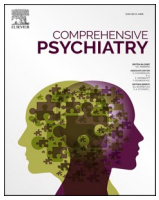
Comprehensive Psychiatry 124 (2023) 152391

Contents lists available at ScienceDirect

Comprehensive Psychiatry

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



The "zipper model of empathy" applied to violence in schizophrenia: A search for social cognitive underpinnings of lack of empathic behavior

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ARTICLE INFO

Keywords:
Antisociality
Psychopathy
Theory of mind
Emotion processing
Facial affect perception

ABSTRACT

Background: The "zipper model of empathy" has been proposed for psychopathy. It postulates that empathic behavior may fail to arise due to impaired facial emotion recognition. In this study, we examined if the model may be of relevance for schizophrenia.
Methods: In a sample of participants with schizophrenia and a history of severe interpersonal violence, associations between measures of social cognition (emotion recognition, theory of mind) and aspects of psychopathy (lack of empathy, lack of remorse) were investigated. A non-violent sample experiencing schizophrenia served as a control group.
Results: Correlation analyses revealed a specific and statistically significant association between facial emotion recognition and lack of empathy in the violent sample. Follow-up analyses identified that neutral emotions were of particular importance. Logistic regression analyses confirmed that impairments in facial emotion recognition predicted levels of empathy in the violent sample experiencing schizophrenia.
Conclusions: Our results suggest that the "zipper model of empathy" may be relevant for schizophrenia. The findings further point to the potential benefit of including social cognitive training in the treatment of persons with schizophrenia and a history of interpersonal aggression.

1. Introduction

It has been proposed that the failure to act empathically observed in persons with psychopathy may be tracked back to deficient processing of facial emotions [1]. Social cognition is defined as the mental processes that underlie social interactions [2], and facial emotion recognition is one such social cognitive function. Social cognition is often divided into different domains. Of these, facial emotion recognition belongs to emotional processing, a broad domain referring to the ability to perceive and use emotional information [2]. Although findings are mixed [3]; impaired facial emotion recognition has been found in persons with psychopathy [4,5].

According to the "zipper model of empathy" [1], empathic behavior may not arise in individuals with psychopathy due to impairments in facial emotion recognition. The "zipper model" views mature empathic behavior as a result of several cognitive and affective processes, with the "zipping up" to empathic behavior depending on the interaction of these processes. The model sees facial emotion recognition as a precursor to empathic behavior through its initiation of two processes central to the unfolding of empathic behavior. *Mimicry* is an automatic motor response to the emotional expression of another person [6] which can translate into *emotional contagion* [7–9], a term used to describe experiencing an affective reaction that is similar to the emotions one observes in another person. These two affective processes, in interaction with cognitive processes such as explicitly thinking about the perspective of the other (or theory of mind: ToM), may then have a down-stream effect, and underlie empathic behavior or "mature empathy". The model incorporates both affective and cognitive empathy, a distinction central to

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https://doi.org/10.1016/j.comppsych.2023.152391

Available online 4 May 2023

the empathy literature. Affective empathy refers to the ability to experience and be sensitive to the emotional states felt by others [10], of which emotional contagion forms a basic part. Cognitive empathy is the ability to infer the mental state of others or take their perspective [10], i.e. ToM. Whereas the "zipping" also depends on other features, such as context (whether the other is an in- or out-group member) and psychological states (fatigue, motivation), the model postulates that impairments in facial emotion recognition may prevent mature empathy from emerging [1]. The model has been proposed for psychopathy, but could be relevant for other groups characterized by lack of empathic behavior.

Another group that may act with limited consideration for the wellbeing of others are persons with schizophrenia who sometimes act violently. A small but particularly visible minority of individuals experiencing schizophrenia inflict severe physical injury, sometimes death, to other people. Recent meta-analytic evidence indicates that less than 5% of women and less than 25% of men with schizophrenia spectrum disorders commit violent acts, but that individuals experiencing schizophrenia spectrum disorders have a 17-fold risk of homicide perpetration compared to the general population [11]. In "zipper model" terminology, they fail to show mature empathy. Indeed, psychopathy scores are significantly higher in persons with schizophrenia who act violently compared to persons with schizophrenia who were never violent [12]. Interestingly, substantial social cognitive impairment is present in schizophrenia [13] including deficits in facial emotion recognition [14]. Although the research base is mixed, there are also reports of larger social cognitive impairments in individuals experiencing schizophrenia who act violently compared to individuals with schizophrenia who were never violent [15,16]. Further, social cognition predicts violent recidivism in individuals with schizophrenia receiving forensic treatment [17], and mentalizing (i.e. ToM) has been shown to mediate between psychopathy and aggression in schizophrenia [18].

