# Metacognitive impairments in schizophrenia are arrested at extreme levels of psychopathy: The cut-off effect

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# Title Page

**Title**: Metacognitive impairments in schizophrenia are arrested at extreme levels of psychopathy: The cut-off effect

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**Abstract**

Psychopathy and metacognitive difficulties have been associated with the occurrence of violence in schizophrenia. However, evidence suggests that non-schizophrenic psychopaths match or even outperform healthy controls on tests of metacognition. We hypothesize that the metacognitive difficulties associated with schizophrenia may be ameliorated by co-morbid psychopathy. To this end, metacognition (using the Metacognition Assessment Scale-Abbreviated (MAS-A)) and psychopathy (using the Hare Psychopathy Checklist-Revised (PCL-R)) are assessed in 79 patients with schizophrenia with a history of criminal offending. Piece-wise regression reveals that the association between metacognition and psychopathy changes from a negative to a positive association at a breakpoint corresponding to a score of 24 on the PCL-R. This score is within the range of the cut-off point used for the diagnosis of psychopathy in Europe, which corresponds to a score of 26 on the PCL-R. The patients scoring above 24 on the PCL-R demonstrated better overall metacognitive abilities, suggesting that these patients constitute a specific group in which schizophrenia has an attenuated impairing effect on metacognition. However, this effect was absent for the *Mastery* subscale of the MAS-A, which refers to the ability to use one's own mental states to solve social and psychological dilemmas. Our results suggest that the relative preservation of metacognitive abilities in schizophrenic patients with extreme levels of psychopathy may contribute to their offending behavior as it may enable them to understand how to manipulate and extort their victims. However, enhancing the *Mastery* domain of metacognition in these patients may attenuate this offending behavior.

*Keywords:* aggression, co-morbidity, violence, piecewise regression, Theory of mind

**Lay summary**

The study examined psychopathic traits and metacognition (the ability to think about thinking) in schizophrenia patients with a history of criminal offending. The study suggests that difficulties in metacognition are less pronounced in patients with high psychopathy scores.

## Introduction

There is a well-established relationship between schizophrenia and violence. This relationship has been associated, among other factors, with co-morbid psychopathy and poor metacognitive abilities (Bo, Abu-Akel, Kongerslev, Haahr, & Simonsen, 2011). Specifically, violence in schizophrenia has been associated with elevated incidences of psychopathy (Abushua'leh & Abu-Akel, 2006; Nolan, Volavka, Mohr, & Czobor, 1999; K. Rasmussen & Levander, 1996; Tengstrom, Hodgins, Grann, Langstrom, & Kullgren, 2004). In addition, psychopathy level is considered a robust discriminator between violent and nonviolent patients with schizophrenia (K Rasmussen, Levander, & Sletvold, 1995; Tengstrom et al., 2004), particularly in individuals scoring above the threshold for psychopathy on the Hare Psychopathy Checklist-Revised (PCL-R).

Metacognitive abilities refer to the processes associated with monitoring and controlling one's own cognitive processing as well as the reflections people form about others (or mentalizing) (Frith, 2012). These abilities range from discrete acts in which people recognize specific cognitive and affective mental states to more synthetic acts in which an array of intentions, thoughts, feelings, and connections between events are integrated into larger complex representations. Importantly, synthetic forms of metacognition are not specifically what one thinks or correctly notices (as commonly assessed with standard socio-cognitive tasks of false belief, for example), but is instead whether basic elements of experience are recognized and then synthesized into meaningful wholes (Bo, Kongerslev, Dimaggio, Lysaker, & Abu-Akel, 2015; Lysaker et al., 2013). As such, metacognitive abilities are essential for social interactions in that they supply reasons as to why one carries out a certain act, as well as premises for deciding what

is the best course of action to resolve dilemmas encountered in daily interactions. They may also act as an inhibitor of violence (R. J. Blair, 1995), particularly given their role in recognizing distress in others and responding empathically (Decety & Cowell, 2014). In addition, research has demonstrated that metacognitive difficulties (Brune, 2005; Lysaker, Shea, et al., 2010; Tas, Brown, Esen-Danaci, Lysaker, & Brune, 2012), particularly those associated with the recognition of affective states (Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010), contribute to the predisposition of schizophrenia patients to violence (Abu-Akel & Abushua'leh, 2004; Bo, Abu-Akel, Kongerslev, Haahr, & Bateman, 2014; Bo et al., 2011). Support for this comes from studies showing that violent schizophrenia patients have difficulties with empathic reasoning and spotting faux pas (unintended socially-awkward acts made because of lack of contextual knowledge) (Abu-Akel & Abushua'leh, 2004), as well as with reasoning about the emotion of others (Bo et al., 2014; Marsh & Blair, 2008).

