Psychiatry Research 265 (2018) 93–99

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Social-cognitive risk factors for violence in psychosis: A discriminant function analysis

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A B S T R A C T

It has been proposed that mixed findings in studies investigating social cognition as a risk factor for violence in psychosis may be explained by utilizing a framework distinguishing between social-cognitive tests which measure relatively more basic operations (e.g. facial affect recognition) and measures of more complex operations (mentalizing, metacognition). The current study investigated which social cognitive and metacognitive processes are related to a violent history over and above illness-related deficits. Data from control participants (n = 33), patients with a psychotic disorder and no violent history (n = 27), and patients with a psychotic disorder in a forensic clinic (n = 23) were analyzed utilizing discriminant analysis. Metacognition and associative learning emerged as significant factors in predicting group membership between the three groups. In a follow-up analysis between only the patient groups, metacognitive Self-Reflectivity and Empathic Accuracy emerged as statistically significant predictors of group membership. The control group presented with higher levels of social cognitive and metacognitive capacity than patient groups, and the forensic patient group had lower levels than the non-forensic patient group. Our findings support previous research findings implying impaired metacognitive Self-Reflectivity in particular as a risk factor for violence.

1. Introduction

There is considerable debate whether psychotic disorders are a risk factor for violent behavior, and if so, which specific processes contribute to this risk. Based on meta-analyses, there is a “small, but significant relationship between psychosis and aggressive behavior” (Douglas et al., 2009; van Dongen et al., 2016; Volavka, 2013). The relationship between psychosis and violence may be mediated by impaired ‘social cognition’ (Green et al., 2008), which broadly refers to mental operations underlying social interactions (National Institute of Mental Health (NIMH), 2017). Literature reviews on risk of violence in patients with a psychotic disorder indicate social cognition as a fruitful avenue for further exploration, but a paucity of (large) studies and mixed evidence preclude firm conclusions (Bo et al., 2011; Bragado-Jimenez and Taylor, 2012; Malone et al., 2012). It is possible that these mixed findings may be in part due to different measurement instruments for social cognition.

To avoid confusion, we therefore first specify that in this paper, the term ‘social cognition’ refers to scores on instruments such as those recommended by the NIMH Research Domain Criteria (RDoC) Matrix (National Institute of Mental Health (NIMH), 2017). In these tasks, participants are *prompted* to perform socio-cognitive activities such as self-report questionnaires (e.g. the Interpersonal Reactivity Index; Davis, 1983), short tests of understanding social ‘hints’ in stories (Hinting Task; Corcoran et al., 1995) or emotion recognition (e.g. Reading the Mind in the Eyes; Baron-Cohen et al., 2001).

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https://doi.org/10.1016/j.psychres.2018.04.048
Received 7 November 2017; Received in revised form 13 April 2018; Accepted 13 April 2018
Available online 14 April 2018

Measured in this way, patients with psychotic disorders display marked deficiencies in performance on emotion recognition tasks, 'false-belief tasks', tasks measuring an understanding of social 'hints', and measurements of self-reported empathy (Bora et al., 2009; Kohler et al., 2010; Montag et al., 2007; Vohs et al., 2014; Weijers et al., 2016). While these impairments are more pronounced in persons with acute psychosis, and state should be considered an important moderator, they remain present in patients in remission (Bora et al., 2009). Longitudinal assessments have demonstrated the stability of deficits in social cognition over 12 months (Horan et al., 2012), and impairments in self-reported empathy over 3 years (Haker et al., 2012). In addition, deficits in social cognition have been found present in persons at *ultra-high risk* for psychosis, and predictive of transition to a psychotic disorder (Kim et al., 2011).

