



## Mentalization and empathy as predictors of violence in schizophrenic patients: Comparison with nonviolent schizophrenic patients, violent controls and nonviolent controls

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### ABSTRACT

There are conflicting results concerning risk of violence in schizophrenia. Empathy and mentalization deficits are associated both with schizophrenia and violence, however, there are only a few studies with equivocal results concerning their relationship. 88 violent and nonviolent paranoid schizophrenic and violent and nonviolent control males in psychiatric, forensic psychiatric and correctional institutions completed the Ekman 60 Faces test, Faux Pas Recognition Test, Eysenck IVE test, Interpersonal Reactivity Index, and the Spielberger Anger Expression Scale. Data were analysed with ANOVA and logistic regression models. Significant group differences with a characteristic pattern were detected in mentalization, facial affect recognition, fear and anger recognition, interpersonal distress, and frequency of direction of anger expression. Predictors of violent behaviour were different in the schizophrenic and non-schizophrenic groups. Lack of major differences in empathy and mentalization between violent and nonviolent schizophrenia patients suggests that such deficits are core features of schizophrenia but do not determine emerging violence in this illness. Our results emphasise the importance of distinguishing between violence related to core positive symptoms of schizophrenia and that emerging from independent comorbid antisocial personality traits in order to identify targets for screening, detection, prevention and management of violence risk in different subpopulations of schizophrenia patients.

### 1. Introduction

Although the majority of psychiatric patients never perform any violent or aggressive behaviour and they make up only a small proportion of violent offenders (Huszár, 2010; O'Reilly et al., 2015; Varshney et al., 2016), the association of major mental disorders and criminality has always been surrounded by high interest and debate. In case of schizophrenia, there is a great variability in the conclusion of studies concerning the risk of violence in subjects with this illness. While some studies suggest that altogether schizophrenia and psychoses *per se* (i.e. without comorbid substance use disorder) have minor, if any, influence on the risk of violence (Bo et al., 2011; Elbogen and Johnson, 2009; Varshney et al., 2016), a large number of papers indicate that schizophrenia is associated with aggressive behaviour as well as increased risk for violent and non-violent crimes (Fazel et al., 2009; Hodgins, 2008; Nestor, 2002; Short et al., 2013; Swanson et al., 1990; Van Dorn et al., 2012; Witt et al., 2013) showing the contradiction of

the relationship between schizophrenia and criminality and violence. In addition, such mediators as stigma, shame and powerlessness may also play a role in violence in schizophrenia, while the genetic explanation of schizophrenia as a genetically based disorder not only significantly enhanced stigmatising attitudes towards patients even among medical professionals but also influenced the perception of other people's beliefs about dangerousness and unpredictability of schizophrenia patients and desire for social distance from them (Serafini et al., 2011).

In order to identify factors contributing to violence in schizophrenia, phenomena beyond the disease itself should also be considered. Violent actions take place in special social and ecological contexts which include among others the patient with their own history, health status, condition and environmental effects (Swanson et al., 2006).

Research aiming to understand the background of violent behaviour in schizophrenia has largely focused on four main factors. These factors include psychotic symptoms (Douglas et al., 2009; Haddock et al.,

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2013; Teasdale, 2009), comorbid substance abuse (Elbogen and Johnson, 2009; Fazel et al., 2009; Richard-Devantoy et al., 2013; Short et al., 2013; Slijepevic et al., 2014; Van Dorn et al., 2012), antisocial personality disorder (Abu-Akel et al., 2015; Huber et al., 2016; Nolan et al., 1999; Sedgwick et al., 2017), and treatment status (and adherence to treatment) (Fazel et al., 2014; Witt et al., 2013). Whilst these studies provide valuable data for the understanding of violent behaviour in schizophrenia, research so far has not given much emphasis to such processes and capacities as mentalization and empathy, which are relevant both to violence and schizophrenia.

Impairments of social cognition and empathic attunement are major characteristics of schizophrenia and its extent is directly proportional to the functional outcome (Bora et al., 2006; Fett et al., 2011). In more precise terms, schizophrenia is associated with impairments of representing mental states which can lead to deterioration of the ability to monitor the thoughts and intentions of others (Corcoran et al., 1995; Frith, 2004; Pickup and Frith, 2001).

Theory of mind (ToM) refers to the cognitive aspect of empathy and is defined as the ability to understand and conceptualize the mental states or feelings of others. It allows an individual to predict and understand another person's behaviour (Baron-Cohen and Wheelwright, 2004). Impairments in ToM may result in a bias in the internal representation of others' intentions which, in turn, may lead to ideas and beliefs that others are concealing their true intentions, leading then to the development of persecutory beliefs or delusions (Doody et al., 1998), symptoms and attributional styles which, besides an integral feature of certain types of schizophrenias may be linked to violence (Bo et al., 2011; Swanson et al., 2006).

Excessive amount of research data suggest that schizophrenic patients have an impaired ability to recognize emotions and facial expressions of others (Kohler et al., 2010; Marwick and Hall, 2008); this inability has as an expressed presence in the case of negative emotions like fear, sadness, anger and disgust (Edwards et al., 2001; Hall et al., 2008; Kohler et al., 2003). Silver et al. (2005) comparing violent and nonviolent schizophrenic patients to healthy controls reported that both patient groups were less able to recognize emotions, though the violent group performed better in perceiving happy and sad facial emotions compared to the non-violent group. Presumably this impaired ability incurs further dysfunction in reacting appropriately to signs of conflict and this has a negative effect on social interactions (Harris and Picchioni, 2013).

Early research underlines the fact that better understanding of different emotional mental states can help reduce the probability of patients committing violent acts (Miller and Eisenberg, 1988). Later studies report that providing patients with empathy education facilitates the reduction of their aggressive behaviour and hostile responses, and increases the propensity to perform socially appropriate behaviour (Darmedru et al., 2017; Eisenberg and Fabes, 1990; Romero-Martinez et al., 2016).

Further research examined the association between violence and mentalizing abilities in forensic and non-forensic patients with schizophrenia. Results underline that the ability to make empathic inferences decreases the propensity for violence, whilst demonstrating comprehension of cognitive mental states increases the possibility thereof (Abu-Akel and Abushua'leh, 2004; Majorek et al., 2009). The association of intact cognitive mentalizing abilities with increased risk of violence may appear paradoxical; however, taking it into account that these abilities foster manipulative and deceptive acts, mentalizing can be an effective way to manipulate their victims (Abu-Akel and Abushua'leh, 2004) and commit premeditated violent crimes (Rice, 1997).

Since the number of available studies on the relationship between schizophrenia, violence, mentalization and empathy is limited, more profound investigations are essential. The current research compares mentalization and empathic abilities of violent and non-violent schizophrenia patients to nonviolent and violent healthy control subjects.

We hypothesised that differences in distinct aspects of mentalization and empathy are associated with violence in schizophrenic patients and that therefore we expected significant differences in measures assessing these capacities in violent and nonviolent patients. To control for the effect of schizophrenia on mentalization and empathy, we also used violent and nonviolent nonschizophrenic groups for comparison.