In contrast to schizophrenia, research investigating metacognitive abilities in individuals with psychopathy has shown that while psychopaths have deficits in empathizing and responding to the emotions of others, they nonetheless demonstrate relatively intact understanding of the cognitive mental states and perspective of others (J. Blair et al., 1996; Dolan & Fullam, 2004; Fertuck et al., 2009; Lyons, Healy, & Bruno, 2013; Richell et al., 2003; Wai & Tiliopoulos, 2012). For example, Richell et al. (Richell et al., 2003) failed to identify any generalized impairment among psychopaths relative to non-psychopaths in the ‘Reading the Mind in the Eyes Test’, a task requiring the identification of affective mental states from photographs of the eye region. Similarly, Dolan and Fullam (Dolan & Fullam, 2004) observed no significant differences in basic social cognition tests between individuals with antisocial personality

disorder with and without psychopathy compared with healthy controls. The authors accordingly argued that the psychopath's antisocial behavior may not reflect a failure to take the perspective of others, but rather a failure to express concern for others' suffering. More recently, Lyons and colleagues found a significant association between the ability to detect lies and primary psychopathy (an aspect of psychopathy that is associated with interpersonal and emotional traits) (Lyons et al., 2013). Wai and Tiliopoulos also reported that psychopathy was mainly associated with deficits in empathizing with others and relating to their emotions, but not in reasoning about their cognitive mental states (Wai & Tiliopoulos, 2012). Similar findings were reported in male violent offenders (Seidel et al., 2013) and in psychopathic criminal offenders (Shamay-Tsoory et al., 2010). Taken together, the poor emotion recognition and empathic deficits seen in psychopaths would be expected to increase the probability of them offending violently. Conversely, their intact reasoning abilities about the cognitive mental states of others may contribute to their offending behavior as it may enable them to understand how to manipulate and extort their victims. Thus the metacognitive profile of the psychopath which emerges from these studies is consistent with a defining feature of the condition, that is the ability to deceive and manipulate others, and a proclivity toward premeditated or goal directed acts of aggression (Glenn & Raine, 2009).

The above discussion indicates that while both individuals with psychopathy and those with schizophrenia show an increased tendency toward violence, they nonetheless present with contrasting metacognitive abilities. Thus, while psychopaths show intact or even superior metacognitive abilities relative to normative values, patients with schizophrenia show impairments in these abilities. However, the association between psychopathy and metacognition

in patients with schizophrenia is poorly understood, since it is uncommon to assess both aspects in the same patients. In order to better understand the nature of their association, in this paper, we simultaneously assess psychopathy and metacognitive abilities in forensic patients with schizophrenia. Although we expect patients with schizophrenia to show overall metacognitive difficulties, we hypothesize that these difficulties may be attenuated at extreme levels of psychopathy. This hypothesis is supported by evidence showing an association between the heightened levels of psychopathy and the incidence of premeditated violence among patients with schizophrenia (Bo, Abu-Akel, Kongerslev, Haahr, & Simonsen, 2013), as such transgressions require good cognitive perspective-taking abilities (Abu-Akel & Abushua'leh, 2004; Bo et al., 2011; Rice, 1997).

## Materials and Method

### *Participants*

The data of 79 patients meeting the International Classifications of Diseases-10$^{th}$ Revision (IDC-10) diagnostic criteria for schizophrenia were analysed for the purposes of this study. These patients were recruited from forensic psychiatric facilities in Denmark, which provide compulsory treatment plans for criminal offenders and include psychosocial, psychological, fitness and, if needed, medical plans that are designed for the prevention of criminal recidivism. These diagnoses were made by highly experienced psychiatrists who work in the forensic psychiatric system in Denmark, and are based on the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) (First, Spitzer, Gibbon, & Williams, 2002) and the Schedules for Clinical Assessment in Neuropsychiatry (SCAN) (Wing et al., 1990). Importantly, and in line with the Danish Qualitative Model (regulated by the Danish Mental Health System), a panel of

psychiatrists and health professionals (nurses and psychologists) confirm all diagnoses in a conference session. Within the forensic system in Denmark, diagnoses are subject to a thorough evaluation given the legal implication of the diagnosis for the accused offender and the decision of the court. Hence, it is highly unlikely that our sample included malingerers.