There is, however, great plurality in the conceptualizations of terms such as 'social cognition', 'theory of mind', 'metacognition' and 'mentalizing' (Brune, 2014). Some authors have used terms interchangeably (Brüne, 2005; Pinkham et al., 2014), while others caution, for instance, that 'mentalizing in schizophrenia is more than just solving theory of mind tasks' (Dimaggio et al., 2013). One possible way in which this can be clarified is by distinguishing between social cognitive abilities, which can be marked 'correct' or 'incorrect' (e.g. facial affection recognition) and higher-order, more synthetic abilities in which complex and coherent representations of the self and others are formed and reflected upon (Lysaker and Hasson-Ohayon, 2014). Different theoretical frameworks have led to a variety of terms for these higher order processes, such as mentalizing (Levinson and Fonagy, 2004) and metacognition (Lysaker et al., 2014; Semerari et al., 2003). There is currently no consensus on which theoretical framework is superior to others. For the purposes of this paper, we will use the term 'metacognition' for this more complex, higher-order process.

Though various definitions of the concept of metacognition exist (de Jong et al., 2016b; Moritz et al., 2011; Wells, 2009), the current paper utilizes a conceptualization of metacognition as the way people make sense of their own, and other people's thoughts and emotions (Lysaker et al., 2014; Semerari et al., 2003). Metacognition is seen as a range of semi-independent mental activities to 'think about thinking and feeling' along four domains: Self-Reflectivity, Understanding the Other's Mind, Decentration (the ability to abandon one's own personal perspective) and Mastery (the ability to use representations of oneself, others and the social world to address psychological distress). Metacognition, from this perspective, refers to the dynamic processes that synthesize information into complex representations, and is measured by scoring speech samples in which no social-cognitive prompts are introduced. In so doing, it is important to acknowledge that the presented Metacognition Assessment Scale–A (MAS-A) scores may be interpreted as measuring a similar phenomenon as mentalizing (Fonagy et al., 2011).

Recent studies offer evidence that deficits in social cognition and metacognition represent different forms of dysfunction (Lysaker et al., 2013) that impact social quality differently (Hasson-Ohayon et al., 2015). Metacognition has consistently been found to be impaired in persons with psychotic disorders (Bo et al., 2015; Dimaggio and Lysaker, 2015; Lysaker et al., 2008; Vohs et al., 2014; Weijers et al., 2016). Longitudinal studies have shown that these deficits remain relatively stable over at least six months, suggesting them to be a stable feature of schizophrenia (Hamm et al., 2012). Associations were found between impaired metacognition and violent behavior (Abu-akel et al., 2015), though not in all studies (Mitchell et al., 2012). In a review on violence and psychotic disorders, it was noted that research into the association between metacognition and violence is sparse and that further research on paradigms involving both cognitive and affective aspects is warranted (Bo et al., 2011).

If the distinction between the more basic processes (which we refer to as 'social cognition') and the more complex, higher-order processes (which we refer to as 'metacognition') were to hold true, it may shed light on the hitherto mixed findings surrounding the link between social cognition and violence. Previous studies utilized different instruments of measurement associated with different conceptualizations of the constructs involved, though generally using tasks of social cognition, which are scored 'correct' or 'incorrect' or self-report. Given how results on those measures are mixed, we hypothesized that higher-order capacities such as metacognition may prove to be more stable predictors of violence. As such, examining several different measures together may reveal their unique contributions to a statistical model predicting violence in psychosis. Such a finding would furthermore lend credence to the suggestion by Bo et al. (2011) that specific mentalizing profiles may be associated with violence in schizophrenia.

As such, the current study was constructed to investigate which measures of social cognition and metacognition are related to a violent history over and above the deficits commonly associated with psychotic disorders. Scores on measures of social cognition and metacognition were collected and compared from a group of persons with a psychotic disorder in care at a forensic clinic for a violent crime (forensic and psychotic: F–P), a group of persons with a psychotic disorder without a forensic history (psychotic: P) and a control group with no known diagnosis of a mental disorder (control: C).

Based on previous research (Abu-Akel and Abushua' leh, 2004; Abu-akel et al., 2015; Majorek et al., 2009), we hypothesized that both patient groups would perform worse than controls on measures of social cognition and metacognition, but that metacognition would be a better predictor of a violent history. Secondly, if differences in metacognition between F–P and P would prove significant, we were interested in which of the four specific domains of metacognition are particularly indicative of a violent history. Due to limited research and theory on the topic, this latter relationship was examined in an explorative way.