## 2. Method

### 2.1. Participants

88 adult males participated in the study, including 22 violent paranoid schizophrenic patients (V-SCH), 22 nonviolent paranoid schizophrenic patients (NV-SCH), 22 violent controls (V-CRL) and 22 nonviolent controls (NV-CRL) matched according to sex and education. Enrolment and assessment of patients took place between August 2016 and May 2017. Diagnoses were given by psychiatrists of the assigned institutes based on SCID interviews and clinical judgement. Patients diagnosed with other schizophrenia subtypes or schizoaffective disorder, as well patients suffering from any other neuropsychiatric disorders or mental retardation were excluded. Both violent and nonviolent patients with schizophrenia were hospitalized at the time of their inclusion but they were in remission (before emission in case of nonviolent patients) and receiving medication. Medications in both schizophrenia groups included clozapine, sulpride, amisulpride, olanzapine, quetiapine, aripiprazole, sertindole, ziprasidone, risperidone in the atypical group and haloperidol, trifluoperazine, chlorpromazine, thirodazine, chlorprotixen and zuclopenthixole in the typical group. Long acting injectable formulations of paliperidone and olanzapine were also used in patients. Information on medication status is provided in Table 1. V-SCH subjects – recruited from the Forensic Psychiatric and Mental Institution in Hungary – have a criminal record and have committed violent criminal acts. The V-CRL group was selected from the Márianosztra Strict and Medium Regime Prison. The NV-SCH group was recruited from general psychiatric wards. For members of the NV-CRL group, exclusion criteria were history of any psychiatric diagnosis, mental retardation and any type of felony. Selection of the NV-CRL group was performed by opportunity sampling. The study was carried out in accordance with the Declaration of Helsinki, and ethical

**Table 1**  
Sociodemographic characteristics of the sample.

	Patient groups		Control groups	
	V-SCH	NV-SCH	V-CRL	NV-CRL
N	22	22	22	22
Mean Age (in years)	36.23	37.40	33	28
Mean Duration of Education (in years)	12.09	11.86	11.45	12.72
Medication (%) <sup>a</sup>				
atypical antipsychotics	41	73		
typical antipsychotics	14	9		
both	36	14		
benzodiazepines	86	77		
antidepressants	9	18		
Alcohol use (%)				
Never tried	13.6	40.9	9.1	31.8
Occasional	50	40.9	59	54.5
Regular	31.8	18.1	31.8	13.6
Regular in the past	4.5	0	0	0
Drug use (%)				
Never tried	22.7	54.5	36.4	22.7
Only tried	36.4	18.1	54.5	45.5
Rare	4.5	9.1	9.1	13.6
Regular	22.7	4.5	0	9.1
Regular in the past	13.6	13.6	0	9.1

<sup>a</sup> In the V-SCH group there was no information on the medication status of 2 patients, while in the NV-SCH no information on medication status was available for one patient.

**Table 2**

Comparison of violent and nonviolent schizophrenic patients and violent and nonviolent controls (V-SCH, NV-SCH, V-CRL, NV-CRL) regarding their performance in various psychometric tasks with one-way ANOVA.

Variable	mean (SD)				F (df = 3)	p	FDR Q
	V-SCH	NV-SCH	V-CRL	NV-CRL			
FP	<b>13.27 (3.16)</b>	<b>12.73 (3.54)</b>	<b>15.64 (1.53)</b>	<b>14.00 (3.13)</b>	<b>4.057</b>	<b>0.010</b>	<b>0.030</b>
EFT60	<b>44.23 (4.40)</b>	<b>39.59 (8.03)</b>	<b>47.36 (4.20)</b>	<b>44.64 (6.46)</b>	<b>6.391</b>	<b>0.001</b>	<b>0.006</b>
Happiness	9.86 (0.64)	9.50 (1.60)	9.91 (0.43)	9.86 (0.47)	0.952	0.419	0.539
Sadness	6.04 (1.76)	5.91 (2.52)	6.32 (1.94)	6.50 (2.06)	0.356	0.758	0.802
Disgust	7.27 (2.37)	6.81 (2.80)	7.86 (1.81)	7.32 (2.98)	0.629	0.599	0.674
Fear	<b>4.50 (2.44)</b>	<b>3.32 (2.56)</b>	<b>5.64 (2.54)</b>	<b>4.36 (2.48)</b>	<b>3.348</b>	<b>0.023</b>	<b>0.046</b>
Surprise +	<b>9.41 (0.73)</b>	<b>8.09 (2.74)</b>	<b>9.50 (0.74)</b>	<b>9.04 (1.21)</b>	<b>3.626</b>	<b>0.016</b>	<b>0.038</b>
Anger	<b>7.14 (1.39)</b>	<b>5.95 (2.50)</b>	<b>8.14 (1.55)</b>	<b>7.55 (1.71)</b>	<b>5.541</b>	<b>0.002</b>	<b>0.009</b>
IRI_PT	16.50 (4.55)	16.14 (5.30)	16.96 (4.77)	16.86 (4.27)	0.137	0.938	0.938
IRI_FS	13.91 (5.73)	17.64 (5.22)	14.04 (5.61)	14.23 (7.14)	1.984	0.123	0.201
IRI_EC	17.36 (4.57)	17.91 (4.22)	15.36 (4.25)	16.64 (6.34)	1.101	0.354	0.490
IRI_PD	<b>9.50 (4.65)</b>	<b>13.86 (4.43)</b>	<b>7.09 (2.94)</b>	<b>9.45 (4.94)</b>	<b>9.443</b>	<b>&lt; 0.001</b>	<b>0.006</b>
AES_Ex	<b>46.36 (5.29)</b>	<b>43.82 (5.79)</b>	<b>50.45 (8.11)</b>	<b>42.41 (7.44)</b>	<b>6.011</b>	<b>0.001</b>	<b>0.006</b>
AES_I	<b>17.18 (3.38)</b>	<b>20.18 (4.14)</b>	<b>17.00 (3.77)</b>	<b>19.55 (4.71)</b>	<b>3.576</b>	<b>0.017</b>	<b>0.038</b>
AES_O	<b>15.27 (3.33)</b>	<b>15.91 (4.03)</b>	<b>19.36 (5.70)</b>	<b>14.59 (4.28)</b>	<b>5.074</b>	<b>0.003</b>	<b>0.011</b>
IVE_I	8.04 (3.39)	9.36 (4.85)	8.32 (5.22)	9.73 (5.30)	0.637	0.593	0.674
IVE_K	13.46 (6.43)	9.91 (4.52)	13.46 (5.71)	12.27 (5.00)	2.059	0.112	0.201
IVE_E	14.86 (4.10)	15.59 (4.26)	13.36 (3.99)	15.68 (3.64)	1.576	0.201	0.302

FP = Faux Pas Test, EFT60 = Ekman 60 Faces Test, IRI = Interpersonal Reactivity Index, IRI\_PT = Perspective Taking, IRI\_FS = Fantasy, IRI\_EC = Empathic Concern, IRI\_PD = Personal Distress; AES = Anger Expression Scale, AES\_Ex = Expression frequency, AES\_I = In, AES\_O = Out; IVE = Eysenck Impulsivity Inventory, IVE\_I = Impulsiveness, IVE\_V = Venturesomeness, IVE\_E = Empathy. Bold type indicates  $p < 0.05$ . + According to Games-Howell post hoc test there are no between groups differences

permission was granted by the Institutional Review Board of participating institutions. All participants agreed voluntarily to take part in the study and provided written informed consent.