All patients were stabilized on fixed doses of anti-psychotic medications. None suffered an organic brain disorder, was under the influence of alcohol or drugs, or showed signs of being under the influence of psychotic symptoms at the time of the interview for the assessment of psychopathy and metacognitive abilities. All patients were informed about the nature of the study, and were given written summary of the purposes and procedures of the study. The study was approved by the Danish Ethical Committee and complies with the requirements of the Declaration of Helsinki.

*Clinical and demographic measures*

The clinical and demographic data were collected using translated and validated Danish measures and included a socio-demographic questionnaire, the vocabulary subtest of the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III) (Wechsler, 1997), the Global Assessment of Functioning Scale (GAF), and the abbreviated version of the Positive and Negative Syndrome Scale (PANSS) (Kay, Opler, & Lindenmayer, 1989). All assessments and interviews were videotaped and assessed by a trained and experienced clinical psychologist (S.B). Collateral information was also gathered and medical records were inspected to corroborate the assessments made by the rater. For inter-rater reliability purposes, the video recording and collateral information of 25% of all cases were made available to a second

specially trained rater who was blind to the study. According to the Fleiss-Guidelines (Fleiss, Levin, & Paik, 2003), the inter-rater reliability for all instruments were excellent (ICC, all *rs*≥ 0.80, all *ps* < 0.001). (All subsequent inter-rater reliability measures reported in this study are evaluated using the Fleiss-Guidelines).

*Assessment of psychopathy*

Psychopathy was assessed using the Hare Psychopathy Checklist-Revised (PCL-R) (Hare, 2003). The PCL-R is a clinical construct rating scale that uses a semi-structured interview, file-records (including criminal records) and specific scoring criteria to assess whether a person possesses psychopathic traits. Specifically, it assesses an individual's interpersonal, behavioural and affective aspects, factorially grouped into two factors: Factor 1 relates to the emotional and the interpersonal aspects of psychopathy (e.g., deception, deceitfulness, lack of remorse or guilt), and Factor 2 relates to the behavioral aspect (e.g., impulsivity, irresponsibility). The PCL-R consists of 20 items on a 3-point scale (0, 1, 2). The total score ranges from 0-40 and reflects the extent to which a person matches the prototypical psychopath.

The interview was videotaped. The video recordings of the interview and the collateral information used for the assessment of 25% of the cases were made available to a second rater who was blind to the purposes of the study. The inter-rater reliability agreement was excellent (ICC, $r$=.87, $p$<0.001). It is important to note that naïve raters may face difficulties in distinguishing between schizophrenia symptoms and psychopathy traits. For example, there can be confusion between schizophrenia negative symptoms and diminished affectivity in psychopathy. However, we guarded against these pitfalls, as both raters in our study are certified raters (educated by Adele Forth and certified by the Robert Hare Lab) with significant

experience in administering and scoring the PCL-R including in patients with schizophrenia as well as patients with personality disorders. Such confusions would be expected to result in significant associations between the PCL-R and the patients' schizophrenia symptoms. This is not the case here as the PCL-R scores were not associated with either the positive (r=.06, p=.62) or the negative (r=-.08; p=.48) symptoms.