2. Methods

2.1. Participants

For this study we compared male outpatients diagnosed with a psychotic disorder without a forensic history (psychosis group, $n = 27$), male patients diagnosed with a psychotic disorder in treatment at a forensic clinic for highly violent crime (forensic psychosis group, $n = 23$), and male participants without a known history of mental disorder or violent crime (control group, $n = 33$). Inclusion criteria for the patient groups were: 1) a primary diagnosis of schizophrenia or schizoaffective disorder (DSM-IV-TR), 2) age > 18 and 3) not having had a significant change in medication in the 30 days prior to assessment. Exclusion criteria were: 1) a florid psychosis (PANSS positive avg. ≥ 4) at the time of assessment, 2) comorbid neurological disorder, 3) an inability to read / write or 4) an estimated IQ lower than 70. All three groups were similar with regard to age, mean level of education, ratio of diagnoses of schizophrenia vs. schizoaffective disorder and the median number of admissions into a mental healthcare institute.

The psychosis group was recruited from GGZ Friesland, a Dutch mental health care center, as an extension of a multicenter randomized controlled trial investigating the effects of a new metacognitive psychotherapy (Van Donkersgoed et al., 2014). For this clinical trial, inclusion criteria involved difficulties in metacognitive capacity, sixteen participants met these criteria. To ensure a representative sample, all participants from this institute who were excluded from the randomized controlled trial on these grounds were approached for participation in the current study by a research assistant, and added to the baseline assessment data pool from the randomized controlled trial, adding eleven participants for a final sample of 27.

The forensic psychosis group was recruited from forensic clinics: FPC Dr. S. van Mesdag, FPA Franeker, FPK Assen and FPA Zuidlaren. In addition, for the forensic psychosis group, inclusion was only possible if they were in forensic care for serious violence from criminal court proceedings. The control group was recruited using social media and posters spread in the Netherlands.

2.2. Instruments

2.2.1. Mini International Neuropsychiatric Interview (M.I.N.I. Plus; Sheehan et al., 1998)

This structured interview was used to confirm a diagnosis of schizophrenia or schizoaffective disorder according to the DSM-IV-TR criteria.

2.2.2. Positive And Negative Syndrome Scale (PANSS; Kay et al., 1987)

The PANSS is a 30-item interviewer-rating scale, intended to measure symptoms along three domains (positive, negative and general psychopathology). Interviews and scoring were performed by students enrolled in a master's degree program of Psychology, who had completed a 2-day PANSS training.

2.2.3. Trailmaking Test A&B (Reitan and Wolfson, 1985)

As a part of the Halstead-Reitan Battery, the TMT provides information on the neurocognitive functioning of participants. During part A of the test, the participant is asked to draw lines sequentially, connecting 25 encircled numbers on a page. During part B, the participant is asked to do the same, though this time alternating between numbers and letters (1-A-2-B etc.). The final score is the time used (seconds) of part B minus the time used (seconds) on Part A.

2.2.4. Digit symbol Test (Wechsler, 1995)

This task evaluates neurocognitive function. Participants are presented with a row of boxes, pairing numbers with a symbol followed by several rows of paired boxes, where the symbol is omitted. Participants are asked to fill in the missing symbols. The final score of the test is the amount of symbols the participant has filled in 90 seconds.

2.2.5. Interpersonal Reactivity Index (IRI; Davis, 1983)

The IRI is a questionnaire intended to measure self-reported empathy, using 28 items on a 5-point Likert scale, resulting in a total score.

2.2.6. Questionnaire Of Cognitive And Affective Empathy (QCAE; Reniers et al., 2011)

The QCAE is a self-report questionnaire developed to measure cognitive and affective empathy using 31 items on a 4-point Likert-scale. The questionnaire was developed based on factor analysis of items from other well-known empathy questionnaires (including the IRI, causing some overlap in items). The total score of all items was used for analysis.

2.2.7. Faux-Pas task (Baron-Cohen et al., 1999)

This task intends to measure 'Theory of Mind'. During the task, ten stories are read aloud to the participant. In five of these, a character in the story commits a 'faux pas' . Scoring consists of the amount of faux pas the participant correctly identified, and the amount of 'empathy questions' (e.g. 'how does person X in the story feel?') answered correctly.

