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ORIGINAL PAPER

Facial emotion recognition in people with schizophrenia and a history of violence: a mediation analysis

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Abstract

Evidence for an association between impaired facial emotion recognition and violence in people with schizophrenia is inconclusive. In particular, the role of misidentification patterns involving specific emotions such as anger and the influence of clinical characteristics on this association remain unclear. In this study, we compared facial emotion recognition performance in age- and gender-matched schizophrenia spectrum disorders subjects with ($N=52$) and without ($N=52$) a history of violence. Data on current symptom severity, Cluster B personality status, past victimization, and alcohol and substance misuse were also collected. Compared to those without, subjects with a history of violence showed worse facial emotion recognition performances, involving anger, fear, disgust, sadness, and happiness. When formally testing the reporting of angry faces, evidence of enhanced sensitivity to anger was not supported. Finally, when the impact of current symptoms was assessed, higher severity of activation symptoms, including motor hyperactivity, elevated mood, excitement and distractibility, mediated the relationship between history of violence and poor facial emotion recognition performance. As a whole, our findings seem to support the role of perceptual deficits involving different emotions as well as of a mediation played by activation symptoms. Facial emotion recognition deficits associated with the propensity to violence, as well certain symptoms mediating their relationship, should be targeted by specific treatment approaches.

Keywords Facial emotion recognition · Violence · Schizophrenia · Mediation analysis

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Introduction

Facial Emotion Recognition (FER) is often impaired in people with schizophrenia [1, 2]. The degree of this deficit seems to be associated with illness-related factors and understandably with current medication [3]. FER deficits in schizophrenia more often involve negative emotions such as anger, fear and disgust [4, 5], and include a general tendency to misidentify negative valence facial emotions [5, 6]. These impairments in patients' abilities to recognize the facially expressed emotions of other people have a negative impact on global levels of functioning [7], including social skills [5, 8, 9] and propensity to violence [10].

Explanatory theories based on the General Aggression Model (GAM) [11] suggest that the cognitive, personality and affective characteristics of a person in a particular social situation might influence propensity to violence [12]. For example, violent offenders experience a bias to perceive neutral and ambiguous social signs as hostile ("hostile

attribution bias") [13, 14], but also a tendency to misidentify anger in non-angry facial expressions [15–17]. A hostile attribution bias may be a mechanism leading to violence because of perceived, misinterpreted, threats [18]. However, research examining FER performance among violent subjects suffering in particular from schizophrenia has provided mixed results [19]. For instance, the degree of FER impairment, especially for fear and anger recognition [20], has been reported to be larger in violent compared to non-violent subjects [21, 22]. However, these differences could not be detected in other studies [23], and a recent one found even better scores for fear and anger recognition among violent subjects with schizophrenia [24].

It is plausible to hypothesize that other individual factors may influence the relationship between impaired FER and violence in people with schizophrenia. For example, violence propensity in this clinical population is associated with higher levels of active positive psychotic symptoms, alcohol and substance misuse [25, 26], younger age and co-morbid Cluster B personality [3, 27, 28], as well as with traumatic experiences during childhood [29]. Co-morbid antisocial personality disorder is also likely to influence FER performance in schizophrenia [30, 31].

This study aimed to explore which individual characteristics of subjects with schizophrenia may influence the association between FER performance and their propensity to violence using a community sample of subjects with schizophrenia spectrum disorders (SSDs) and a history of violence compared to age- and gender-matched SSDs subjects without a similar history. We hypothesized that, after adjusting for certain clinical confounders, people with SSDs and a history of violence would perform worse on FER as compared with non-violent subjects. Furthermore, we aimed to test whether the relationship between FER performance and violence might be potentially mediated by factors known to be associated with violence such as symptom severity, substance and alcohol misuse, and co-morbid Cluster B personality.

Methods

Participants

We recruited 104 subjects with SSDs from four Departments of Mental Health in Northern Italy. Participants with ($N = 52$) and without ($N = 52$) a history of violence in the past 10 years were matched by age and gender. We defined subjects with a history of violence as those who had committed at least one episode of violence that led to physical injury of the victim. Violence-related data were extracted from the medical records and verified with clinical staff. All subjects met the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV-TR) [32] criteria for an SSD using the Italian version of the Structured Clinical Interview for DSM for Axis I Disorders (SCID-I) [33]. Exclusion criteria were based on a diagnosis of mental retardation, dementia or organic brain disorder, epilepsy, and significant traumatic brain injury. All participants provided written informed consent to participate after a comprehensive description of the study aims and procedures. Ethics Committee of each recruiting centre approved the study.