*Metacognition*

The patients' metacognitive abilities were assessed using the Metacognition Assessment Scale-Abbreviated Version (MAS-A) (Lysaker et al., 2005), which was specifically developed to measure these abilities in patients with serious mental diseases such as schizophrenia. This scale is an adaptation of the MAS by Semerari et al. (Semerari et al., 2003) which was originally designed to detect changes in these abilities in patients with personality disorders undergoing psychotherapy. Typically, the MAS-A utilizes a conversational paradigm (Lysaker, Clements, Plascak-Hallberg, Knipscheer, & Wright, 2002) with the objective to provide a more naturalistic method to evaluate the use of metacognitive abilities as opposed to scripted, laboratory-based paradigms in which these abilities are cued. Specifically, during the interviews used for the purposes of this study, the interviewer discussed with the patient a number of topics such as employment history, career goals, upbringing and family history, friends and intimate relations and antisocial behavior. For example, patients recounted in an interactive way with the interviewer their school history, whether they liked their school period, how their teachers would have described them, and how they interpreted their own role in the peer group. Similarly, a discussion of antisocial behavior offers a rich context during which patients can demonstrate the use or lack thereof of complex metacognitive abilities, as well as to examine how they reflect on

their antisocial behaviors. Thus, there are a number of opportunities throughout the interview for the patient to demonstrate the ability to think about their own mental states, the mental states of others, as well as the ability to dealing with certain challenges.

As all interviews are videotaped, another important advantage of this procedure is that it allows the rater to take into account valuable information conveyed through gesture and facial expressions when coding the these abilities. Gestures (as in pointing to oneself or another) can be helpful in ascertaining whether the patient understands and appropriately represents certain mental states such as intentionality. Similarly, facial expressions can mirror certain affective mental states such as those referring to anger and sadness, and thus a mismatch may indicate a failure to relate to these emotions.

The validity of the MAS-A has been demonstrated in studies showing that patients with schizophrenia scored more poorly than individuals with a serious and chronic, non-psychiatric, medical illness (Lysaker et al., 2012) and adults with substance use disorders but no history of a diagnosis of psychosis (Lysaker, Leonhardt, Brune, et al., 2014). In addition, studies demonstrate that the scores on the MAS-A are associated with illness insight (Kukla, Lysaker, & Salyers, 2013), tests of self-awareness (Lysaker, Dimaggio, Carcione, et al., 2010) as well as of social cognition (Lysaker, Dimaggio, Daroyanni, et al., 2010). The MAS-A has also been used to assess metacognition in patients with schizophrenia in whom psychopathy levels were assessed using the PCL-R (Bo et al., 2014). To the authors knowledge, no studies have used the MAS-A in healthy individuals (See Lysaker and colleagues (Lysaker, Leonhardt, Pijnenborg, et al., 2014) for a recent review of studies utilizing the MAS-A).

The MAS-A consists of four subscales: Self-Reflectivity (or *MAS-A-Self*) is a 9-point likert scale which assesses the comprehension of one's own mental states and use of these mental states to form complex ideas about oneself; Awareness of the mind of the other (or *MAS-A-Other*) is a 7-point likert scale that assesses the comprehension of mental states of other individuals and the integration of this understanding in an increasingly complex and coherent manner; Decentration (or *MAS-A-Decentration*) is a 3-point likert scale which assesses the ability to see that others can have independent motives and unique perspectives on life events; and Mastery (or *MAS-A-Mastery*) is a 9-point likert scale which assesses the ability to use one's own mental states to implement effective action strategies to deal with psychological and social dilemmas.

This four-subscale structure of MAS-A diverged from the original structure of the MAS (Semerari et al., 2003) which consisted of only of the Self-Reflectivity, Awareness of the mind of the other, and Mastery subscales. Importantly, the use of the 3-point Decentration subscale has been problematic, as it tends to produce skewed distribution not appropriate for correlational analyses (Lysaker et al., 2005; Lysaker et al., 2008). Specifically, it has been noted that about 75% of the schizophrenia patients tend to score 1 or below 1 on this subscale (Lysaker et al., 2008)—in our sample, 71% of the participants scored 1 or below 1 on this subscale. Due to the problematic properties of this subscale, there is precedence from the authors of the MAS-A to exclude the Decentration subscale from analyses (Lysaker, Dimaggio, Daroyanni, et al., 2010). In addition, in our data, the Decentration subscale scores correlated negatively and significantly ($p<.05$) with the scores on the other ($r=-.37$) and the mastery ($r=-.32$) subscales and nonsignificantly with the self subscale ($r=-.23$) and the MAS-A-Total ($r=-.18$), further

highlighting the problematic nature of this subscale, and the interpretability of findings associated with it. Given these considerations, the Decentration subscale is not considered in this study. Specifically, we conduct our analyses on the scores obtained on the Self (9-points), Other (7-points) and Mastery (9-points) subscales, as well as on the combined scores of these subscales (MAS-A-Total), as a measure of the patients' overall metacognitive abilities.