2.2.8. Empathic Accuracy Test (EAT, Zaki et al., 2008)

The Dutch version of this task (Aan Het Rot and Hogenelst, 2014) was used to measure empathic accuracy. Participants are required to watch four videos in which someone tells a personal story, and provide continuous ratings of valence (happy – sad). Participants are asked to continuously rate 'how the target person in the video is feeling' . Scores are correlated with the speaker's own ratings, leading to an index of empathic accuracy.

2.2.9. Indiana psychiatric illness interview (IPII; Lysaker et al., 2002)

This open interview is intended to elicit a spontaneous speech sample, specifically developed for use with the MAS-A (see following instrument). Through five questions, the participant is asked to speak freely about their life story and their illness narrative (in the case of patients) or a significant adverse event in their lives (controls). All interviews were transcribed before receiving ratings on metacognition using the Abbreviated Metacognition Assessment Scale (MAS-A).

2.2.10. Metacognition Assessment Scale–abbreviated (Lysaker et al., 2005)

The MAS-A relies on trained raters to score transcripts of spontaneous speech samples along the domains of Self-Reflectivity, Understanding the Other's Mind, Decentration and Mastery. Raters completed a training session and participated in three consensus meetings with experienced raters before their ratings were used. All MAS-A ratings were first performed individually before a joint score was constructed in a consensus meeting with a minimum of three raters.

2.2.11. Dutch adult reading test (Schmand et al., 1991)

This test, in which participants are asked to pronounce uncommon Dutch words, serves as an indicator of premorbid intellectual functioning.

All measures demonstrated acceptable to good internal consistency, with Cronbach's alphas: PANSS (0.85) QCAE (0.82), IRI (0.76) and MAS-A (0.79).

2.3. Procedures

The protocol for this study was approved by the University Medical Center Groningen (NL47493.042.13) and is registered in the Dutch Trial Register (NTR4501) in 2014. Recruitment procedures for the patient group without a forensic history are described elsewhere (Van Donkersgoed et al., 2014). All clients which fit the in- and exclusion criteria in the participating therapist's caseloads were informed of the study. In the first meeting participants signed informed consent, if applicable the diagnoses were confirmed using the MINI PLUS, and the PANSS and IPII interviews were administered. The rest of the test battery was administered during a second sitting, or more if there were symptoms of fatigue. All measurements were performed by persons enrolled in a Master's degree program of psychology.

2.4. Analyses

The analyses were conducted using IBM SPSS Statistics version 24. Groups were compared on demographic variables using Fisher's Exact-*z* (education level, # of admissions), chi-square test (diagnosis) or ANOVA (age).

After verification that groups did not differ significantly on demographic variables, a stepwise Discriminant Function Analysis (Field, 2013) was conducted in order to determine which variables constitute a statistically significant predictor of group membership (control, psychosis, forensic psychosis).

Follow-up analysis was conducted to determine which specific elements of metacognition (Self-Reflectivity, Understanding the Other's Mind, Decentration and Mastery) predict being in forensic care amongst persons with psychosis. This was tested using a second stepwise Discriminant Function Analysis, omitting the control group, and substituting MAS-total scores for its subscales.

Discriminant Function Analysis (DFA) relies on several assumptions: the data must represent a sample from a multivariate normal distribution, homogeneity of variances/covariances and non-multicollinearity. DFA is known to be relatively robust against violations of multivariate normality, particularly in cases where the smallest group >20 (Mertler and Reinhart, 2017), but has been documented as being sensitive to outliers. As such, multivariate outliers were assessed first by calculating squared Mahalanobis distances for each case, per group and testing these against the chi-square distribution using the number of predictors (9) for degrees of freedom, $p = 0.001$ (Tabachnick and Fidell, 2007). Second, to ensure the resulting model is reliable, cross-validation (also called leave-one-out or 'jack-knife' classification) was applied in which each case is classified by the functions derived from all

Table 1
Comparison of demographic details between groups, using ANOVA (F), Fisher's Exact-z (z) or chi-square (χ^2) tests.