The aim of this study was to examine if one of the premises for the "zipper model" holds true also for schizophrenia. In a sample of participants with schizophrenia and a history of interpersonal violence, we asked whether there is an association between social cognition and lack of empathic behavior assessed with a psychopathy measure. We hypothesized that we would find a stronger relationship of lack of empathic behavior with facial emotion recognition, than with other social cognitive domains. Two control conditions were included for specificity purposes. First, associations with social cognition were examined for another aspect of psychopathy; lack of remorse. We chose lack of remorse because it is more similar to lack of empathy than other aspects of psychopathy and therefore would lend more confidence to a significant finding. Second, a control group of persons with schizophrenia without a history of violence was included. In order to provide support for our hypothesis, the study should provide the following results. Stronger associations should be present between facial emotion recognition (not other measures of social cognition) and lack of empathy (not lack of remorse) in participants with a history of violence (not in participants without a history of violence).

2. Methods

2.1. Participants

The study was conducted at Vestre Viken Hospital Trust in Norway, with data additionally collected at collaborating units across the nation. The study was approved by the Regional Committee for Medical and Health Research Ethics (REC South East 2015/713). Participants received information about the study by their treating clinician before meeting the second author who then provided detailed information on study participation. All participants provided written informed consent prior to assessments. Data was collected between October 2015 and June 2017 by the second author. The study is a comparison of individuals with ICD-10 [19] schizophrenia who have or have not acted violently and has been described in several previous publications [16,20]. The violent sample ($n = 26$) consisted of persons sentenced to compulsory mental care for homicide ($n = 12$) or homicide attempt ($n = 14$) (HOS: homicide offenders with schizophrenia). The nonviolent group (non-HOS) was comprised of persons without a history of interpersonal violence. Diagnostic evaluations (HOS: schizophrenia $n = 23$, schizoaffective disorder $n = 3$; non-HOS: schizophrenia $n = 27$, schizoaffective disorder $n = 1$) were made by the treating clinician at collaborating units, prior to study inclusion. Only individuals who had sufficient knowledge of the Norwegian language to undergo clinical interviews and cognitive assessments were included. One person eligible for participation was excluded for this reason [see 20 for complete information on study procedures].

2.2. Measures

Psychosis-specific and general symptomatology was measured with the Positive and Negative Syndrome Scale (PANSS) [21], based on the semi-structured interview and clinical observation. The original PANSS manual provides scores for positive, negative and general symptoms. *Psychopathy* was assessed with Hare Psychopathy Checklist: Screening Version (PCL:SV) [22]. It has 12 items reflecting two factors (interpersonal/affective and social deviance/behavior). For the current study, we were interested in one PCL item: "lack of empathy" as an operationalization of lack of mature empathy according to the zipper model. For comparison purposes, to inform whether effects were specific, we also included another related PCL item: "lack of remorse". Any item is scored 0, 1, or 2, providing three levels of psychopathy.

Further, we measured *intelligence* (IQ) with the two-test version of Wechsler Abbreviated Scale of Intelligence (WASI) [23] and administered four social cognitive tests. Two of them measure emotion processing. Emotion in Biological Motion (EmoBio) [24] gives information on the ability to *perceive emotions in moving bodies*, whereas Pictures of Facial Affect (PFA) [25] is a measure of *facial emotion recognition*. The EmoBio test was scored according to the proportional method [26] using Norwegian norms [27]. EmoBio assesses the ability to recognize happiness, fear, sadness, anger, and neutral emotions from point-light displays of moving bodies. PFA contains 28 black-and-white photographs of faces (all Caucasians) showing one of six emotions (happiness, fear, sadness, anger, surprise, disgust) or a neutral expression. Two of the social cognitive tests measure *ToM*, i.e. the Hinting Task [28] and the Movie for the Assessment of Social Cognition (MASC) [29]. The Hinting Task consists of 10 short vignettes describing an interaction between two characters, of which one drops a hint. The MASC test is a video-based measure where the respondent is asked about the feelings, thoughts and intentions of characters in a short movie. The Norwegian versions of Hinting Task [30] and MASC [31] are suitable for use in schizophrenia.