Instruments

Sociodemographic and clinical variables

Sociodemographic, substance misuse, and current treatment information was collected from the clinicians responsible for the care programme. Data on history of violence, early life violence and victimization were recorded using a standardized form, as reported by both clinicians and patients. Current symptoms were assessed using the Brief Psychiatric Rating Scale-Expanded (BPRS-E) [34, 35]. The BPRS-E rates 24 psychiatric symptoms on a seven-point Likert scale, where lower scores indicate fewer symptoms (range 24–168). Following established methods [36], the BPRS-E scores were summarized into four dimensions: positive, negative, affective and activation symptoms. Four items, unusual thought content, hallucinations, suspiciousness, and grandiosity, define the BPRS-E positive symptom domain. The BPRS-E negative symptoms include blunted affect, emotional withdrawal, and motor retardation. The BPRS-E affective dimension encompasses items assessing anxiety, depression, guilt, and suicidality. Finally, four items, motor hyperactivity, elevated mood, excitement, and distractibility, define the BPRS-E activation dimension.

Functioning

The Italian version of the Specific Level of Functioning (SLOF) [37] scale was completed by clinicians responsible for care programmes, to evaluate participants' daily life abilities across six factors, considered over the past 7 days. These were physical functioning (range 5–25), personal care skills (range 7–35), interpersonal relationships (range 7–35), social acceptability (range 7–35), activities of community living (range 11–55), and work skills (range 6–30). The SLOF consists of 43 items, each rated on a five-point Likert scale (1 = poorest functioning, 5 = best functioning), with total scores ranging from 43 to 215, and higher ones indicating better overall functioning.

Cluster B personality co-morbidity

The presence of co-morbid personality disorder traits was established using the Italian version of the Millon Clinical Multiaxial Inventory-III (MCMI-III) [38]. The MCMI-III consists of one hundred and seventy-five self-report items, and maps onto DSM-IV-TR diagnoses. For this study, four domains related to Cluster B personality disorder traits were considered (histrionic, narcissistic, antisocial and borderline). A base rate equal to or greater than 75 was used to identify Cluster B personality conditions [38].

FER

FER accuracy was measured using the Facially Expressed Emotion Labelling (FEEL) test [39]. The FEEL is a computer-based test that includes a set of 42 male and female, emotional faces from the Japanese and Caucasian Facial Expressions of Emotion series (JACFEE) [40] and has good reliability (Cronbach's alpha, $r = 0.76$) [39]. Pictures of faces showing one of the six basic emotions (i.e., anger, disgust, sadness, fear, surprise, happiness) [41] are displayed for 3 s, after the same face has been shown in the neutral state for 1.5 s. Subjects are asked to name the emotion shown. Based on the number of correct responses, the overall FEEL score can range from 0 to 42, while the accuracy for each emotion ranges from 0 to 7. We used the overall FEEL score as measure of FER performance. We also calculated the misidentification scores for each of the six emotions. Following previous studies [16], we defined misidentification as the tendency to confuse different emotions, for example, labelling happiness as fear. In particular, we focused on the misidentification of anger from other emotions to check for the presence of a hostile misattribution bias on FER performance.

Violence

History of violence was double-checked by a self-report questionnaire, the Brown–Goodwin Lifetime History of Aggression (BGHA) [42]. In addition, current aggressive behaviours were assessed with the Modified Overt Aggression Scale (MOAS) [43]. This is a five-point Likert scale across four behavioural dimensions, including verbal violence, physical violence against objects, against the self, and against others. Higher MOAS scores indicate increasing severity of violence. The score in each dimension is multiplied by a factor, i.e., 1 for verbal, 2 against property, 3 against the self and 4 against others [43]. Thus, the MOAS weighted total score ranged from 0 to 40.