Each subscale is scored in a hierarchical order, with higher levels (or steps) demonstrating that the individual is able to think about oneself and other's knowledge, intentions and emotions in an increasingly complex and integrated manner. Failing at lower steps suggests that the individual may not be capable of passing higher ones. For example, it should not be possible to understand links between one's thoughts and one's feelings, if the individual has difficulties in recognizing his or her emotions. A point is awarded for passing each step. A half point can be awarded if the individual demonstrates inconsistent appropriate use of certain abilities such as the use of emotions in particular instances/topics and failure to do so in others (See *Supplementary Information* for detailed description of the various steps associated with each of the subscales and the scoring procedure).

The same raters assessing the PCL-R also assessed the MAS-A. Crucially, the second rater who was blind to the purposes of this study assessed 25% of the cases and was also blind to the PCL-R scores of these cases. The inter-rater reliability for this scale was excellent (ICC, r=0.83 ($p<$ 0.001).

**Results**

To estimate the relationship between the patients' scores on the MAS-A and the PCL-R, we first conducted a correlation analysis between the MAS-A-Total scores and the various clinical and demographic variables (Table 1). The results indicated significant negative associations with the PCLR-R scores and positive symptoms, and positive associations with intelligence and social functioning (GAF). In addition, the female patients scored significantly higher than the male patients on both the MAS-A-Total (Mean difference=2.01; $t_{df=77}$=2.17; p=.033; Cohen's *d*=.57) and the MAS-A-Mastery (Mean difference =1.11; $t_{df=77}$=2.63; p=.010; Cohen's *d*=.82).

*Table 1 about here*

We thus first fitted a simple linear regression to estimate the MAS-A-Total scores as a function of the PCL-R scores using Generalized Linear Models, controlling for gender, intelligence, positive symptoms and social functioning. We obtained an overall significant model ($X^2$=92.25, df=5, p<.001). As can be seen from Figure 1A, there is a significant negative association between the metacognition scores and psychopathy (β(SE)=-0.28(0.03); 95% CI=-0.33, -0.23), p<.001). However, the residuals plot (Figure 1B) revealed a curvilinear trend (β(SE)=0.53(0.18; t=3.02, p=.003), confirming the curvilinearity one can observe from a visual inspection of the data presented in Figure 1A. This suggests that fitting a linear regression runs the risk of misrepresenting the association between these two factors.

*Figure 1 about here*

We therefore fitted a piece-wise regression model where we regressed the PCL-R scores against the standardized adjusted MAS-A-Total scores to account for the confounding effects of gender, intelligence, social functioning and positive symptoms. Piecewise regression, also known as segmented linear regression, is a method used to quantify an abrupt change in the nature of the association between the dependent and independent variables. In this type of analysis, the independent variable is sectioned into segments. Each segment is then fitted a separate regression line. These segments are separated by a breakpoint or a threshold value, beyond which the nature of the association between the dependent and independent variable changes (Abu-Akel, Bailey, & Thum, 2004; Thum & Bhattacharya, 2001). This approach has the advantage of not only estimating the nonlinearity in the data but also allows us to detect a potential change point in the data, that is, where a change in the magnitude or direction of the association between psychopathy and metacognitive abilities might be present. Importantly, our model assumed an *unknown* breakpoint ($\theta$) at which the association between metacognition and psychopathy changes. We utilize the bootstrap method to estimate the confidence intervals of the regression coefficient for each segment as well as the breakpoint in the data. The bootstrap method is an alternative to parametric methods when the assumptions of those methods are in doubt, or where parametric inference is impossible (Davison & Hinkley, 2006). Specifically, the bootstrap method repeatedly samples from the original data with replacement and calculates the statistics of interest for each generated sample. The confidence interval is calculated from the resulting variation of the statistics. In our application of the bootstrap method, the statistics is calculated by the constrained nonlinear regression algorithm (CNLR; (IBM, 2011)), such that for each generated sample the CLNR determines the parameters (statistics) of the piecewise linear regression. For our model, we report the parameter estimates and their confidence intervals (CI)

based on the results of 100 bootstrap samples. The analysis yielded a significant model ($F(4,75)=5.98$, $p<.001$, Cohen's $d=1.30$). The model estimated a breakpoint corresponding to 24 on the PCL-R scale (SE= .99; Bootstrap 95% CI= 22.04, 25.96) (see Figure 2), observing a significant negative association between the metacognition and psychopathy scores prior the breakpoint (β(SE)=-0.10(0.03); Bootstrap 95% CI= -0.17, -0.03), and a significant positive association post the breakpoint (β(SE)=0.37(0.10); Bootstrap 95% CI= 0.17, 0.58).