2.3. Statistical analyses

Descriptive analysis includes absolute frequencies for categorical variables and means, standard deviations and range for continuous variables. The relationship between social cognition and lack of empathy/lack of remorse was examined in three steps, for each of the two groups, separately. In the first step, initial bivariate correlation analyses (Spearman's rho) examined associations of the PCL "lack of empathy" and "lack of remorse" items with the total scores of the four social cognitive tests (EmoBio, PFA, Hinting Task, MASC). In the second step, significant associations from the first step were subjected to closer scrutiny by performing the same correlational analyses, but this time with subscores of the social cognitive test in question. In the third step, a hierarchy was created between any two variables that were significantly associated in the first two steps. Specifically, social cognitive differences between individuals belonging to either of the three levels of the PCL items (0,1, or 2) were examined using mean plots, with Bonferroni post-hoc correction for multiple comparisons. We then estimated logistic

Table 1
Demographics and clinical characteristics in homicide offenders with schizophrenia (HOS) and non-violent schizophrenia controls (non-HOS).

	HOS (n = 26)	non-HOS (*n* = 28)	
	Mean (SD)	Mean (SD)	Statistic
Demographics			
Age	38.2 (7.3)	36.7 (10.1)	$t = 0.36$, $p = .534$
Sex (males/females)	25/1	25/3	$x^2 = 0.9$, $p = .336$
Education (years)	9.6 (2.2)	11.1 (1.6)	$t = -2.80$, $p = .007$
WASI IQ	87.0 (16.7)	98.0 (15.8)	$t = -2.48$, $p = .016$
Clinical characteristics			
PANSS positive symptoms	11.3 (4.3)	10.0 (3.4)	$t = 1.22$, $p = .227$
PANSS negative symptoms	13.0 (5.5)	10.5 (3.1)	$t = 2.10$, p = .041
PANSS general symptoms	25.4 (6.0)	23.4 (4.3)	$t = 1.45$, $p = .153$
Medication, DDD	1.84 (0.80)	1.36 (0.64)	$t = 2.44$, $p = .018$
Illness duration (years)	15.7 (6.7)	13.7 (10.1)	$t = 0.82$, $p = .414$

WASI = Wechsler Abbreviated Scale of Intelligence. PANSS = Positive and Negative Syndrome Scale. DDD = defined daily dose.

regression models, with significant social cognition variables as predictors and the level of the PCL item in question (0,1,2) as dependent variable. To do these statistical analyses we used SPSS (IBM SPSS Statistics for Windows, version 28. IBM Corp., Armonk, N.Y., USA).

3. Results

Table 1 shows the main demographic and clinical characteristics. The large majority were males, with a mean age in the late thirties for both groups. The HOS sample had shorter education, lower IQ, more

Table 2
Psychopathy and social cognitive performance of homicide offenders with schizophrenia (HOS) and non-violent schizophrenia controls (non-HOS).