## 2.2. Assessment instruments

We estimated alcohol and drug use of participants with the question: "How often do/did you consume alcohol / drugs?". In case of drug use, patients should indicate their answers on a scale scored from 0 ('never tried') to 5 ('regularly'), in case of alcohol consumption the scale ranged from 0 ('never tried') to 4 ('regular').

The Ekman 60 Faces Test (Ekman and Friesen, 1976) was used to evaluate the ability to recognize and identify basic facial emotions (anger, disgust, fear, happiness, sadness, and surprise), using a range of photographs from the Ekman and Friesen series of Pictures of Facial Affect.

The Faux Pas Recognition Test (Varga et al., 2008) was employed to assess mentalization abilities, using 5 faux pas stories and 5 control stories without a faux pas in a constant randomly chosen order followed by two questions for faux pas detection and for understanding inappropriateness and intentions and motives of the speaker (Stone et al., 1998).

Impulsivity, Venturesomeness and Empathy was tested by the Eysenck Impulsivity Inventory (IVE) (Eysenck et al., 1985).

Interpersonal reactivity was evaluated with The Interpersonal Reactivity Index (IRI) (Davis, 1983), a self-report questionnaire commonly used to assess four different dimensions of dispositional empathy including: Perspective Taking – how much the patient is able to spontaneously adopt their peer's psychological attitude; Fantasy – taps respondents' tendencies to transpose themselves imaginatively into the feelings and actions of fictitious characters in books, movies, and plays; Empathic Concern – peer-related feelings, i.e. if they are sympathetic and concerned about the peers; and Personal Distress – measures self-focused responses to others' suffering.

Anger expression was evaluated by the Spielberger Anger Expression Scale (Spielberger et al., 1985), a frequently used self-report measure of the styles of anger expression, assessing tendencies towards inward and outward expressions of anger, by three subscales: Anger Expression, Anger In and Anger Out.

## 2.3. Statistical analyses

Data were analysed using IBM SPSS Statistics 25. To compare groups by demographic characteristics (age, education, alcohol and drug abuse) and test results we used One-Way ANOVA and Tukey HSD or Games-Howell post hoc tests based on variance homogeneity. To correct for multiple comparisons, FDR Q was applied. We constructed logistic regression models to explore the risk factors of homicide behaviour in the whole sample and separately in schizophrenic and non-schizophrenic patients as well.

For all analyses  $p < 0.05$  was accepted as nominally significant, and  $Q < 0.05$  as significant in case of multiple comparisons.

## 3. Results

### 3.1. Demographic variables

Baseline demographic characteristics of the groups are presented in Table 1.

There were no significant differences between the four groups in education ( $F(3) = 1.839$ ,  $p = 0.146$ ). The V-CRL group was significantly younger than the patient groups (V-SCH, NV-SCH) ( $F(3) = 4.299$ ,  $p = 0.007$ ; post hoc  $p = 0.004$  and  $p = 0.030$  as compared to the V-SCH and NV-SCH groups respectively), there was no significant age difference between the two patient groups (V-SCH, NV-SCH) ( $p = 0.983$ ) and the two control groups (V-CRL, NV-CRL) ( $p = 0.309$ ). V-SCH patients tend to use drugs more frequently than V-CRL subjects ( $F(3) = 2.452$ ;  $p = 0.069$ ; post hoc  $p = 0.056$ ). There were no statistically significant differences in drug use between the two patient (V-SCH, NV-SCH) ( $p = 0.322$ ) and the two control groups (V-CRL, NV-CRL) ( $p = 0.827$ ). There is only trend for difference in alcohol use between V-SCH and NV-SCH groups ( $F(3) = 3.135$ ,  $p = 0.030$ ; post hoc  $p = 0.075$ ), with more frequent alcohol use in the V-SCH group. There are no significant differences between the other groups in alcohol use (post hoc  $p > 0.119$  in all cases).

**Table 3**

Differences between violent (V-SCH) and nonviolent schizophrenic (NV-SCH) patients and violent (V-CRL) and nonviolent controls (NV-CRL) in test scores: individual comparison of groups based on post hoc tests.

Variable	Post hoc	V-SCH		NV-SCH		V-CRL	
		NV-SCH	V-CRL	NV-CRL	V-CRL		NV-CRL
FP	Games-Howell	0,949	<b>0,018</b>	0,869	<b>0,007</b>	0,591	0,145
Ekman60Sum	Tukey HSD	<i>0,057</i>	0,311	0,996	<b>0,000</b>	<b>0,032</b>	0,435
Anger	Games-Howell	0,232	0,127	0,820	<b>0,007</b>	<i>0,082</i>	0,630
Fear	Tukey HSD	0,377	0,413	0,998	<b>0,011</b>	0,487	0,312
Surprise	Games-Howell	0,158	0,977	0,630	0,120	0,454	0,449
AES/EX	Tukey HSD	0,597	0,193	0,219	<b>0,009</b>	0,900	<b>0,001</b>
AES/I	Tukey HSD	<i>0,072</i>	0,999	0,217	<b>0,050</b>	0,953	0,163
AES/O	Games-Howell	0,940	<b>0,031</b>	0,935	0,111	0,721	<b>0,016</b>
IRI PD	Tukey HSD	<b>0,006</b>	0,256	1,000	<b>0,000</b>	<b>0,006</b>	0,272

FP = Faux Pas Test, EFT60 = Ekman 60 Faces Test, IRI = Interpersonal Reactivity Index, IRI\_PD = Personal Distress; AES = Anger Expression Scale, AES\_Ex = Expression frequency, AES\_I = In, AES\_O = Out. Bold type indicates significant results, italic type indicates a strong trend.