Statistics

Between-group differences in demographic and clinical characteristics that may assume the role of potential confounders among people with SSDs and violence, such as gender, age, education, clinical characteristics, symptoms severity, alcohol and/or substance misuse, and Cluster B personality co-morbidity, were tested. Comparisons were made using Pearson's Chi-square test, Fisher's exact test, ANOVA, or Mann–Whitney test, according to the nature of the data. Between-group differences in FER performance were investigated in terms of FEEL accuracy scores. FEEL sub-scores, based on the number of correct responses for each of the six emotions, were explored between those with and without a history of violence. As most of these data were not normally distributed, we used non-parametric tests. In addition, focusing on those subjects who made at least one FER misidentification error, we calculated, in each group and for each emotion, the proportion of subjects who made misidentification errors. Combining across emotions, we explored potential disproportionate faces reporting of certain emotions (e.g., anger) in misidentification errors. Thus, we carried out negative binomial regression models to test reporting differences by history of violence. These analyses were supplemented by further regression analyses evaluating the association between history of violence and overall FER performance, yielding regression coefficients with 95% CIs, with a Box–Cox power transformation applied to the dependent variable. Due to the novel and exploratory nature of this study, we focused on the relationship between the history of violence and FER performance, exploring whether this was a direct relationship or through putative intervening/mediator variables such as psychotic symptoms severity. Thus, we dealt with the following intervening model: history of violence was postulated to exert an effect on FER performance through candidate variables (e.g., psychotic symptoms severity). Although the most widely used approach to deal with mediation is causal step approach by Baron and Kenny [44], other methods support hypotheses which test the intervening variable effect. We adopted the bootstrapping method as it appears promising, among these alternatives, to quantify the indirect effect rather than to infer the existence from a set of tests on constituent paths [45]. Consistently, resampled data sets were generated and the product of coefficients $a \times b$ (a = coefficient for history of violence in a model predicting the candidate mediator variable from history of violence; b = coefficient in a model predicting FER performance from the candidate mediator variable) was repeatedly recorded. An inference was made about the size of the indirect effect using the k estimates to generate confidence intervals, based on an empirical estimation of the sampling distribution [46].

Statistical significance was set at $p < 0.05$. We analysed data using Stata [47].

Results

Sociodemographic and clinical characteristics

Most subjects were male and single (Table 1). No between-group differences were observed in terms of illness duration, education and marital status, but violent subjects were more likely than non-violent ones to be unemployed. The vast majority of participants were prescribed antipsychotic medication, with no differences between groups. Relatively few participants had misused alcohol or other substances in the preceding year (21.15% of the whole sample), though almost two-fifths had a co-morbid Cluster B condition (37.50%). They were more likely to report episodes of violence in the past including assaults ($n = 44$, 86.27%), other kind of assaults ($n = 3$, 5.88%), sexual violence ($n = 3$, 5.88%), and stalking ($n = 1$, 1.96%).

Symptoms and global functioning

Symptom severity, as measured by BPRS-E, was similar in the two groups (Table 1), apart from the BPRS-E activation dimension: subjects with a history of violence scored higher than their non-violent-counterpart (mean, SD = 5.94, 2.44 vs. 4.88, 1.68, $p = 0.009$). Mean global functioning as measured by SLOF was lower among violent as compared with non-violent subjects in terms of social acceptability (mean, SD = 24.64, 4.10 vs. 27.45, 2.48, $p = 0.0001$) and total scores (mean, SD = 166.24, 22.14 vs. 178.02, 17.84, $p = 0.006$) (Table 1).

Violence

BGHA scores confirmed that SSD subjects in the violent group reported lifetime violence more often than non-violent ones (mean, SD = 38.45, 11.71 vs. 31.64, 8.21; $p = 0.007$). They were also more likely to report violent behaviours in the 2 weeks before the assessment, showing greater MOAS overall scores, particularly considering the verbal dimension (mean, SD = 0.48, 0.92 vs. 0.10, 0.30; $p = 0.010$) (Table 1).

Facial emotion recognition

Five participants in each group did not complete the task due to poor motivation. Subjects with a history of violence performed worse on the FEEL test as compared with non-violent subjects (Table 1). They scored lower on recognition of anger (mean, SD = 3.49, 2.33 vs. 4.57, 2.03; $p = 0.022$), fear (mean, SD = 3.70, 1.92 vs. 4.60, 2.00; $p = 0.023$), sadness (mean, SD = 4.30, 1.93 vs. 5.28, 1.86; $p = 0.015$), disgust (mean, SD = 4.55, 1.95 vs. 5.43, 1.72; $p = 0.020$), and happiness (mean, SD = 5.98, 1.48 vs. 6.60, 0.95; $p = 0.006$). Examining the patterns of errors, subjects with a history of violence committed misidentifications more frequently than non-violent ones (Table 2). Specifically, they most commonly misrecognized fear as surprise (70% vs. 43%), sadness as surprise (49% vs. 23%) and disgust as both sadness and surprise (36% vs. 15%, and 25% vs. 6%, respectively). Furthermore, even if not at a statistically significant level, fear, sad and happy facial expressions appeared most commonly misrecognized as angry facial expressions by subjects with a history of violence (21% vs. 17%, 19% vs. 15% and 8% vs. 2%, respectively). Conversely, a greater number of non-violent subjects misidentified disgusted faces as angry (57% vs. 53%) and surprised faces (13% vs. 2%). We thus carried out a negative binomial regression model to further test the reporting of angry faces in terms of other emotions misidentification errors, hypothesizing a higher proportion of angry faces for subjects with a history of violence. This model did not show any statistically significant estimate (coefficient = 0.119, $p = 0.573$).