	HOS (n = 26)	non-HOS (n = 28)	
Psychopathy	Median (range)	Median (range)	Statistic
PCL:SV interpersonal/affective (factor 1)	2.0 (0–9)	0.0 (0–2)	$U = 118.5$, Z = −4.79 **$p < .001$**, $r = 0.65$
PCL:SV social deviance/behavior (factor 2)	7.0 (1−12)	0.5 (0–5)	$U = 33.0$, Z = −5.80 **$p < .001$**, $r = 0.79$
	n for score = 0/1/2	n for score = .0/1/2	
PCL:SV "lack of empathy"	13/7/6	28/0/0	$x^2 = 18.4$, **$p < .001$**
PCL:SV "lack of remorse"	10/9/7	26/2/0	$x^2 = 18.5$, **$p < .001$**
Social cognition	Mean (SD)	Mean (SD)	
PFA total (% correct)	66.5 (13.5)	70.3 (14.6)	$t = -0.97$, $p = .168$, Cohen's $d = 0.26$
PFA happiness (% correct)	97.1 (8.2)	94.6 (10.5)	$t = 0.97$, $p = .170$, Cohen's $d = 0.27$
PFA fear (% correct)	31.7 (28.8)	42.9 (31.1)	$t = -1.36$, $p = .090$, Cohen's $d = 0.37$
PFA sadness (% correct)	57.7 (25.3)	62.5 (23.1)	$t = -0.73$, $p = .234$, Cohen's $d = 0.20$
PFA anger (% correct)	67.3 (29.8)	68.8 (29.4)	$t = -0.18$, $p = .429$, Cohen's $d = 0.05$
PFA surprise (% correct)	89.4 (16.1)	89.3 (24.9)	$t = 0.02$, $p = .491$, Cohen's $d = 0.01$
PFA disgust (% correct)	51.0 (26.9)	55.4 (32.2)	$t = -0.54$, $p = .295$, Cohen's $d = 0.15$
PFA neutral (% correct)	71.2 (28.9)	77.7 (24.9)	$t = -0.89$, $p = .188$, Cohen's $d = 0.24$
EmoBio total (0–1)	0.65 (0.15)	0.74 (0.15)	$t = -2.07$, **$p = .022$**, Cohen's $d = 0.60$
MASC total (0–45)	20.8 (8.8)	27.6 (7.6)	$t = -3.16$, **$p = .001$**, Cohen's $d = 0.86$
MASCaff (0–18)	8.1 (3.3)	10.8 (3.2)	$t = -3.05$, **$p = .002$**, Cohen's $d = 0.83$
MASCcog (0–26)	12.4 (5.9)	16.6 (5.0)	$t = -2.86$, **$p = .003$**, Cohen's $d = 0.78$
MASC undermentalizing errors (0–45)	11.9 (5.5)	7.2 (4.2)	$t = 3.50$, **$p < .001$**, Cohen's $d = 0.96$
MASC overmentalizing errors (0–45)	5.9 (3.0)	5.9 (2.7)	$t = -0.01$, $p = .494$, Cohen's $d = 0.00$
MASC no mentalizing errors (0–45)	6.2 (4.0)	5.4 (6.3)	$t = 0.55$, $p = .292$, Cohen's $d = 0.15$
Hinting Task (0−20)	14.7 (3.7)	16.0 (2.3)	$t = -1.63$, $p = .055$, Cohen's $d = 0.44$

PCL:SV = Psychopathy Check List: Short Version. PFA = Pictures of Facial Affect. EmoBio = Emotion in Biological Emotion. MASC = Movie for the Assessment of Social Cognition.
PCL:SV scores were presented in Engelstad et al. (2019b), except the two item scores which have not been published earlier. Social cognitive data reproduced from Engelstad et al. (2019a) except PFA subscores, which have not been presented in previous publications.

Table 3
Bivariate associations (Spearman's rho) between PCL items and social cognitive performance in homicide offenders with schizophrenia (HOS) and non-violent schizophrenia controls (non-HOS).

	PCL:SV "lack of empathy"		PCL:SV "lack of remorse"	
Social cognitive test	HOS (n = 26)	non-HOS (n = 28)	HOS (*n* = 26)	non-HOS (n = 28)
PFA total	**−0.47 p = .015**	No variance in PCL item	−0.29	−0.31
PFA happiness*	−0.12	–	–	–
PFA fear*	−0.04	–	–	–
PFA sadness*	−0.30	–	–	–
PFA anger*	−0.34	–	–	–
PFA surprise*	−0.28	–	–	–
PFA disgust*	−0.24	–	–	–
PFA neutral*	**−0.62 p < .001**	–	–	–
EmoBio total	−0.16	No variance in PCL item	0.05	−0.26
MASC total	-0.21	No variance in PCL item	−0.17	**−0.40 p = .037**
MASCaff*	–	–	–	−0.36
MASCcog*	–	–	–	**−0.39 *p* = .041**
MASC undermentalizing errors*	–	–	–	0.32
MASC overmentalizing errors*	–	–	–	**0.42 *p* = .025**
MASC no mentalizing errors*	–	–	–	0.25
Hinting Task	-0.15	No variance in PCL item	−0.17	**−0.41 p = .034**