**3.2. Performance of the different groups on psychometric tasks reflecting mentalization and empathy**

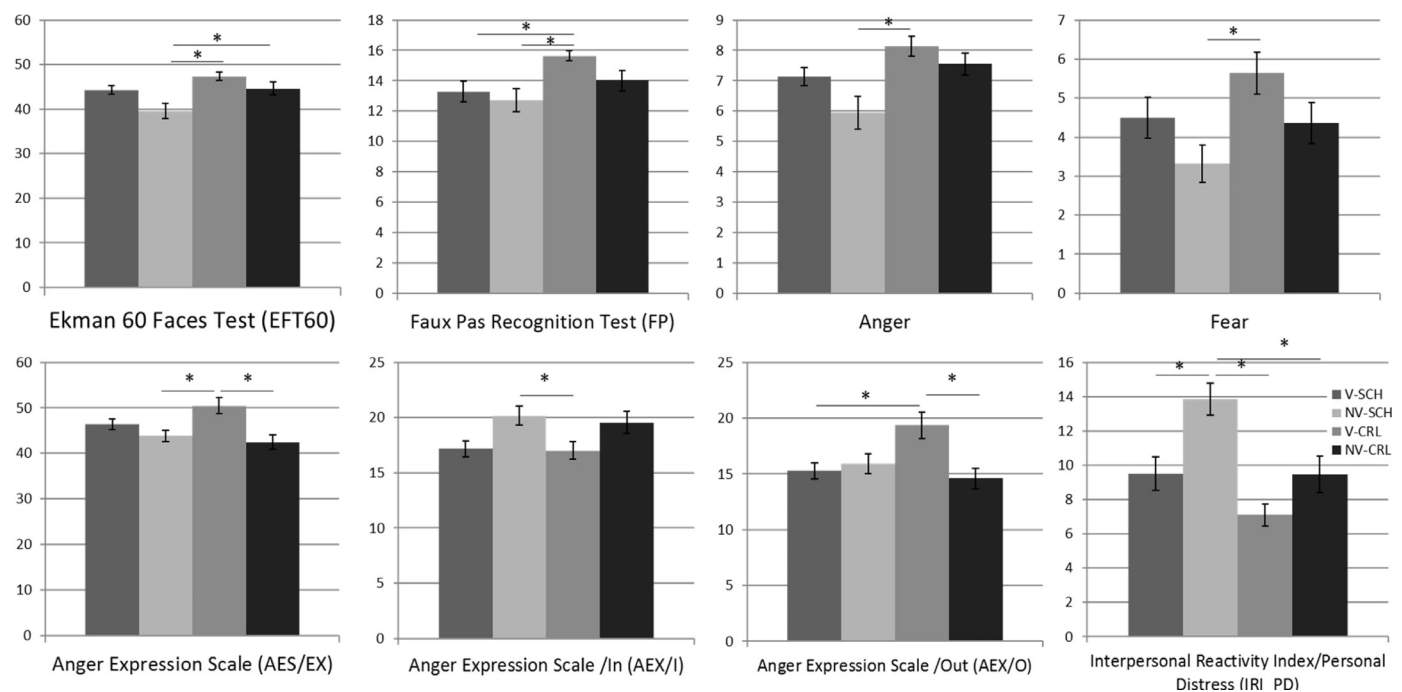
Scores of the investigated groups (V-SCH, NV-SCH, V-CRL, NV-CRL) and their comparisons regarding their performance in various psychometric tasks with one-way ANOVA are shown in Table 2. Individual between group comparison post hoc test significances are shown in Table 3.

**3.2.1. Mentalization and Theory of Mind: performance of violent (V-SCH) and nonviolent schizophrenic (NV-SCH) and violent (V-CRL) and nonviolent control (NV-CRL) groups on the Faux Pas recognition task**

There was a significant difference comparing the four investigated study groups with ANOVA on the Faux Pas Recognition Test measuring mentalization capacities and Theory of Mind (ToM) ( $F = 4.057$ ,  $FDR Q = 0.03$ ). Post hoc tests indicated that the V-CRL groups scored significantly higher than the V-SCH and NV-SCH groups ( $p = 0.018$  and  $p = 0.007$ , respectively) (Tables 2 and 3; Fig. 1).

**3.2.2. Identification of facial emotions: performance of violent (V-SCH) and nonviolent schizophrenic (NV-SCH) and violent (V-CRL) and nonviolent control (NV-CRL) groups on the Ekman faces test**

There was a significant difference between the four investigated study groups on the Ekman faces test measuring emotion recognition ( $F = 6.391$ ,  $FDR Q = 0.006$ ). Post hoc tests indicated that the NV-SCH group had a significantly lower score compared to both the V-CRL and NV-CRL groups and a strong tendency to score lower than the V-SCH group ( $p = 0.000$ ,  $p = 0.032$  and  $p = 0.057$ , respectively). Analysing recognition of different types of emotions separately, no significant difference was found for recognition of happiness, sadness and disgusts, and a significant difference according to the ANOVA results was observable for surprise, however, no significant differences emerged during the post hoc tests comparing the groups individually. However, there were significant differences regarding recognition of fear and anger ( $F = 3.348$ ,  $FDR Q = 0.046$  and  $F = 5.541$ ,  $FDR Q = 0.009$ , respectively). Comparing the investigated groups with post hoc tests, in case of fear recognition, the NV-SCH group had a significantly lower score compared to the V-CRL group ( $p = 0.011$ ). In case of anger



**Fig. 1.** Comparison in violent (V-SCH) and nonviolent schizophrenic (NV-SCH) patients and violent and (V-CRL) nonviolent (NV-CRL) controls on measures reflecting mentalization and empathy: significant differences Mean and SE values of test scores of the study groups on scales with significant between groups differences are presented. \* indicates post hoc  $p < 0.05$ .

recognition, the NV-SCH group had a significantly lower score compared to the V-CRL group ( $p = 0.007$ ), and a strong tendency to score lower than the NV-CRL group ( $p = 0.082$ ) (Tables 2 and 3; Fig. 1).

### 3.2.3. Expression of anger: performance of violent (V-SCH) and nonviolent schizophrenic (NV-SCH) and violent (V-CRL) and nonviolent control (NV-CRL) groups on the Anger Expression Scale

There was a significant difference between the investigated study groups on all measures of anger expression, including expression frequency, expression of anger outwards, and expression of anger inwards ( $F = 6.011$ ,  $FDR Q = 0.006$ ;  $F = 5.074$ ,  $FDR Q = 0.011$ ;  $F = 3.576$ ,  $FDR Q = 0.038$ , respectively). In case of frequency of anger expression, the V-CRL group scored significantly higher compared to both the NV-SCH and NV-CRL groups ( $p = 0.009$  and  $p = 0.001$ , respectively). In case of expressing anger outwards, the V-CRL group scored significantly higher compared to both the V-SCH and NV-CRL groups ( $p = 0.031$ ,  $p = 0.016$ , respectively). In case of expressing anger inwards, the NV-SCH groups scored significantly higher compared to the V-CRL group ( $p = 0.050$ ) and showed a string tendency to score higher compared to the V-SCH group ( $p = 0.072$ ) (Tables 2 and 3; Figure 1).

### 3.2.4. Interpersonal reactivity: scores of violent (V-SCH) and nonviolent schizophrenic (NV-SCH) and violent (V-CRL) and nonviolent control (NV-CRL) groups on the Interpersonal Reactivity Index

There was no significant difference between the four investigated groups on the Perspective taking, Fantasy, and Empathic concern subscales of the Interpersonal Reactivity Index. A significant difference, however, emerged on the Personal distress subscales ( $F = 9.443$ ,  $FDRQ = 0.006$ ), with post hoc tests indicating that the NV-SCH group had a significantly higher score compared to all three other groups ( $p = 0.006$ ,  $p = 0.000$ ,  $p = 0.006$  for V-SCH, V-CRL and NV-CRL group comparisons, respectively) (Tables 2 and 3; Figure 1).

### 3.2.5. Impulsivity, Venturesomeness, Empathy: scores of violent (V-SCH) and nonviolent schizophrenic (NV-SCH) and violent (V-CRL) and nonviolent control (NV-CRL) groups on the Eysenck IVE scale

There were no significant differences between the investigated groups concerning either Impulsivity, Venturesomeness or Empathy scores (Table 2).

### 3.2.6. Risk factors of violence

When examining the risk factors of violent behaviour, the combined sample (schizophrenic and non-schizophrenic subjects) our model based on logistic regression ( $X_{\text{Wald},F^2}(4) = 32.277$ ,  $p < 0.001$ ;  $-2LL = 89.717$ ,  $\text{Cox\&Snell } R^2 = 0.307$ ,  $\text{Nagelkerke } R^2 = 0.409$ ) has shown that significant predictors were alcohol consumption ( $\text{Exp}(B) = 2.152$ ,  $p = 0.039$ ), sensitivity to recognizing anger ( $\text{Exp}(B) = 1.383$ ,  $p = 0.044$ ), high frequency of expressing anger (AEX) ( $\text{Exp}(B) = 1.152$ ,  $p = 0.001$ ) and personal distress ( $\text{Exp}(B) = 0.890$ ,  $p = 0.040$ ).