*Figure 2 about here*

Using this change point, we divided the sample into two groups. One group consisted of individuals scoring 24 or less on the PCL-R (N=48) and the other consisted of individuals scoring above 24 on the PCLR-R (N=31). There were no differences on any of the demographic or clinical variables between the groups. However, the group with extreme psychopathy scored significantly higher on the adjusted MAS-A-Total scores ($F(1,77)=4.29$, df=1, $p=.042$, Cohen's $d=.47$). This effect size means that about 69% of the high psychopathy group scored above the mean of the adjusted MAS-A-Total scores of the low psychopathy group.

However, given the multicomponent nature of metacognitive abilities, the observed association between psychopathy and MAS-A might be driven by a more nuanced aspect of metacognition. We thus ran the analyses, both linear (using Generalized Linear Models) and piece-wise regression (as detailed above) on the adjusted scores of the self, other and mastery subscales of the MAS-A after controlling for potential confounds as revealed by correlational analyses with the various demographic and clinical measures (see Table 1).

First, we ran a linear regression model examining the association between the PCL-R scores and the *MAS-A-Self* subscale, while controlling for the WAIS vocabulary scores. The model was significant ($X^2$=56.88, df=2, p<.001), revealing a significant negative association between the two measures (β(SE)=-0.08(0.01); 95% CI=-0.10, -0.06), p<.001). The piece-wise regression model was also significant (*F*(4,75)=3.09, p=.021, Cohen's *d*=.81). Specifically, it revealed that the negative association between the two measures (β(SE)=-0.04(0.02); Bootstrap 95% CI= -0.07, -0.002) is arrested at a score corresponding to 25 on the PCL-R (SE= 1.29 Bootstrap 95% CI= 22.44, 27.56), which then becomes positive in individuals scoring above 25 on the PCL-R (β(SE)=0.18(0.08); Bootstrap 95% CI= 0.03, 0.33).

Second, we ran a linear regression model examining the association between the PCL-R and *MAS-A-Other* scores, while controlling for GAF, PANSS positive symptoms and WAIS vocabulary. The model was significant ($X^2$=74.94, df=4, p<.001), revealing a negative association between the two measures (β(SE)=-0.11(0.01); 95% CI=-0.13, -0.08). Here, too, the piece-wise regression model was significant (*F*(4,75)=5.74, p<.001, Cohen's *d*=1.09). It revealed that this negative association (β(SE)=-0.05(0.02); Bootstrap 95% CI= -0.08, -0.02) is arrested at a score corresponding to 24.96 on the PCL-R (SE= 1.44 Bootstrap 95% CI= 22.11, 27.82), which then becomes positive in individuals scoring above 24.96 on the PCL-R (β(SE)=0.23(0.09); Bootstrap 95% CI= 0.06, 0.40).

Finally, the linear regression examining the association between the PCL-R scores and the *MAS-A-Master*y subscale, controlling for gender, positive symptoms, GAF and WAIS vocabulary was significant ($X^2$=38.87, df=5, p<.001), revealing a significant negative association between the two measures (β(SE)=-0.09(0.02); 95% CI=-0.12, -0.05), p<.001). Here, however, the piece-wise regression model was non-significant (*F*(4,75)=1.07, p=.38; Cohen's *d*=.33).