PCL:SV = Psychopathy Check List: Screening Version. PFA = Pictures of Facial Affect. EmoBio = Emotion in Biological Emotion. MASC = Movie for the Assessment of Social Cognition. MASCaff = MASC affective ToM. MASCcog = MASC cognitive ToM.
* Correlations only shown for subscores if the correlation for the total score for the test in question was statistically significant.

negative symptoms, and used larger dosages of antipsychotic medication than the non-HOS sample. Table 2 shows the social cognitive performance and psychopathy scores of the studied samples. The HOS sample had larger social cognitive impairment and higher psychopathy scores than the non-HOS sample. Please note that this has been the focus of previous work from our group, thoroughly described in earlier publications [12,16].

The results of the correlation analyses of the first and second step are presented in Table 3.

Among HOS participants, PCL "lack of remorse" was not significantly associated with any of the social cognitive tests. PCL "lack of empathy" was statistically significantly correlated only with PFA total (Spearman's rho = −0.47, $p = .015$) and PFA neutral (Spearman's rho = −0.62, $p < .001$). Better facial emotion recognition was associated with more empathy. In the non-HOS group, there was no variation for the PCL "lack of empathy" item: all participants had a score of 0, indicating intact empathy. Hence, no correlation coefficients could be computed. PCL "lack of remorse" was significantly associated with the two ToM measures, i.e. the Hinting Task (Spearman's rho = −0.41, $p = .034$) and MASC (for the total score: Spearman's rho = −0.40, $p = .037$). Showing less remorse was associated with worse ToM.

In the third step, for the HOS group, the Bonferroni post-hoc correction for multiple comparisons (mean difference = 4.190, 95% CI = (−13.16; 21.54), $p = 1.000$; Supplementary Table 1s) showed that the difference between PCL "lack of empathy" levels 1 and 2 was non-significant for PFA total (Fig. 1). Based on this similarity in PFA total score between HOS participants with level 1 and 2 of PCL "lack of empathy" (see Fig. 1), and the small sample size, we chose to estimate as few parameters as possible. Therefore, the subsequent analyses were done with two HOS subgroups, which happened to be of equal size: high-empathy (PCL "lack of empathy" = 0: $n = 13$) vs. low-empathy (PCL "lack of empathy" = 1 or 2: n = 13) participants (Fig. 2).

With this binary outcome (high- vs. low-empathy participants), the logistic regression models (Table 4) confirmed our preliminary results. For every additional point on PFA total, the probability of belonging to the low-empathy group decreased by 10% ($OR_{Total} = 0.901$, 95% CI =

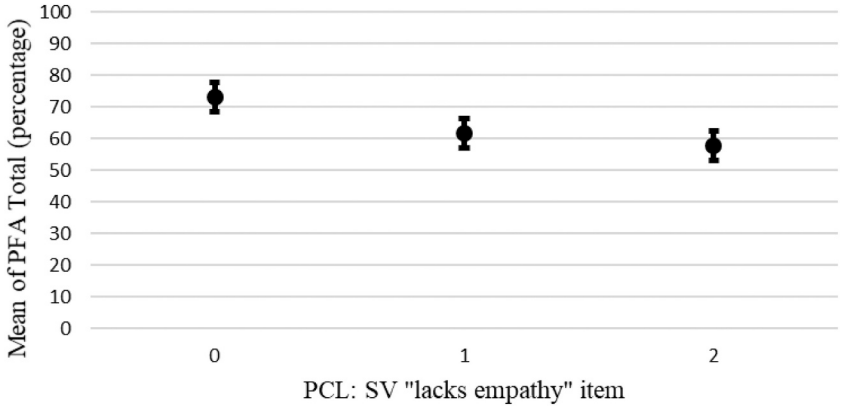

Fig. 1. Means (and standard errors) of PFA Total (percentage) by PCL "lack of empathy" item levels in homicide offenders with schizophrenia (HOS).