In the non-schizophrenic groups (V-CRL and NV-CRL) the logistic regression model ( $X_{\text{Wald},F^2}(3) = 21.180$ ,  $p < 0.001$ ;  $-2LL = 39.817$ ,  $\text{Cox\&Snell } R^2 = 0.382$ ,  $\text{Nagelkerke } R^2 = 0.509$ ) has shown that significant predictors were alcohol consumption ( $\text{Exp}(B) = 3.174$ ,  $p = 0.024$ ), sensitivity to recognising anger ( $\text{Exp}(B) = 1.993$ ,  $p = 0.002$ ), and high frequency of expressing anger (AEX) ( $\text{Exp}(B) = 1.228$ ,  $p < 0.001$ ).

In the schizophrenic groups (V-SCH and NV-SCH) the logistic regression model ( $X_{\text{Wald},F^2}(4) = 26.910$ ,  $p < 0.001$ ;  $-2LL = 34.087$ ,  $\text{Cox\&Snell } R^2 = 0.458$ ,  $\text{Nagelkerke } R^2 = 0.610$ ) has shown that significant predictors were sensitivity to recognising surprise ( $\text{Exp}(B) = 4.035$ ,  $p = 0.019$ ), sensitivity to recognising fear ( $\text{Exp}(B) = 1.600$ ,  $p = 0.027$ ), and high level of expressing anger inwards /AEX-1/ ( $\text{Exp}(B) = 0.787$ ,  $p = 0.059$ ) and personal distress ( $\text{Exp}(B) = 0.790$ ,  $p = 0.065$ ).

## 4. Discussion

In our study investigating the role of mentalization, empathy, emotion recognition, interpersonal reactivity and anger expression in violent schizophrenic patients compared to nonviolent schizophrenia patients, violent nonschizophrenic controls and nonviolent controls, we identified a characteristic pattern of dysfunction revealing possible mechanisms of emerging violence in schizophrenic patients. While we could not establish that significantly impaired mentalization and empathy differentiates violent schizophrenic patients from nonviolent patients or violent psychiatrically healthy subjects, we found that at least in part in violent schizophrenic patients better facial emotion recognition is coupled with lower personal distress and lower inward expression of anger with no differences in mentalization or frequency of anger expression and outward anger expression, suggesting that differences in impairment of mentalization and empathy do not play a role in emerging violence in schizophrenic patients. Compared to non-schizophrenic controls, worse mentalization which is likely to be related to schizophrenia itself rather than violent schizophrenia, and lower outward anger expression was found which latter results suggests that violence in our violent schizophrenic group is not related to anti-social traits. Our results suggest, in line with previous assumptions (Bo et al., 2011) that in schizophrenic patients without previously identified antisocial behaviours violent behaviours are likely to be related to psychotic processes and symptoms rather than impairment of mentalization or empathy.

### 4.1. Mentalization and empathy in schizophrenia: comparison of nonviolent schizophrenic and nonviolent control patients

Several previous studies reported on deficits of mentalization (Bora, 2017), emotion recognition (Bortolon et al., 2015; Schneider et al., 2006), empathy (Bonfils et al., 2017; Derntl et al., 2009) in schizophrenic patients. We found no significant difference in mentalization comparing nonviolent schizophrenic patients to healthy nonviolent controls. However, schizophrenic patients showed a significant deficit of emotion recognition in general with a strong trend for worse recognition of faces expressing anger. This is partly in line with studies indicating that schizophrenic patients exhibit problems in recognising facial emotions (Goghari et al., 2011; Kohler et al., 2010) and particularly negative facial expressions, although contrary to previous studies where schizophrenic patients performed worse in perceiving fear, sadness or disgust (Hofer et al., 2009; Kohler et al., 2010), we did not detect differences in case of those emotions. This may in part be due to a fact that fear recognition may pose difficulties even for healthy subjects with frequent misinterpretations for other emotional expressions (Ekman, 1999; Mendoza et al., 2011).

Also, significantly higher interpersonal distress was observable in nonviolent schizophrenic patients compared to normal controls which corroborates findings of a recent meta-analysis of 36 studies (Bonfils et al., 2017), where unlike our results, also significantly reduced perspective taking, empathic concern and fantasy was observed in schizophrenia.

It should be noted, that our nonviolent schizophrenic patients were outperformed by all other groups and not only healthy nonviolent controls in facial recognition and showed higher personal distress compared to other groups indicating that these are core features of schizophrenia.

### 4.2. Association of mentalization and empathy with violence in schizophrenia and beyond

#### 4.2.1. Association of mentalization and empathy with violence in schizophrenia: comparison of violent and nonviolent schizophrenic patients

Contrary to our hypothesis no significant differences in mentalization between violent and nonviolent schizophrenic patients emerged in

our study, indicating that mentalization deficits are a core feature of schizophrenia in general but may not play a marked role in violence specifically associated with this illness. Previous studies reported better mentalization in violent schizophrenic patients (Abu-Akel and Abushua'leh, 2004; Bo et al., 2011), giving rise to postulating that this increased mentalization may be useful for manipulation and deception in delinquent schizophrenic populations. However, given the few studies on the association of mentalization with violence in schizophrenia, no conclusions can be drawn, and better performance in Theory of Mind and inferring cognitive states in violent schizophrenia patients in some studies should be interpreted considering marked differences between these studies concerning institution of patient samples, substance use, comorbidity and age (Bragado-Jimenez and Taylor, 2012).

Considering empathy as reflected by interpersonal reactivity, we did find significantly higher interpersonal distress in nonviolent schizophrenic patients coupled with worse recognition of facial emotions reflecting a deficit of empathic capacity. In spite of the worse facial affect recognition which supports previous studies reporting that violent schizophrenia patients perform worse in general on facial emotion perception compared both to non-violent schizophrenia patients and controls (Tang et al., 2016), we did not detect significant differences between the two groups in the recognition of specific emotions, which is in line with the results of another study, where the authors concluded that lack of difference between nonviolent and violent schizophrenic patients in specific facial expression recognition may be due to the fact that emotion recognition deficit is a general trait marker of schizophrenia independently of violence (Demirbuga et al., 2013). It must be noted that while in the first study violent schizophrenia patients showed comorbid antisocial traits, the second study employed a non-antisocial but violent schizophrenic group, and in our sample we did not investigate antisocial traits in our violent subgroup. Thus these results suggest that there are distinct processes operating in the background of violence when it is related to core psychotic features, or when it may be independent of schizophrenia and is rather a result of superimposed comorbid antisocial personality disorder which may also manifest prior to disease onset (Bo et al., 2011).

Interestingly, violent schizophrenia patients did not show higher outward directed anger or higher frequency of anger expression compared to nonviolent schizophrenic patients, but a trend to manifest less inward-directed anger emerged. This may suggest that violence in schizophrenia may not result from generally increased anger or a higher tendency to direct anger outwards, but rather impaired capacity to cope with inward building tension.