	Controls (N = 33)	Psychosis (N = 27)	Forensic (N = 23)	F (df) / z / χ^2	p
Age min–max	22–74	20–67	21–56		
Age mean (SD)	38.61 (11.02)	35.41 (11.27)	37.26 (9.11)	6.75 (2)	0.51
Education mean[1]	5.15	4.89	4.65[2]	2.37	0.69
Schizophrenia, #		19	19	2.83	0.24
Schizoaffective disorder, #		8	3		
Psychotic disorder NOS, #		0	1		
Age first psychosis, mean (SD)		24.30 (6.89)	24.09 (6.67)[3]	0.11 (1)	0.92
Illness duration in years, mean (SD)		11.11 (9.58)	12.81 (5.95)[3]	0.53	0.47
Mode no. of admissions		2–4 (44%)	2–4 (39%)	3.120	0.59

[1] Education classification system of Verhage, 1983.
[2] Data missing (n = 6).
[3] Missing data for 1 participant.

cases other than that case, resulting in a more conservative estimate.

3. Results

Demographic variables are presented in Table 1. Unfortunately, there were some missing values, particularly on the neurocognitive measures in the control group (Table 2). To account for this, missing values were replaced by group means as these were highly similar to those obtained in other studies (Joy et al., 2004; Mahurin et al., 2006; Tombaugh, 2004). Not all variables (Table 2) are normally distributed in all 3 groups according to Shapiro–Wilk tests (Faux Pas Test, IRI, EAT, Trailmaking and QCAE); transformations of the data could not resolve this in all groups simultaneously. A per-case test of Mahalanobis distances revealed no significant multivariate outliers. Box's M test (Field 2013) revealed the assumption of homogeneity of variance/covariance was met. To test hypothesis one, a discriminant function analysis was conducted to uncover the dimensions which differentiate control participants, persons diagnosed with a psychotic disorder and persons with a psychotic disorder in forensic care for a violent crime. Variables entered were MAS-Total scores, Trailmaking final scores, Digit Symbol scores, DART scores, Faux Pas # correctly identified, Faux Pas # Empathy questions wrong, QCAE total scores, IRI total scores and EAT scores.

Two discriminant functions emerged (Table 3): the first function explained 92.8% of the variance, canonical $R^2 = 0.34$, whereas the second function explained only 7.2%, canonical $R^2 = 0.04$. As such, only the first significantly differentiated between the groups, Wilks' $\Lambda = 0.636$, $\chi^2(4) = 21.462$, $p < 0.001$. The second function did not reach significance, Wilks' $\Lambda = 0.962$ $\chi^2(1) = 1.854$, $p = 0.17$. Interpretation of functions at group centroids confirms that a structural hierarchy exists in the order of scores (Table 4), with the forensic group scoring worse than the psychosis group, and both patient groups scoring worse than controls. Correlations between the group membership and the discriminant function (Table 3) revealed that only two variables loaded onto this first function, namely metacognition total scores ($r = 0.792$), and the Digit Symbol Test ($r = 0.675$). The combination of functions 1 and 2 correctly classify 57.8% of the cases in their respective groups (Table 5). The more conservative cross-validated model correctly classified 54.2%.

As a second question, we were interested to see whether specific domains of metacognition are particularly indicative of a violent history. A per-case test of Mahalanobis distances revealed no significant multivariate outliers. As such, another discriminant analysis was performed, omitting the control group and substituting MAS-total scores for scores on its subscales. This resulting model consisted of only one function explaining 100% of the variation, canonical $R^2 = 0.38$. This function significantly differentiated between the groups, Wilks' $\Lambda = 0.612$, χ^2 (2) = 15.206, $p = > 0.001$. Once more, two variables loaded onto this function (Table 5): scores on Self-Reflectivity ($r = 0.743$), and scores on the EAT ($r = 0.234$). Group centroids revealed the same hierarchy, with lower scores associated with membership to the forensic group (Table 4). This model correctly classified 80% of the cases between the psychosis and forensic psychosis group; the more conservative cross-validated model correctly classified 78% (Table 5).

4. Discussion

The current study was constructed to investigate which measures of social cognition and metacognition are related to a violent history over and above the deficits commonly associated with psychotic disorders. As this is the first study which includes both measures of social cognition and metacognition conducted in samples with a psychotic disorder with and without a forensic history and controls, the results of the current study cannot be directly compared to prior research.