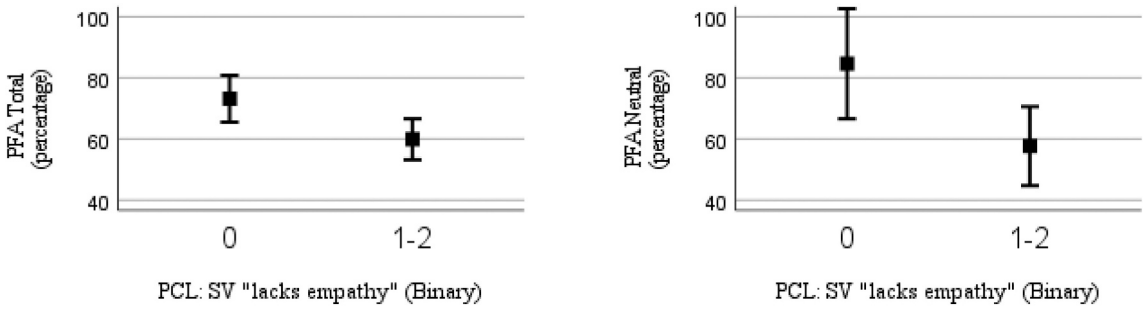

Fig. 2. Means (and 95% CI) of PFA Total and Neutral (percentages) by PCL: SV "lack of empathy" item levels (collapsing levels 1 and 2) in homicide offenders with schizophrenia (HOS).

Table 4
Logistic regression models in homicide offenders with schizophrenia (HOS):PCL: SV "lack of empathy" item levels (collapsing levels 1 and 2) as dependent variable, PFA Total and Neutral (percentages) as independent variables.

Model 1				
	Sig.	Odds ratio	95% CI for odds ratio	
			Lower	Upper
PFA Total	0.025	0.901	0.822	0.987
Constant	0.027	1064.324		

Model 2				
	Sig.	Odds Ratio	95% CI for Odds Ratio	
			Lower	Upper
PFA Neutral	0.027	0.959	0.924	0.995
Constant	0.040	20.620		

PFA = Pictures of Facial Affect. CI = confidence interval.

(0.822–0.987) $p = .027$). Similarly, every additional point on PFA neutral decreased that probability by 4% ($OR_{Neutral} = 0.959$, 95% CI = (0.924–0.995), $p = .025$).

4. Discussion

In this study, we identified a specific association between reduced facial emotion recognition and lack of empathy in participants with schizophrenia and a history of interpersonal violence. A similar association was not present for lack of remorse, nor did it appear for any other social cognitive test, and it could not be computed in our comparison sample of non-violent participants with schizophrenia since they all had intact empathy. Among persons with schizophrenia and a history of violence, lack of empathy correlated with reduced facial emotion recognition, whereas among non-violent schizophrenia controls, lack of remorse correlated with ToM. With this, the study provided the three results needed to support our hypothesis, mentioned in the Introduction, as well as the relevance of the "zipper model" for schizophrenia. In spite of the fact that the two groups did not differ significantly for PFA, this difference (Cohen's $d = 0.26$) was large enough to show the relevance of facial emotion recognition for empathy. Our findings align well with one of the premises of the "zipper model of empathy", namely that one possible root of lack of empathic behavior is reduced facial emotion recognition.

Although impairments in other social cognitive domains may also relate to non-empathic social behavior, the associations identified in our study indicate that, at least cross-sectionally, the ability to perceive emotional information in other people's faces indeed is of particular importance. Emotions guide us. Both the emotions we perceive in others and the ones we experience in ourselves provide information that help us decide how to relate to others. Impaired facial emotion recognition, therefore, puts an individual at disadvantage when maneuvering the social world. Consequently, reduced facial emotion recognition is an obstacle that people with schizophrenia face, its association with reduced real-world social functioning thoroughly documented [32]. Having trouble in handling social interactions is unlikely to foster a sense of social mastery, from which social *withdrawal* may result [33,34]. Our current findings suggest that reduced facial emotion recognition in some cases may have social *approach* implications. Interpersonal violence implies approaching someone, and physical proximity to a victim, where the disadvantage of impaired facial emotion recognition may put the individual at increased risk of interpersonal aggression.