#### 4.2.2. Association of mentalization and empathy with violence: comparing violent and nonviolent control subjects

We also investigated the association of empathy and mentalization with violence in the non-schizophrenic groups to study if we see a different relationship in case of healthy subjects. We found no significant differences between violent and nonviolent healthy subjects in mentalization, recognition of any emotions, interpersonal reactivity or empathy. Our findings contradict previous results where individuals exhibiting violent and aggressive psychopathic traits showed impairment in recognising negative facial expressions including sad and fearful faces (Dawel et al., 2012; Dolan and Fullam, 2006; Marsh and Blair, 2008).

Not surprisingly, however, violent controls showed both significantly higher frequency of anger expression and outward directed anger compared to nonviolent controls. It is interesting that this pattern of differences did not match that observable between violent and nonviolent schizophrenic patients, who did not differ in frequency of anger expression and outward directed anger but where violent schizophrenia patients showed lower interpersonal distress and inward directed anger, as well as better facial recognition, suggesting that there is a difference dynamics and background mechanism of emergence of violence in schizophrenia patients compared to controls.

#### 4.2.3. Mentalization, emotion recognition, anger expression and interpersonal distress in violent schizophrenic patients compared to violent controls

Finally, we were also interested whether mentalization and empathy has a different role in the background of violence in schizophrenia and in non-schizophrenic subjects. We observed significantly higher mentalization and significantly higher outwards directed anger in violent controls, but no differences in inward directed anger or frequency of anger expression, emotion recognition, empathy or interpersonal reactivity. Our results, while are partly in line with the results of a previous meta-analysis which found that violent antisocial controls and violent schizophrenic patients show qualitatively similar but quantitatively different emotion processing deficits (Sedgwick et al., 2017) confirm the previously mentioned hypothesis (Bo et al., 2011) that violence as a feature of psychosis is significantly different from violence emerging as a result of antisocial personality organisation, and highlights the need to differentiate between violent antisocial schizophrenic patients from those patients where violence may be related to positive symptoms of psychosis for better prediction and prevention of violent behaviours in schizophrenic patients.

#### 4.3. Personal distress and emotion recognition differentiate nonviolent schizophrenic patients from violent schizophrenic, violent control and nonviolent control subjects

While contrary to our expectations we did not manage to establish characteristics of mentalization, emotion recognition, anger expression or interpersonal reactivity that clearly differentiate between violent schizophrenic patients from subjects in the other three groups, we found that nonviolent schizophrenic subjects differ highly from both violent schizophrenia patients as well as violent and nonviolent controls subjects in showing significantly higher personal distress compared to all three groups as well as lower recognition of emotions. This pattern may in part be a result of negative symptoms of schizophrenia possibly more characteristic of nonviolent patients, given the postulation that violence may be a manifestation of positive symptoms.

#### 4.7. Predictors of violent behaviour

In our study we found that in the whole population violent behaviour was significantly predicted by alcohol use, anger recognition and frequency of anger expression while increasing personal distress decreased its likelihood. Similarly, in the non-schizophrenic population, alcohol use, anger recognition and frequency of anger expression predicted violent behaviour, while in the schizophrenic group violent behaviour was predicted by recognising surprise and fear, and personal distress and higher level of expressing anger inwards decreased the risk of violent behaviour. Our results therefore indicate that predictors of violence are different in the schizophrenic group compared to the psychiatrically healthy samples.

A review evaluating risk factors for violence in schizophrenia previously described two different pathways of emerging violence in schizophrenic patients, one related to positive symptoms of the illness and another one independent of schizophrenia symptoms but related to personality pathology (Bo et al., 2011). Thus besides different predictors of violent behaviours operate in non-schizophrenic and schizophrenic subjects, it appears that different contributing factors may lead to violence also within different violent schizophrenic subpopulations which demands further research in order to identify predictive signs and factors of approaching violence and to establish risk-reducing treatments. Besides treatment for positive symptoms mainly via pharmacological interventions, psychosocial interventions targeted at mentalization in schizophrenic patients may be a helpful tool to reduce violence, but only in certain patient subgroups.

#### 4.8. Limitations

Several limitations of our sample must be noted. Our sample size was small, however, this was limited by the small number of documented violent schizophrenic patients accessible, and generally our sample size is comparable to those involved in studies on violence in schizophrenia. Also we used an all-male sample, which may limit the generalisability of conclusions. We didn't test for criminal acts committed prior to onset of schizophrenic symptoms, or comorbid personality traits, which may constitute a distinct subgroup within schizophrenia. Furthermore, our schizophrenic samples were under antipsychotic medication, which could have influenced the results, especially given the higher ratio of atypical antipsychotics in the non-violent schizophrenia sample and the higher ratio of combination of typical and atypical antipsychotics in violent schizophrenia patients. We couldn't control for the duration of the illness, which may have also impacted the investigated cognitive and emotional processes.

#### 4.9. Conclusions

Although we could not establish a marked and straightforward pattern of significant differences between violent schizophrenic patients compared to the other groups with respect to mentalization and empathy, we identified a characteristic pattern of association between the above characteristics and processes and violent behaviours in schizophrenic and control patients. Most importantly we concluded that emergence of violence has different dynamic contributors and background mechanisms in schizophrenic patients compared to controls, and we also observed that nonviolent schizophrenic patients significantly differed from all other groups in worse emotion recognition and higher personal distress. Further clinical and neurobiological (still not adequately explored) predictors should demonstrate their validity in predicting the complexity of aggressive behaviour/violence in schizophrenic subjects in further research addressing this important topic. Our results emphasise the importance of identifying contributors to the emergence of violence in psychiatric disorders and specifically in schizophrenia to establish viable means of early detection as well as targets and methods of prevention and also to decrease stigma associated with this illness.

#### Conflict of interest

The authors have no conflict of interest to declare in relation to the present study.

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#### References

Abu-Akel, A., Abushua'leh, K., 2004. Theory of mind' in violent and nonviolent patients with paranoid schizophrenia. *Schizophr. Res.* 69 (1), 45–53.  
 Abu-Akel, A., Heinke, D., Gillespie, S.M., Mitchell, I.J., Bo, S., 2015. Metacognitive impairments in schizophrenia are arrested at extreme levels of psychopathy: the cut-off effect. *J. Abnorm. Psychol.* 124 (4), 1102–1109.  
 Baron-Cohen, S., Wheelwright, S., 2004. The empathy quotient: an investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. *J. Autism. Dev. Disord.* 34 (2), 163–175.  
 Bo, S., Abu-Akel, A., Kongerslev, M., Haahr, U.H., Simonsen, E., 2011. Risk factors for violence among patients with schizophrenia. *Clin. Psychol. Rev.* 31 (5), 711–726.  
 Bonfils, K.A., Lysaker, P.H., Minor, K.S., Salyers, M.P., 2017. Empathy in schizophrenia: a meta-analysis of the interpersonal reactivity index. *Psychiat. Res.* 249, 293–303.  
 Bora, E., 2017. Relationship between insight and theory of mind in schizophrenia: a meta-analysis. *Schizophrenia Res.* 190, 11–17.  
 Bora, E., Eryavuz, A., Kayahan, B., Sungu, G., Veznedaroglu, B., 2006. Social functioning,

