. Non-HOS participants did however perform better than HOS participants. The Hinting Task only allows for correct/incorrect answers, not for inferences regarding mentalizing style. This is, however, a possibility in our second ToM measure.

HOS participants performed significantly weaker than both HC and non-HOS participants on the MASC test. HOS participants showed overall ToM deficits as indicated by the MASC total score, and these deficits were larger than for the non-HOS group. The group difference was mainly driven by a larger number of undermentalizing errors in the HOS group. However, the effect sizes for the difference between HOS and non-HOS were large for total correct ToM, cognitive ToM and affective ToM, in addition to the undermentalizing scale. HOS and non-HOS committed approximately the same number of overmentalizing and no ToM errors, yielding a small effect size for the no ToM domain.

HOS participants showed large undermentalizing impairments, performing 4.5 standard deviations below HC. This was a larger deficit than for the non-HOS group. Visual inspection of the graphs in Fig. 1 gives the impression that HOS participants show disproportionately large impairments in the undermentalizing domain compared to non-HOS participants. It has been discussed whether individuals with schizophrenia do have a concept of others' mind, but fail to apply this information successfully, or if they completely lack a concept of other people's mind ("mind-blindness") (Langdon et al., 2006; Montag et al., 2011). Undermentalizing, as indexed by the MASCless variable, indicates the former; HOS participants seem to have a concept of other people's mind, but have difficulties applying the information correctly. One speculation is that the large impairments in the HOS group could lead to misunderstandings in social interactions. An inability to grasp the emotions or intentions of others could, under given circumstances, increase the risk for violent behaviour. For example, if the intention of others is erroneously interpreted as hostile or threatening, it could lead to a violent reaction (Abu-Akel and Bo, 2018). The notion that ToM is a prerequisite for the ability to empathize (Shamay-Tsoory et al., 2010) lends further support to the involvement of ToM deficits in increased violence risk.

The HOS group performed significantly poorer than the non-HOS group on both cognitive and affective ToM, with large effect sizes. This finding contrasts previous studies that have differentiated between affective and cognitive ToM and found that violence was specifically associated with reduced affective ToM (Bo et al., 2014; Shamay-Tsoory et al., 2010). However, only one of these studies (Bo et al., 2014) included participants with schizophrenia and focused specifically on psychopathic traits. Comparisons of participants with schizophrenia and healthy controls, without a specific focus on psychopathy, have on the other hand indicated that participants with schizophrenia perform weaker than healthy controls on both affective and cognitive ToM (Montag et al., 2011), which is confirmed by the current study.

We have previously shown that HOS performed at about 1.5–2 standard deviations below HC on non-social cognitive functioning (Engelstad et al., 2018), which is a smaller deficit than what is detected in this study. Even though HOS and non-HOS no longer perform significantly different on the EmoBio after controlling for IQ, indicating that IQ partly explains social cognitive performance, we do not believe that the current results are better explained by a generally compromised cognitive functioning. The fact that the groups remained significantly different on all MASC subscales except MASCexc supports an incremental value of social cognition in violence risk in schizophrenia.

Bo et al., (2014) point out that because only a minority of patients

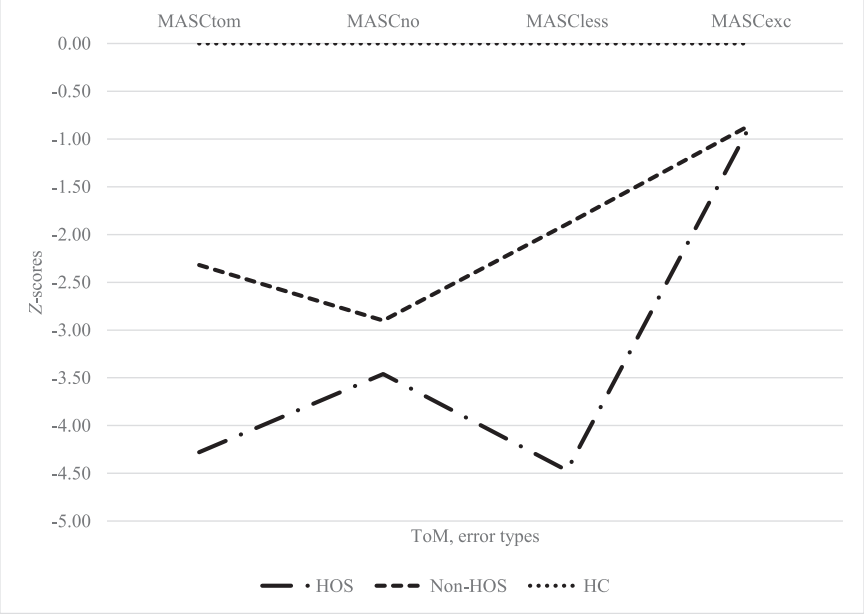

Fig. 1. ToM performance across groups and error types, converted to *z*-scores.

with schizophrenia commit violence, the diagnosis by itself is of little significance when evaluating violence risk in the clinic. We agree, and we think a further differentiation of the schizophrenia population based on social cognitive performance, could be of more value. Current violence risk assessment tools have limited predictive validity in the assessment of individuals with schizophrenia (Singh et al., 2011). We believe that the current results point to specific aspects of social cognition that should be taken into consideration in future violence risk assessments. Potentially these findings could also be relevant for the development of social cognitive training programs aimed at individuals with schizophrenia who have committed violence.

Strengths of the current study include the inclusion of two clearly defined groups of participants with schizophrenia when it comes to violence history, in addition to HC. The use of validated measures of emotion perception and ToM is another strength.

A limitation to the study is that most participants in both the HOS and non-HOS groups were male, while the HC group consisted of approximately equal numbers of men and women. We cannot rule out that this has influenced our results, but we do not find it likely. For emotion perception from body language there are findings that indicate equal performance across gender (Vaskinn et al., 2016). For the ToM domain, and the MASC test applied in the current study, previous results have indicated that men and women do not perform significantly different (Fretland et al., 2015).

As seen in Table 1, significantly more HOS than non-HOS participants did not speak Norwegian as their first language, which may have had impact on the results. However, when repeating the same analyses on only native speaking participants, the results remained mainly the same. Only the MASCno scale was no longer significant ($p = 0.95$). Thus we believe that the results do not merely reflect differences in native language. However, we do acknowledge that the MASC represents a “middle-class” dinner party, displaying only Caucasian actors, which may not reflect the sociodemographic diversity of our participants (Newbury-Helps et al., 2017).

HOS-participants received higher doses of medication, were more frequently inpatients and showed higher levels of excitement/hostility symptoms. These characteristics may have affected our results. We have however chosen to not include these variables in the analyses, because they may be important features of the HOS group. It is likely that the higher medication dose among HOS reflects stricter treatment conditions for these patients.

To summarize, we compared HOS to non-HOS on social cognitive functioning. HOS participants showed reduced social cognitive functioning compared to non-HOS in both emotion perception from body language and ToM. Having committed severe interpersonal violence was particularly associated with a high number of undermentalizing errors on an ecologically valid measure of ToM.

These results indicate possible targets for violence risk assessment and rehabilitation of individuals with schizophrenia. The findings also underscore the importance and advantage of applying sensitive measures in the assessment of social cognition.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2018.12.087.

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