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## Proneness to aggression and its inhibition in schizophrenia: Interconnections between personality traits, cognitive function and emotional processing

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## ABSTRACT

**Objective:** Research on aggression in schizophrenia has focused on narrowly defined deficits, while ignoring interconnections among these impairments which provide better explanatory power. Our goal was to investigate interrelations among impairments in important domains related to aggression: personality traits, including psychopathy and impulsivity, cognition and processing of emotions.

**Method:** 34 healthy controls, 37 high aggression (HAG) and 31 low aggression (LAG) patients with schizophrenia participated. The Barratt Impulsiveness Scale, Psychopathy Checklist, Wisconsin Card Sorting Test (WCST), and Emotion Recognition Test were administered. Psychiatric symptoms were assessed. Canonical Discriminant Analysis (CDA) was performed to determine how these measures distinguish among the groups and to identify underlying symptom profiles.

**Results:** CDA revealed two statistically significant profiles of deficits which differentiated the groups. The first comprises impulsivity, psychopathy, and impairments in cognition and fear recognition. It indicates proneness to aggression. The second consists of WCST perseverative errors and facial affect processing impairment; it has an inverse relationship with aggression. These profiles are linked to different psychiatric symptoms in the schizophrenic patients: The first to excitement and poor impulse control; the second to blunted affect and motor retardation. HAG's manifested primarily the first; LAG's had a moderate score on the first and a high score on the second.

**Conclusion:** Proneness to aggression in schizophrenia is characterized by a multivariate confluence of impulsivity, psychopathy, cognitive difficulties and impairment in fear recognition. There exists, however, a second pattern of psychopathology that may suppress expression of aggression. These opposing patterns have important implications for integrated treatments of aggression.

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## 1. Introduction

There are important person characteristics that are impaired in subjects with schizophrenia and aggressive populations: these include personality traits, cognitive impairments and emotional-social deficits. Psychopathic and impulsive traits are considered to play a major role in the emergence of aggression in the general population (Walters, 2003; Barrat, 1994) and in patients with major mental illness. In a large study of patients with major mental disorder (Skeem and Mulvey, 2001), the Psychopathy Checklist was the strongest clinical

predictor of aggression. It was also strongly associated with aggression in schizophrenia (Hodgins et al., 1999). Impulsivity is also strongly linked to aggression in schizophrenia (Enticott et al., 2008; Witt et al., 2013), but some studies have failed to find such an association (MacArthur Risk Assessment Group, 2012).

Impairments in executive function have been implicated in aggression in the general population (Ogilvie et al., 2011) and in schizophrenia (Lysaker et al., 2002; Rasmussen et al., 1995). The Wisconsin Card Sorting Test, a measure of executive function, has been used in the evaluation of these subjects. It assesses strategic planning, ability to shift cognitive sets, and modulation of impulsive responding (Heaton et al., 1993). Poor WCST performance is associated with violence in the community (Krakowski et al., 1997) and poor response to pharmacological anti-aggression treatment in patients with schizophrenia (Krakowski and Czobor, 2012).

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Facial emotion recognition is of great importance for normal social interaction, which includes control of aggression (Corden et al., 2006). Patients with schizophrenia show a deficit in this ability (Edwards et al., 2001; Green et al., 2005), separately from their neurocognitive impairment (Edwards et al., 2001). Such a deficit is also found in violent and antisocial persons, but their deficit is most prominent for fear recognition (Marsh and Blair, 2008). Processing of fearful expressions allows for the inhibition of aggression (Blair, 2001; Montagne et al., 2005).

There are important interrelated deficits in basic individual characteristics that influence aggressive behavior. Multivariate methods allow us to assess their joint contribution, and thereby constitute a more valid approach to multi-determined behavior. We use here such an approach to investigate how three key domains discriminate among the healthy controls, the high-aggression and the low aggression patients. More importantly, this differentiation allows us to identify multivariate dimensions that underlie proneness to aggression in the context of underlying schizophrenic psychopathology, and points to factors that may inhibit aggressive tendencies.

## 2. Methods

### 2.1. Design and participants

102 subjects participated: 37 high-aggression (HAG), 31 low-aggression (LAG) patients with schizophrenia, and 34 healthy controls (HC). They had no significant medical/neurological illnesses. The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID) was administered to confirm diagnosis of schizophrenia in patients (patient version) and absence of psychiatric disorders in controls (non-patient version), and history of alcohol/drug abuse/dependence. The patients were recruited from inpatient and outpatient units of a large state hospital. The healthy controls were recruited from the community through a special volunteer pool at the research institute set up specifically for that purpose; they were from the same geographical areas as the subjects with schizophrenia.