theory of mind and neurocognition in outpatients with schizophrenia; mental state decoding may be a better predictor of social functioning than mental state reasoning. *Psychiat. Res.* 145 (2-3), 95–103.  
 Bortolon, C., Capdevielle, D., Raffard, S., 2015. Face recognition in schizophrenia disorder: a comprehensive review of behavioral, neuroimaging and neurophysiological studies. *Neurosci. Biobehav. Rev.* 53, 79–107.  
 Bragado-Jimenez, M.D., Taylor, P.J., 2012. Empathy, schizophrenia and violence: a systematic review. *Schizophrenia Res.* 141 (1), 83–90.  
 Corcoran, R., Mercer, G., Frith, C.D., 1995. Schizophrenia, symptomatology and social inference - investigating theory of mind in people with schizophrenia. *Schizophr. Res.* 17 (1), 5–13.  
 Darmedru, C., Demily, C., Franck, N., 2017. Cognitive remediation and social cognitive training for violence in schizophrenia: a systematic review. *Psychiat. Res.* 251, 266–274.  
 Davis, M.H., 1983. Measuring individual-differences in empathy - evidence for a multi-dimensional approach. *J. Pers. Soc. Psychol.* 44 (1), 113–126.  
 Dawel, A., O'Kearney, R., McKone, E., Palermo, R., 2012. Not just fear and sadness: meta-analytic evidence of pervasive emotion recognition deficits for facial and vocal expressions in psychopathy. *Neurosci. Biobehav. Rev.* 36 (10), 2288–2304.  
 Demirbuga, S., Sahin, E., Ozver, I., Aliustaoglu, S., Kandemir, E., Varkal, M.D., Emul, M., Ince, H., 2013. Facial emotion recognition in patients with violent schizophrenia. *Schizophr. Res.* 144 (1-3), 142–145.  
 Derntl, B., Finkelmeyer, A., Toygar, T.K., Hulsmann, A., Schneider, F., Falkenberg, D.I., Habel, U., 2009. Generalized deficit in all core components of empathy in schizophrenia. *Schizophr. Res.* 108 (1-3), 197–206.  
 Dolan, M., Fullam, R., 2006. Face affect recognition deficits in personality-disordered offenders: association with psychopathy. *Psychol. Med.* 36 (11), 1563–1569.  
 Doody, G.A., Gotz, M., Johnstone, E.C., Frith, C.D., Owens, D.G.C., 1998. Theory of mind and psychoses. *Psychol. Med.* 28 (2), 397–405.  
 Douglas, K.S., Guy, L.S., Hart, S.D., 2009. Psychosis as a risk factor for violence to others: a meta-analysis. *Psychol. Bull.* 135 (5), 679–706.  
 Edwards, J., Pattison, P.E., Jackson, H.J., Wales, R.J., 2001. Facial affect and affective prosody recognition in first-episode schizophrenia. *Schizophr. Res.* 48 (2-3), 235–253.  
 Eisenberg, N., Fabes, R.A., 1990. Empathy - conceptualization, measurement, and relation to prosocial behavior. *Motiv. Emotion* 14 (2), 131–149.  
 Ekman, P., 1999. Facial expressions. In: Dalgleish, T., Power, M. (Eds.), *Handbook of Cognition and Emotion*. Wiley&Son, New York.  
 Ekman, P., Friesen, W.V., 1976. *PictuRes. of Facial Affect*. Consulting Psychologists Press, Palo Alto.  
 Elbogen, E.B., Johnson, S.C., 2009. The intricate link between violence and mental disorder. *Arch. Gen. Psychiat.* 66 (2), 152–161.  
 Eysenck, S.B.G., Pearson, P.R., Easting, G., Allsopp, J.F., 1985. Age norms for impulsiveness, venturesomeness and empathy in adults. *Pers. Individ. Differ.* 6 (5), 613–619.  
 Fazel, S., Gulati, G., Linsell, L., Geddes, J.R., Grann, M., 2009. Schizophrenia and violence: systematic review and meta-analysis. *Plos Med.* 6 (8).  
 Fazel, S., Zetterqvist, J., Larsson, H., Langstrom, N., Lichtenstein, P., 2014. Antipsychotics, mood stabilisers, and risk of violent crime. *Lancet* 384 (9949), 1206–1214.  
 Fett, A.K.J., Viechtbauer, W., Dominguez, M.D., Penn, D.L., van Os, J., Krabbendam, L., 2011. The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: a meta-analysis. *Neurosci. Biobehav. Rev.* 35 (3), 573–588.  
 Frith, C.D., 2004. Schizophrenia and theory of mind. *Psychol. Med.* 34 (3), 385–389.  
 Goghari, V.M., MacDonald, A.W., Sponheim, S.R., 2011. Temporal lobe structures, and facial emotion recognition in schizophrenia patients and nonpsychotic relatives. *Schizophr. Bull.* 37 (6), 1281–1294.  
 Haddock, G., Eisner, E., Davies, G., Coupe, N., Barrowclough, C., 2013. Psychotic symptoms, self-harm and violence in individuals with schizophrenia and substance misuse problems. *Schizophr. Res.* 151 (1-3), 215–220.  
 Hall, J., Whalley, H.C., McKirdy, J.W., Romaniuk, L., McGonigle, D., McIntosh, A.M., Baig, B.J., Gountouna, V.E., Job, D.E., Donaldson, D.I., Sprengelmeyer, R., Young, A.W., Johnstone, E.C., Lawrie, S.M., 2008. Overactivation of fear systems to neutral faces in schizophrenia. *Biol. Psychiat.* 64 (1), 70–73.  
 Harris, S.T., Picchioni, M.M., 2013. A review of the role of empathy in violence risk in mental disorders. *Aggression Violent Behav.* 18 (2), 335–342.  
 Hodgins, S., 2008. Violent behaviour among people with schizophrenia: a framework for investigations of causes, and effective treatment, and prevention. *Philos. Trans. R. Soc. B.* 363 (1503), 2505–2518.  
 Hofer, A., Benecke, C., Edlinger, M., Huber, R., Kemmler, G., Rettenbacher, M.A., Schleich, G., Fleischhacker, W.W., 2009. Facial emotion recognition and its relationship to symptomatic, subjective, and functional outcomes in outpatients with chronic schizophrenia. *Eur. Psychiat.* 24 (1), 27–32.  
 Huber, C.G., Hochstrasser, L., Meister, K., Schimmelmann, B.G., Lambert, M., 2016. Evidence for an agitated-aggressive syndrome in early-onset psychosis correlated with antisocial personality disorder, forensic history, and substance use disorder. *Schizophr. Res.* 175 (1-3), 198–203.  
 Huszár, I., 2010. Az agresszió megjelenési formái a pszichiátriai kórképekben, in: Hárدي, I. (Ed.), *Az agresszió világa*. Medicina Kiadó, Budapest, pp. 125–156.  
 Kohler, C.G., Turner, T.H., Bilker, W.B., Brensinger, C.M., Siegel, S.J., Kanes, S.J., Gur, R.E., Gur, R.C., 2003. Facial emotion recognition in schizophrenia: Intensity effects and error pattern. *Am. J. Psychiat.* 160 (10), 1768–1774.  
 Kohler, C.G., Walker, J.B., Martin, E.A., Healey, K.M., Moberg, P.J., 2010. Facial emotion perception in schizophrenia: a meta-analytic review. *Schizophr. Bull.* 36 (5), 1009–1019.  
 Majorek, K., Wolfkuhler, W., Kuper, C., Saimeh, N., Juckel, G., Brune, M., 2009. Theory