The primary aim of the study was to determine if support could be found for the notion that mixed findings in social cognition vis a vis violence in psychosis (Abu-Akel and Abushua'leh, 2004; Harris and Picchioni, 2013; Majorek et al., 2009; Malone et al., 2012) could be explained by a conceptual distinction between more basic processes ("social cognition") and higher-order, integrative processes ("metacognition") in predicting violence in psychosis (Abu-Akel and Abushua'leh, 2004; Bo et al., 2011; Mitchell et al., 2012).

Our results are in line with such a distinction: metacognitive capacity as measured by the MAS-A, and associative learning scores on the Digit Symbol Test were the only variables that significantly differentiated between all three groups. As expected, controls performed better on all measures than both patient groups, and patients without a forensic history outperformed those in treatment at a forensic clinic. Scores on measures of social cognition between the forensic group of patients and the non-forensic group are highly similar, whereas a clear

Table 2
Average scores per group on measures of neurocognition, empathy and metacognition, mean (SD).

	Trailmaking	Dig. Symb.	DART	FP-Rec.	FP-Emp.	QCAE	IRI	EAT	MAS-A
Control	36.00 (22.94)[1]	72.44 (16.38)[1]	78.47 (12.57)[2]	4.28 (0.80)	2.62 (1.21)	89.48 (8.67)	53.15 (11.68)	1.24 (0.47)	14.53 (2.83)
Psychosis	64.96 (48.38)	56.89 (16.89)	78.96 (8.57)	3.81 (1.18)	2.63 (1.62)	89.56 (12.00)	62.33 (12.25)	1.07 (0.52)	11.44 (3.38)
For. Psychosis	69.89 (43.62)[3]	53.78 (11.58)[1]	71.81 (15.69)[4]	3.22 (1.51)	2.43 (1.31)	88.70 (9.11)	57.13 (12.27)	0.88 (0.64)	9.00 (2.80)

Note: Trailmaking = Trailmaking Test B–A; Dig. Symb. = Digit Symbol Test; DART = Dutch Adult Reading Test; FP = Faux Pas Test; QCAE = Questionnaire of Cognitive and Affective Empathy; IRI = Interpersonal Reactivity Index; EAT = Empathic Accuracy Task; MAS-A = Metacognition Assessment Scale–A.
[1] Data are only available for 18 / 33 participants.
[2] Data are only available for 17/33 participants.
[3] Data are only available for 19/23 participants.
[4] Data are only available for 16/23 participants.

Table 3
Discriminant function analyses, structure matrixes and standardized canonical discriminant function coefficients per analysis.

Analysis 1: Control–Psychosis–Forensic Psychosis	Function		SCDFC		Analysis 2: Psychosis–Forensic Psychosis	Function	SCDFC
Entered	Fn 1	Fn 2	Fn. 1	Fn 2	**Entered**	**Fn. 1**	Fn. 1
MAS-A: total	0.792	−0.610	0.741	−0.677	MAS-A: Self Reflectivity	0.743	1.106
Digit Symbol	0.675	0.738	0.612	0.795	EAT	0.234	0.762
Not in the model					**Not in the model**		
IRI	0.190	−0.189			MAS-A: Understanding Other	0.584	
Faux pas empathy	−0.168	−0.163			MAS-A: Mastery	0.443	
QCAE	−0.123	−0.077			Faux Pas–Empathy	−0.295	
Trailmaking	−0.215	−0.385			Faux Pas-Recognized	0.254	
EAT	−0.086	0.315			MAS-A: Decentration	0.234	
Faux pas recognized	0.091	0.290			IRI	0.229	
DART	0.056	0.086			Trailmaking	−0.168	
					QCAE	0.108	
					Digit Symbol	0.029	
					DART	−0.021	

Note: MAS-A = Metacognition Assessment Scale–A; Digit Symbol = Digit Symbol Test; Faux Pas = Faux Pas Test; QCAE = Questionnaire of Cognitive and Affective Empathy; IRI = Interpersonal Reactivity Index; EAT = Empathic Accuracy Task; DART = Dutch Adult Reading Test; Trailmaking = Trailmaking Test B–A.