All subjects provided written informed consent after receiving a description of the study and according to a protocol approved by the institutional review boards and compliant with the Declaration of Helsinki.

### 2.2. Measures

#### 2.2.1. Life History of Aggression (LHA) (Coccaro et al., 1997)

The LHA with well-established psychometric properties (Coccaro et al., 1997) was used to assess aggression. It was completed on the basis of all available information, including self-report, chart review, and official records of arrests, convictions, parole, and probation obtained from the Division of Criminal Justice Services. For inclusion as a high aggression subject (HAG), the participant was required to have a confirmed episode of physical assault against someone else which caused physical injury within past year, and a lifetime LHA score above 15, the cutoff indicated by the scale authors. For inclusion as a low-aggression patient (LAG) or healthy control (HC), the subject was required to have a LHA score  $\leq 15$ , and no episode of physical aggression over the past year causing physical injury.

#### 2.2.2. The Psychopathy Checklist: screening version (PCL:SV) (Hart et al., 1995)

Trained research staff conducted in-depth semi-structured interviews and reviewed all records to complete the scale, which includes two factors: the Affective-Interpersonal and the Impulsive-Antisocial. The Affective-Interpersonal factor was selected for the canonical analyses, as it is more specific to the psychopathy construct; in addition, the Impulsive-Antisocial factor overlaps with some of the other items, i.e., violence and impulsivity.

#### 2.2.3. The Barratt Impulsiveness Scale version 11 (BIS-11) (Patton et al., 1995)

This self-rating scale, consisting of 30 items on a 4-point scale, is the most widely used measure of impulsive traits (Stanford et al., 2009).

#### 2.2.4. Wisconsin Card Sorting Test (WCST) (Heaton et al., 1993)

WCST measures set-shifting ability, conceptual reasoning, response inhibition, and goal-directed planning. As mentioned above, WCST impairment is present in both people with schizophrenia and aggressive subjects.

#### 2.2.5. Emotion Recognition Task (ER-40) (Gur et al., 2002; Carter et al., 2009)

ER-40 is a computerized task which assesses the ability to recognize facial emotion. It presents 40 photographs of faces expressing happiness, sadness, anger, and fear—and neutral expressions. Stimuli were balanced for poser's gender, age, and ethnicity. Task and scoring programs are available at <https://pennncnp.med.upenn.edu>.

We chose the stimuli most relevant to our study: at one extreme, fear recognition, as it is the most specific impairment associated with aggression; at the other extreme, recognition of neutral expressions, as no relationship has been reported between this ability and aggression.

#### 2.2.6. The Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987)

The PANSS was used to assess psychiatric symptoms. Interrater reliability, estimated by ICC, exceeded 0.90. Five factors were used as determined by a factor analysis study (Kay and Sevy, 1990): Positive symptoms, negative symptoms, excitement, cognitive impairment and depression.

### 2.3. Statistical analyses

Group differences for continuous variables were investigated through general linear model analysis with group as the independent variable. Age, gender, ethnicity, years of education, inpatient versus outpatient status and drug/alcohol abuse or dependence were used as covariates for the clinical variables. Where a significant overall association was found, pairwise contrasts were computed. The same covariates were also used for the canonical factors.

Canonical discriminant analysis was the primary analysis, since it allows us to investigate whether membership in a particular group is significantly associated with a set of multivariate predictors (canonical discriminant functions [CDF]) considered together and to delineate the specific multivariate combinations which constitute these predictors. The predictor variables included the BIS-11, the PCL:SV first factor, the WCST perseverative and non-perseverative errors and the ER-40 recognition of fear and recognition of neutral emotion.

With three study groups, there are two canonical discriminant functions; the association of each of these with group membership, respectively, was examined via the canonical correlations using the Likelihood Ratio (LR) test statistics. The Wilk's lambda statistic was used to test the null-hypothesis that all canonical correlations are simultaneously zero, i.e., there is no prediction of group membership from predictor variables. The composition of the CDFs was investigated through the Between Canonical Structure, which shows the loadings between CDFs and the set of predictor variables. In addition, we examined the means of the three groups on each of the two canonical variates. The multivariate constellation of these group means, defined by the CDFs, indicates the space that maximally separates the group's multivariate mean vectors based on the set of predictor variables.

In addition to the above, we examined how the canonical factors were related to aggression and to important clinical variables using Spearman rho. We also investigated the relationship between the variables used for the CDA and measures of aggression and psychiatric symptoms.

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