We then performed a multiple linear regression analysis to explore the relationship between the history of violence and FER performance (Table 3), including in the model potential confounders identified from univariate analyses and existing literature. Subjects with a history of violence performed worse on FER, even after controlling for sociodemographic and clinical characteristics. However, we could uncover a potential mediating role for symptom severity, as measured by the BPRS-E activation dimension, in the relationship between history of violence and FER performance (Table 3). The BPRS-E activation dimension explained about 18% of the overall effect of history of violence on FER performance.

Discussion

The relationship between FER and violence in schizophrenia has been poorly studied so far. In this study, we measured FER accuracy of community subjects suffering from SSDs, with and without a history of violence, matched by age and gender. We explored also the patterns of facial expression misidentifications and considered the role of potential confounding and mediating factors on this relationship. This study yielded several important findings.

First, violent subjects with SSDs performed significantly worse on FER as compared with non-violent subjects on all emotions, except surprise. Consistently with previous evidence [6], the impairment was severe for negative emotions, including anger and fear recognition, followed by sadness and disgust. Previous studies

Table 1 Socio-demographic and clinical variables by history of violence

Variables	Total *N* = 104	Violent *N* = 52	Non-violent *N* = 52	*p* value
Age, years mean (SD)	46.22 (10.07)	46.37 (10.36)	46.08 (9.86)	0.886[a]
Male gender	87 (83.65%)	44 (84.62%)	43 (82.69%)	0.791[b]
Marital status, single	91 (87.50%)	47 (90.38%)	44 (84.62%)	0.374[b]
Education (high school or higher)	37 (35.58%)	14 (26.92%)	23 (44.23%)	0.065[b]
Unemployed*	39 (37.50%)	25 (48.08%)	14 (26.92%)	0.026[b]
Illness duration, yrs. mean (SD)	19.84 (9.31)	20.75 (10.44)	18.92 (8.02)	0.319[a]
Domestic violence episodes*	20 (21.05%)	16 (33.33%)	4 (8.51%)	0.005[c]
If yes, is the patient the victim?	13 (65.00%)	12 (75.00%)	1 (25.00%)	N/A
At least one compulsory admission in the last year	6 (5.83%)	3 (5.88%)	3 (5.77%)	N/A
Antipsychotic treatment				0.590[c]
None	2 (1.98%)	1 (2.04%)	1 (1.92%)	
FGAs only	16 (15.84%)	10 (20.41%)	6 (11.54%)	
SGAs only	68 (67.33%)	30 (61.22%)	38 (73.08%)	
FGAs and SGAs	15 (14.85%)	8 (16.33%)	7 (13.46%)	
Misuse of alcohol or substances, last year				0.150[b]
None	82 (78.85%)	38 (73.08%)	44 (84.62%)	
Yes	22 (21.15%)	14 (26.92%)	8 (15.38%)	
Current aggressive behaviours (MOAS) mean (SD)				
Verbal violence*	0.29 (0.71)	0.48 (0.92)	0.10 (0.30)	0.010[d]
Violence against objects	0.97 (0.41)	0.17 (0.55)	0.02 (0.14)	0.053[d]
Self-violence	0.01 (0.10)	0.02 (0.14)	0 (0)	0.322[d]
Violence against other people	0.06 (0.37)	0.12 (0.51)	0 (0)	0.083[d]
Total score*	0.75 (2.44)	1.35 (3.30)	0.14 (0.49)	0.003[d]
MCMI-III Cluster B personality co-morbidity	39 (37.50%)	21 (40.38%)	18 (34.62%)	0.543[b]
BPRS-E symptoms mean (SD)				
Affect	6.68 (2.49)	6.79 (2.60)	6.58 (2.40)	1.000[d]
Activation*	5.41 (2.15)	5.94 (2.44)	4.88 (1.68)	0.009[d]
Positive symptoms	7.38 (3.06)	7.92 (3.43)	6.85 (2.55)	0.166[d]
Negative symptoms	6.20 (3.15)	5.96 (2.92)	6.44 (3.39)	0.474[d]
Total score	40.27 (10.98)	42.04 (11.85)	38.43 (9.78)	0.101[a]
SLOF global functioning mean (SD)				
Physical functioning	24.27 (1.42)	24.32 (1.23)	24.21 (1.60)	0.595[d]
Personal care skills	32.44 (3.76)	32.20 (3.84)	32.67 (3.70)	0.697[d]
Interpersonal relationship	23.10 (5.74)	22.53 (6.12)	23.65 (5.34)	0.153[d]
Social acceptability*	26.06 (3.65)	24.64 (4.10)	27.45 (2.48)	0.0001[d]
Activities of community living	46.72 (8.06)	45.28 (8.78)	48.10 (7.12)	0.119[d]
Work skills	20.67 (6.38)	19.63 (6.36)	21.69 (6.29)	0.106[d]
Total score*	172.43 (20.75)	166.24 (22.14)	178.02 (17.84)	0.006[d]
FEEL accuracy	Mean (SD) Median (IQR)			
Anger*	4.03 (2.24) 4 (4)	3.49 (2.33) 3 (3)	4.57 (2.03) 5 (3)	0.022[d]
Sadness*	4.79 (1.95) 5 (4)	4.30 (1.93) 4 (3)	5.28 (1.86) 6 (3)	0.015[d]
Disgust*	4.99 (1.88) 5 (3)	4.55 (1.95) 5 (3)	5.43 (1.72) 6 (3)	0.020[d]
Surprise	5.51 (1.76) 6 (2)	5.28 (1.86) 6 (3)	5.74 (1.63) 6 (2)	0.150[d]
Happiness*	6.29 (1.28) 7 (1)	5.98 (1.48) 6 (1)	6.60 (0.95) 7 (0)	0.006[d]