Table 4
Discriminant function analyses, functions at group centroids per analysis.

Analysis 1: Control–Psychosis–Forensic Psychosis	Function		Analysis 2: Psychosis–Forensic Psychosis Function
Group	Fn.1	Fn.2	Fn. 1
Control (C)	0.902	0.107	
Psychosis (P)	−0.172	−0.236	0.646
Forensic (F–P)	−0.849	0.207	−0.923

difference can be observed on scores of metacognition. As such, these results support the idea that the presence of a psychotic disorder is associated with reduced abilities of social cognition and metacognition. However, between the two patient groups, reduced metacognitive abilities proved a better predictor of the presence of a violent history.

As a secondary aim, we sought to investigate which specific domains of metacognition were particularly indicative of a violent history in psychosis. To investigate this, an explorative analysis in which the MAS-A total scores were substituted for scores on its subscales was conducted, omitting the control group. Scores on metacognitive Self-Reflectivity and Empathic Accuracy differentiated between forensic and non-forensic participants, but scores on social cognition (such as ToM) did not. Using the same instrument (MAS-A), Mitchell et al. (2012) did *not* find a forensic sample to differ significantly from a patient group without a forensic history, but included only 11 patients in the group of participants with a psychotic disorder. It is therefore still inconclusive whether metacognitive difficulties are associated to violence in psychosis.

There are several interpretations of the data which merit further elaboration. The first is in respect to instrument choice when studying social cognitive processes. Our findings pertaining to Self-Reflectivity may serve to explain why self-report questionnaires of empathy did not differentiate between the groups. If participants are impaired in their abilities to self-reflect, it stands to reason that their self-reporting of empathic abilities may not be accurate. As such, self-report questionnaires of empathic abilities are likely not a viable instrument to measure empathic abilities or violence-proneness in this patient group. Similarly, scores of faux pas detection via questions about characters in a short vignette appear to demonstrate deficits in basic social cognitive abilities, but may be unrelated to violence among persons with a psychotic disorder. An additional downside to the use of such simple tasks is that social desirability may play a role, particularly when applied in a forensic context.

Furthermore, the Empathic Accuracy Test (EAT) does differentiate between the two patient groups, while the metacognition scale "Understanding the Other's Mind" does not. The EAT measures the accuracy of a person's ability to correctly infer the emotional state of a person who is telling an emotional, personal story. As such, this has a relatively affective character. Understanding the Other's Mind, however, measures the ability of a person to form complex representations of another person, and as such, has a relatively cognitive character. It furthermore does not measure *accuracy* of representation, but only *complexity*. The most straightforward interpretation of these scores is that in most situations (such as walking down the street), complex representations of others are unnecessary. It is, however, important to integrate different modalities (e.g. speech, posture, content of what is said) accurately. If this process goes wrong, others may be erroneously interpreted as threatening or hostile, causing risk of violence.

In addition, in these samples, metacognitive Self-Reflectivity, i.e. the ability to form a complex representation of *yourself*, also differentiates between groups. There is some fMRI evidence that, neurologically, self-relevance determines the amount of emotional processing that takes place in reflecting about others: the more self-relevance, the more emotional processing takes place in the ventromedial prefrontal cortex (van der Meer et al., 2010). A less complex or less stable representation of oneself may make it more difficult to determine that another person is important to oneself. This would lead to reduced

Table 5
Discriminant function analyses, classification tables per analysis.

Analysis 1: Control–Psychosis–Forensic Psychosis		Predicted group membership			Analysis 2: Psychosis–Forensic Psychosis Predicted group membership	
Actual group	*n*	Control	Psychosis (P)	Forensic (F–P)	Psychosis	Forensic
Control (C)	33	23 (70%)	10 (30%)	0 (0%)		
Psychosis (P)	27	6 (22%)	12 (44.4%)	9 (33%)	23 (85.2%)	4 (14.8%)
Forensic (F–P)	23	2 (9%)	8 (35%)	13 (57%)	6 (26.1%)	17 (73.9%)
Percentage of cases correctly classified: 57.8%					Percentage of cases correctly classified: 80%	
Cross-validation correct classification: 54.2%					Cross-validation correct classification: 78%	

emotional processing, resulting in a somewhat solipsistic world-view. Other persons, except for the most intimately known or familiar, are more akin to a 'faceless group' than persons just like oneself with whom experiences can be shared (Parnas and Sass, 2001). Such a conception of the world may share similarities with a more 'psychopathic' or a fear-based view of the world.