It appears that the decoding of neutral information is key in understanding the relationship between reduced facial emotion recognition and lack of empathy. As shown in Fig. 2, the group difference for PFA neutral was much more evident than for PFA total. In spite of this, a stronger effect (OR) was found for PFA total than PFA neutral. This was likely so, because the different variability of the scales had a strong influence on these estimates. This can be seen in the models' constants (Table 4). Taken together, our analyses indicate that the PFA neutral subscale is the main factor of the PFA test and responsible for its ability to classify participants as high-empathy or low-empathy.

Our results suggest that the "zipper model" may be of relevance also for schizophrenia. However, the study cannot provide information concerning how facial emotion recognition may underlie lack of empathy in this group. The "zipper model" assumes it is because mimicry and emotional contagion are not initiated. We would like to acknowledge that there might be other explanations.

One has to do with *how* facial emotions are read, or rather, how they are misrepresented. This is relevant given our finding that impairments in decoding neutral facial expressions appeared to be more important than the (mis)perception of other emotions, largely driving the association between reduced facial emotion recognition and lack of empathy. Perhaps this is not because mimicry and emotional contagion are not activated, but because negatively biased perception of others and the world is present. Seeing emotions in neutral facial expressions may be part of a set of related processes often reported in psychotic disorders, i.e. one of altered or biased perception of the world. For instance, some cognitive biases are quite common in persons with psychosis, such as the 'jumping to conclusions' [35] and 'need for closure' [36] biases. If low-empathy participants find neutral facial emotions to be less likely or more difficult to accept and tolerate, they could be prone to hasty decision-making, failing to consider all relevant information and instead falsely attributing emotions to neutral faces. In this way, misrepresentation of neutral facial expressions could be linked to lack of empathy through false attributions of negative intentions to others. This is referred to as 'attributional style', another social cognitive domain [37] which is altered in persons experiencing schizophrenia [38]. This mechanism is more likely to be present in a population characterized by reality distortion. Therefore, this explanation may be specific to

schizophrenia.

Even if mimicry and emotional contagion should be present, they may fail to result in empathic behavior in schizophrenia due to other characteristics of these disorders. Reduced motivation is commonly seen in schizophrenia [39], and motivation is among the psychological states considered to be of importance for empathic behavior according to the "zipper model" [1]. Moreover, impaired perspective-taking is present in schizophrenia [40] suggesting that the "cognitive empathy zipper" is to a lesser extent available for individuals experiencing schizophrenia. In individuals with psychopathy, however, ToM (i.e. cognitive empathy) is largely intact [10]. They could therefore be able to overcome impairments in facial emotion recognition by explicitly thinking about the perspective of the other - using the "cognitive empathy zipper", increasing their chances of showing empathic behavior. Differences between psychopathy and schizophrenia in terms of cognitive biases [38], ToM [40] or motivation [39] could be of relevance to theoretical models of empathy. Whether this implies that there are diagnostic-specific zipper models is a question for future comparative studies to ask. In addition, for individuals experiencing schizophrenia reduced ToM may preclude the "zipper model's" contextual factors from having an impact, by hampering the ability to consider another person as an in-group member. However, we did not find particularly strong associations between ToM/perspective-taking and lack of empathy, rendering this explanation less likely. Interestingly, in our non-violent schizophrenia control sample, which had intact empathy, worse ToM was associated with lack of remorse. This highlights how trouble in correctly perceiving others is of importance for social behavior, beyond showing empathy. Finally, it is possible that aggressive behavioral impulses could override empathic behavior. A more thorough examination of these features and their relationships lies beyond the scope of the current study.

The two groups differed for some of the demographic and clinical variables. To some extent, the larger antipsychotic medication dose and negative symptom load in the HOS group probably reflect their treatment regimen. According to Norwegian legislation, the treating clinician is, in the case of sentences to compulsory treatment, required to combine the clinical management of the person's psychotic disorder with a duty to protect the larger public from danger. This introduces a strong controlling element to the treatment. Control can be achieved by turning up the medication dosages and limiting leaves from the ward. The latter may perpetuate negative symptoms such as social withdrawal, apathy and lack of motivation. We are not saying that the treating clinicians of our participants have done this, but it remains a possibility.