Table 1 (continued)

Variables	Total $N=104$	Violent $N=52$	Non-violent $N=52$	p value
Fear*	4.15 (2.00) 4 (3)	3.70 (1.92) 4 (3)	4.60 (2.00) 5 (2)	0.023[d]
Total score*	29.88 (7.24) 32 (11)	27.49 (6.95) 29 (10)	32.28 (6.78) 34 (9)	0.0005[d]

Values are numbers *N* (%), unless stated; *BPRS-E* Brief Psychiatric Rating Scale-Expanded, *FEEL* Facial Emotion Expression Labeling, *FGAs/SGAs* first-/second-generation Antipsychotics, *MCMI-III* Millon Clinical Multiaxial Inventory-III, *MOAS* Modified Overt Aggression Scale, *SD* standard deviation, *SLOF* specific level of functioning

*Statistically significant differences between groups at $p<0.05$

[a]ANOVA; [b]Pearson's Chi-square test; [c]Fisher's exact test; [d]Wilcoxon-Mann–Whitney test

Table 2 Patterns of misidentifications at FEEL test by history of violence

FEEL emotion presented	Emotion confused with					
	Anger	Sadness	Disgust	Surprise	Happiness	Fear
Anger						
Violent	–	36%	68%	47%	6%	40%
Non-violent		32%	62%	21%	6%	28%
Sadness						
Violent	19%	–	51%	49%*	6%	32%
Non-violent	15%		32%	23%*	11%	32%
Disgust						
Violent	53%	36%*	–	25%*	8%	25%
Non-violent	57%	15%*		6%*	8%	13%
Surprise						
Violent	2%	11%	30%	–	19%	47%
Non-violent	13%	4%	17%		11%	34%
Happiness						
Violent	8%	19%	13%	21%	–	8%
Non-violent	2%	4%	6%	15%		2%
Fear						
Violent	21%	30%	45%	70%*	6%	–
Non-violent	17%	17%	43%	43%*	4%	

FEEL facial emotion expression labelling

*Significant differences between groups at $p<0.05$

Table 3 Multivariable model exploring the association between history of violence and FER performance