These findings surrounding Self-Reflectivity may, however, also be interpreted to suggest that those with diminished Self-Reflective capacities could find themselves more overwhelmed by emotions, as demonstrated by the average Self-Reflectivity scores between the groups. In both control condition and the non-forensic group, averages are above S4, with only 9% in the control group scoring below S4, and 33% in the non-forensic group. In the forensic group, however, 74% of the participants score below S4, which is reflected in a group average of S3.2. It is at precisely this level of metacognition (S4) where a person demonstrates the ability to differentiate between emotions and integrate these into their self-representation. The average score of S3 in the forensic group indicates only the ability to differentiate between cognitive operations, but not emotions.

Alternative interpretations cannot be ruled out, however, including the notion that the most disabled patients with multiple cognitive deficits are the most prone to violence, that the commission of violent crime or incarceration diminishes metacognitive capacity, or that some factor not measured here accounts for the observed relationship.

The present study has several limitations: while the total sample size is acceptable, the number of participants per group is modest. We used 3-person consensus group ratings for the MAS-A, to ensure the most accurate scores. Future studies could consider using individual raters' scores to serve the additional benefit of obtaining measures of interrater reliability. Furthermore, our study did not include any data on comorbid substance abuse or personality pathology in neither the psychosis group, nor the control groups. Additionally, the current set of instruments pertaining social cognition is only a small sample of the instruments available to measure the construct(s); for instance, the current study did not incorporate the 'Managing Emotions' subtest of the Mayer- Salovey-Caruso Emotional Intelligence Test (MSCEIT), which has also demonstrated an association with violence (O'Reilly et al., 2015). Future research should be designed as prospective studies in which risk assessment batteries are conducted in conjunction with measures of social cognition (particularly metacognition) to determine whether metacognitive capacity demonstrates predictive validity over and above information acquired from comprehensive risk assessment. The further development of instruments targeting more synthetic metacognitive abilities may prove highly informative and useful, in this context. In addition, more investigations into metacognitive capacity in those with personality disorders could potentially further disentangle the complex relationship between psychosis and (comorbid) personality pathology as a risk factor for violence.

One final limitation pertains to symptomatology: our forensic sample can be assumed to be under adequate medication management due to the forced character of treatment, which consisted of both in- and outpatients. Such assumptions cannot be made for our patient non-forensic group, which consisted only of outpatients; it is a common finding that medication adherence is rather poor among patients with a psychotic disorder (e.g. Colizzi et al., 2016). Symptom scores at the time of assessment between groups are virtually identical, but are perhaps not the most relevant information to enter into a statistical model. After all, no information could be entered into the model pertaining to medication use or symptom severity *at the time of the index crime*.

In conclusion, our findings support the notion that basic processes of social cognition are conceptually different from more higher-order processes, and are differentially related to violence. More complex measures, such as the Empathic Accuracy Test and Metacognition Assessment Scale-A may offer an important contribution to statistical models of violence risk. There may be some urgency to direct research efforts into more measures of these abilities and, perhaps more importantly, interventions aimed at these abilities for both treatment of violent offenders but also prevention of violence. To date, several such methods have been developed and are under investigation for their efficacy, based on either the mentalization framework, the notion of metacognition as awareness of susceptibility to one's own biases, or synthetic metacognition (Bateman et al., 2009;de Jong et al.,2018,2016a; Hamm et al., 2013; Moritz et al., 2011; Van Donkersgoed et al., 2014; Wells, 2009). Future research is warranted to determine effectiveness within the field of psychosis, including whether they may prove similarly useful in forensic care. Given the considerable implications for the patient, victim and society at large, further research is needed.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2018.04.048.

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