On the other hand, the larger antipsychotic medication dose and negative symptom load might also be markers of a more severe type of illness in the HOS group. The same is likely to be the case for the lower IQ, and relatedly, shorter education of the HOS group. Cognitive impairment is a central characteristic of psychotic disorders, but with substantial heterogeneity [41]. Persons experiencing schizophrenia, and who have more compromised cognitive functions, also have more severe variants of other illness characteristics, such as increased clinical symptom load and reduced functioning [42]. The variables for which the two groups differ are, therefore, probably inherent to group membership. It can be argued that such variables should not be considered as covariates. For example, in the case of IQ and cognitive outcomes, covarying for IQ may produce overcorrected results [43]. In our main analyses, we have therefore refrained from controlling for the mentioned variables for which the groups differed significantly. However, partial correlations between the study variables (psychopathy and social cognition) after controlling for WASI IQ are presented in Supplementary Table 2s. Findings remained the same. The one exception was that the association between lack of remorse and MASC in the non-HOS group turned non-significant ($r_{partial} = -0.34$, $p = .081$). Consequently, we would argue that our study findings cannot be reduced to group differences in these features.

We have identified several limitations of our study. Our sample size is too small for us to include a richer set of variables and more sophisticated analytic strategies. In addition, we cannot know the extent to which reduced facial emotion recognition was a driver behind the homicide/homicide attempt the individuals in our violent sample had committed, given the cross-sectional design of our study. Further, there are some possible limitations to how we operationalized the constructs. Psychopathy was indexed with a discrete measure - a continuous measure could have provided different results – and we used a static measure of facial emotion recognition (still photographs). Dynamic facial expressions probably produce enhanced mimicry compared to static photographs [44]. Future studies should therefore aim to use dynamic measures. Another issue pertaining to measures of facial emotion recognition is the importance of considering the impact of ethnicity. Cross-ethnic effects in emotion recognition, i.e. better performance when the perceiver has the same ethnicity as the individual expressing the emotion, are present for healthy individuals [45] as well as persons experiencing schizophrenia [46]. The use of stimuli consisting of facial expressions by persons of different ethnicities is preferable.

We do not question that there are other underpinnings of interpersonal violence in persons with schizophrenia besides impairments in facial emotion recognition. Substance abuse, non-adherence to treatment, and hostile behavior are among established risk factors for violence in psychosis [47]. Notwithstanding these risk factors, we believe there are clear benefits to extending the focus of risk management in psychosis to social cognition. Based on the presence of social cognitive impairments in schizophrenia [13] and their associations with functional outcome [32], several social cognitive training programs have been developed. Such training can improve social cognition [48], including facial emotion recognition [49]. Interestingly, studies have also shown that violence reduction follows social cognitive training in individuals with severe mental illness [50,51]. Our current results suggest a particular need for incorporating social cognitive training in the treatment of persons with schizophrenia and a history of violence.

Role of the funding source

This study was supported by Vestre Viken Hospital Trust, Norway [grant number 9603009 to BRR]. The funding source was not involved in study design, analysis, or interpretation of data.

CRediT authorship contribution statement

Anja Vaskinn: Conceptualization, Methodology, Investigation, Formal analysis, Resources, Writing – original draft, Writing – review & editing, Supervision. **Katharina N. Engelstad:** Investigation, Methodology, Writing – review & editing. **Manuel Zamparini:** Methodology, Formal analysis, Writing – review & editing, Visualization. **Giovanni de Girolamo:** Conceptualization, Methodology, Writing – review & editing. **Anne-Kari Torgalsbøen:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Bjørn Rishovd Rund:** Conceptualization, Methodology, Resources, Writing – review & editing, Supervision, Project administration.

Declaration of Competing Interest

Dr. Vaskinn received consulting fees from VeraSci Inc. None of the other authors report any conflict of interest.

Acknowledgement

The authors wish to thank the participants and collaborating units.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.comppsych.2023.152391.

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