- of Mind" and executive functioning in forensic patients with schizophrenia. *J. Forensic Sci.* 54 (2), 469–473.
- Marsh, A.A., Blair, R.J.R., 2008. Deficits in facial affect recognition among antisocial populations: a meta-analysis. *Neurosci. Biobehav. Rev.* 32 (3), 454–465.
- Marwick, K., Hall, J., 2008. Social cognition in schizophrenia: a review of face processing. *Br. Med. Bull.* 88 (1), 43–58.
- Mendoza, R., Cabral-Calderin, Y., Dominguez, M., Garcia, A., Borrego, M., Caballero, A., Guerra, S., Reyes, M.M., 2011. Impairment of emotional expression recognition in schizophrenia: a Cuban familial association study. *Psychiat. Res.* 185 (1–2), 44–48.
- Miller, P.A., Eisenberg, N., 1988. The relation of empathy to aggressive and externalizing antisocial-behavior. *Psychol. Bull.* 103 (3), 324–344.
- Nestor, P.G., 2002. Mental disorder and violence: Personality dimensions and clinical features. *Am. J. Psychiat.* 159 (12), 1973–1978.
- Nolan, K.A., Volavka, J., Mohr, P., Czobor, P., 1999. Psychopathy and violent behavior among patients with schizophrenia or schizoaffective disorder. *Psychiatr. Serv.* 50 (6), 787–792.
- O'Reilly, K., Donohoe, G., Coyle, C., O'Sullivan, D., Rowe, A., Losty, M., McDonagh, T., McGuinness, L., Ennis, Y., Watts, E., Brennan, L., Owens, E., Davoren, M., Mullaney, R., Abidin, Z., Kennedy, H.G., 2015. Prospective cohort study of the relationship between neuro-cognition, social cognition and violence in forensic patients with schizophrenia and schizoaffective disorder. *BMC Psychiatry* 15.
- Pickup, G.J., Frith, C.D., 2001. Theory of mind impairments in schizophrenia: symptomatology, severity and specificity. *Psychol. Med.* 31 (2), 207–220.
- Rice, M.E., 1997. Violent offender Res. and implications for the criminal justice system. *Am. Psychol.* 52 (4), 414–423.
- Richard-Devantoy, S., Bouyer-Richard, A.I., Jollant, F., Mondoloni, A., Voyer, M., Senon, J.L., 2013. Homicide, schizophrenia and substance abuse: a complex interaction. *Rev. Epidemiol. Sante* 61 (4), 339–350.
- Romero-Martinez, A., Lila, M., Martinez, M., Pedron-Rico, V., Moya-Albiol, L., 2016. Improvements in empathy and cognitive flexibility after court-mandated intervention program in intimate partner violence perpetrators: the role of alcohol abuse. *Int. J. Env. Res. Pub. He.* 13 (4).
- Schneider, F., Gur, R.C., Koch, K., Backes, V., Amunts, K., Shah, N.J., Bilker, W., Gur, R.E., Habel, U., 2006. Impairment in the specificity of emotion processing in schizophrenia. *Am. J. Psychiatry* 163 (3), 442–447.
- Sedgwick, O., Young, S., Baumeister, D., Greer, B., Das, M., Kumari, V., 2017. Neuropsychology and emotion processing in violent individuals with antisocial personality disorder or schizophrenia: The same or different? A systematic review and meta-analysis. *Austr. N. Z. J. Psychiatry* 51 (12), 1178–1197.
- Serafini, G., Pompili, M., Haghighat, R., Pucci, D., Pastina, M., Lester, D., Angeletti, G., Tatarelli, R., Girardi, P., 2011. Stigmatization of schizophrenia as perceived by nurses, medical doctors, medical students and patients. *J. Psychiatr. Mental Health Nurs.* 18, 576–585.
- Short, T., Thomas, S., Mullen, P., Ogloff, J.R.P., 2013. Comparing violence in schizophrenia patients with and without comorbid substance-use disorders to community controls. *Acta Psychiatr. Scand.* 128 (4), 306–313.
- Silver, H., Goodman, C., Knoll, G., Isakov, V., Modai, I., 2005. Schizophrenia patients with a history of severe violence differ from nonviolent schizophrenia patients in perception of emotions but not cognitive function. *J. Clin. Psychiatry* 66 (3), 300–308.
- Slijepcevic, M.K., Jukic, V., Novalic, D., Zarkovic-Palijan, T., Milosevic, M., Rosenzweig, I., 2014. Alcohol abuse as the strongest risk factor for violent offending in patients with paranoid schizophrenia. *Croat. Med. J.* 55 (2), 156–162.
- Spielberger, C.D., Johnson, E.H., Russell, S.F., Crane, R.J., Jacobs, G.A., Worden, T.J., 1985. The experience and expression of anger: Construction and validation of an anger expression scale. In: Chesney, M.A., Rosenman, R.H. (Eds.), *Anger and Hostility in Cardiovascular and Behavioral Disorders Hemisphere*. McGraw-Hill, New York, pp. 5–30.
- Stone, V.E., Baron-Cohen, S., Knight, R.T., 1998. Frontal lobe contributions to theory of mind. *J. Cognit. Neurosci.* 10 (5), 640–656.
- Swanson, J.W., Holzer, C.E., Ganju, V.K., Jono, R.T., 1990. Violence and psychiatric-disorder in the community - evidence from the epidemiologic catchment-area surveys. *Hosp. Community Psych.* 41 (7), 761–770.
- Swanson, J.W., Swartz, M.S., Van Dorn, R.A., Elbogen, E.E., Wagner, H.R., Rosenheck, R.A., Stroup, T.S., McEvoy, J.P., Lieberman, J.A., 2006. A national study of violent behavior in persons with schizophrenia. *Arch. Gen. Psychiat.* 63 (5), 490–499.
- Tang, D.Y.Y., Liu, A.C.Y., Lui, S.S.Y., Lam, B.Y.H., Siu, B.W.M., Lee, T.M.C., Cheung, E.F.C., 2016. Facial emotion perception impairments in schizophrenia patients with comorbid antisocial personality disorder. *Psychiat. Res.* 236, 22–27.
- Teasdale, B., 2009. Mental disorder and violent victimization. *Crim. Justice Behav.* 36 (5), 513–535.
- Van Dorn, R., Volavka, J., Johnson, N., 2012. Mental disorder and violence: is there a relationship beyond substance use? *Soc. Psych. Psych. Epid.* 47 (3), 487–503.
- Varga, E., Tenyi, T., Fekete, S., Herold, R., 2008. The evaluation of mentalization deficit by the faux pas test in schizophrenia. *Neuropsychopharm.* Hung. 10 (2), 75–80.
- Varshney, M., Mahapatra, A., Krishnan, V., Gupta, R., Deb, K.S., 2016. Violence and mental illness: what is the true story. *J. Epidemiol. Commun. H.* 70 (3), 223–225.
- Witt, K., van Dorn, R., Fazel, S., 2013. Risk factors for violence in psychosis: systematic review and meta-regression analysis of 110 studies. *Plos One* 8 (2).