Variable	Standardized beta	p value	% (95% CI)
History of violence*	−0.28	0.005	
Male gender[a]	−0.005	0.957	
Age*	−0.31	0.003	
Education[b]	0.08	0.433	
Alcohol and/or substance misuse	0.01	0.909	
BPRS-E activation*	−0.26	0.008	
MCMI-III Cluster B condition	−0.10	0.314	
Mediator: BPRS-E activation			
% of total effect mediated	–	–	18.34 (11.33; 44.33)

BPRS-E Brief Psychiatric Rating Scale-Expanded, *MCMI-III* Millon Clinical Multiaxial Inventory-III

Reference categories: [a]female; [b]compulsory education only. *Significant differences at $p<0.05$

had actually reported mixed results of FER deficits for anger and fear identification in violent schizophrenia [3, 5]. Weiss and colleagues [20], for example, found a correlation between the number of arrests for violent crimes and difficulties in recognizing fear and anger in men with SSDs. Our findings seem suggesting similar evidence about impairment for angry faces recognition in participants with history of violence, who appeared also to misidentify happy, sad, and fearful faces as angry. However, when formally testing the reporting of angry faces, evidence of enhanced sensitivity to anger was not supported, similar to previous research involving both merely violent offenders [48] and violent people with SSDs [22]. Facial fear and anger may thus convey different social meanings and elicit distinguishable behavioural responses, with anger influenced by relational threats, while fear related to signals of environmental dangers [41, 49]. As a whole, our findings, though based on a clinical population, seem supporting the role of a perceptual deficit involving different emotions. These findings are consistent also with evidence from violent offenders without schizophrenia in terms of fearful expressions [48]. On the other hand, an enhanced sensitivity to anger cannot be claimed. Whether a complex link might exist among violent people with SSDs, ranging from the misperception of threatening stimuli to abnormal anger response [50], low frustration tolerance [51], and eventually to wider executive deficits [52], is matter for future research.

Second, we found that subjects with a history of violence misidentified also disgust and sadness more often than non-violent ones. We could thus confirm both poor disgust recognition and a tendency to mislabel disgust with other emotions in violent people with schizophrenia [5]. In particular, we observed that disgust was more frequently confused by violent subjects with two other emotions, i.e., sadness and surprise. Since disgust represents an emotion affecting social behaviour, keeping away someone considered offensive or unpleasant [53], it might be hypothesized that this difficulty in the identification of avoidant emotions may lead to inappropriate behaviour in violent people with schizophrenia. Future research should deal also with cognitive interventions targeting patterns of emotions misidentification to verify whether these might reduce also the risk of repeated violence in people with schizophrenia [54].

Finally, we uncovered the role of activation severity as an intervening variable in the relationship between FER and history of violence, envisioning that the association between FER and violence is potentially mediated by activation severity, as measured by BPRS-E [36]. This is consistent with recently published findings [55], which identify a pattern based on impulsive dyscontrol, impaired FER, anger and excitement, leading to violence in people with schizophrenia. Nonetheless, it is likely that the complex interrelationship among activation and FER may involve other domains such as distractibility, conceptual disorganization and disorientation [56, 57].

This study has a number of limitations. The relationship between history of violence, FER performance, and intervening variables was addressed hypothesizing a logical ordering according to theoretical grounds. However, the observational nature of our study precludes any causal inference. Therefore, the current model, based on symptoms severity as an intervening variable, can provide just a rough picture of influences exerted and cannot comprehensively confirm the concept of a formal mediation that is instead invoked by cause–effect relations [46]. In addition, the low number of subjects with co-morbid Cluster B personality, history of victimization, current aggressive behaviours and substance or alcohol misuse, did not allow examining the potential impact of these confounders. We did not control also for psychopathy, neurocognitive abilities and social cognition which may have an impact on violence [31, 58, 59]. Furthermore, due to the limited sample size, we combined across emotions to increase power of analyses assessing disproportionate misidentification errors in FER. Other methodological limitations involve the need of using more accurate measures for psychopathology and for FER, as the instrument chosen does not assess dynamic facial expressions.

Conclusion

Despite its limitations, the present study makes a contribution to the clinical forensic literature suggesting that in people suffering from SSDs the underlying deficit in emotion recognition associated with the propensity to violence may be at least partly mediated by activation symptoms. Emotion misidentification and activation assessment could be thus included among routine measures for people with schizophrenia and a history of violence. Clinical programs targeting FER deficits and activation symptoms might reduce violence relapses [60].

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Compliance with ethical standards

Conflict of interest The authors declare they have no conflict of interest.

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