**Discussion**

In this paper, we examined the association of metacognitive abilities with psychopathy in forensic patients with schizophrenia. A key finding of our study is that the decline in the patients' overall metacognitive abilities was arrested at extreme levels of psychopathy. Interestingly, this shift occurred within the range of the cut-off point used for the diagnosis of psychopathy in Europe, which corresponds to a score of 26 on the PCL-R. Moreover, the better overall metacognitive abilities of the patients with extreme levels of psychopathy (Cohen's *d* = .47) suggest that these patients may constitute a specific group in which schizophrenia has an attenuated impairing effect on metacognition. Furthermore, the lack of difference between the low and high psychopathy groups on any of the demographic and clinical measures suggests that comorbid psychopathy in schizophrenia is intrinsically associated with functioning metacognitive abilities. This constitutes a profile that is consistent with the ability of these patients to commit premeditated and goal directed acts of violence (Abu-Akel & Abushua'leh, 2004; Bo et al., 2011; Rice, 1997), as well as with findings showing that psychopathic offenders are more instrumental than non-psychopaths in committing their acts of violence (Woodworth & Porter, 2002). Taken together, our findings thus offer important insights to understanding a group

of patients that hitherto has been dubbed “unrecognized subtype of schizophrenia” (Volavka & Citrome, 2008).

However, our analyses pertaining to the association of the PCL-R with the MAS-A subscales, show that the attenuating effect of high psychopathy scores on metacognitive difficulties was detected in all subscales, except for the Mastery domain of the MAS-A, whereby higher PCL-R scores were increasingly associated with more difficulties in the ability to use one’s own mental states to implement effective action strategies to deal with psychological and social dilemmas. While, to the authors’ knowledge, there are no studies to date that used the MAS-A in healthy controls, the mean score on this subscale in the patients scoring above 24 on the PCL-R in our sample was lower than individuals with serious and chronic, non-psychiatric, medical illness (Mean difference=2.91 which is about 1.5 SD below the mean) (Lysaker et al., 2012), as well as adults with substance use disorders but no history of a diagnosis of psychosis (Mean differences =1.19 which is about 1 SD below the mean) (Lysaker, Leonhardt, Brune, et al., 2014). Taken together, these analyses suggest that the attenuating effect of high levels of psychopathy traits and metacognition are primarily driven by metacognitive domains reflective of the ability to understand self and other mental states. Accordingly, we hypothesize that schizophrenia patients with high psychopathy levels will demonstrate better overall theory of mind abilities.

Several proposals suggest that psychosocial treatments may be effective in reducing the propensity of schizophrenia patients for violence (Volavka & Citrome, 2011). There is also evidence showing that psychosocial abilities such as empathizing and understanding the perspective others are associated with reduced violence and aggression (Abu-Akel &

Abushua'leh, 2004; Flight & Forth, 2007; Woodworth & Porter, 2002). Therefore, the current findings may have implication for treatment interventions among the schizophrenia patients with high level or co-morbid psychopathy. Specifically, we suggest that adjunctive treatment that are specifically targeted at enhancing the capacity of the Mastery domain in patients with high levels of psychopathy may be effective in the recognition of and dealing with psychological and social challenges and dilemmas that lead to frustration and offending behavior. This suggestion finds support in research reporting that metacognitive mastery (as assessed by the MAS-A) is predictive of the ability to cope with stressors, having greater insight and higher levels of feeling accepted by peers (Lysaker et al., 2011), as well as of intrinsic motivation, i.e., the propensity to pursue novel experiences and to take part in active self-improvement (Vohs & Lysaker, 2014). There is also promising evidence from rich case studies and open trials suggesting that metacognitive therapy can improve overall functioning in patients with schizophrenia (Van Donkersgoed et al., 2014). The consideration of such interventions are especially important in light of research showing that pharmacotherapeutic interventions appear to have little effect on reducing the propensity of these patients for violence (Nolan et al., 1999; Swanson et al., 2008).

Methodologically, our analytical approach clearly demonstrates that standard linear regression analyses can yield underspecified explanatory models, and thus we highlight the importance of examining non-linear relationships within the context of complex disorders such as schizophrenia. Importantly, however, future research would need to determine the specificity of the observed non-linear association between psychopathy levels and metacognition in these patients. For example, it is unknown whether this association would also be found in measures of executive function. However, when investigating the association of WAIS vocabulary scores

with psychopathy, the piece-wise regression model was non-significant ($F(4,75)=1.09$, $p=.37$). Tentatively, this thus suggests that the non-linear association between psychopathy and metacognition may not be generalizable to other (non-social) cognitive abilities.

In summary, our analyses show that while patients tended to show declining metacognitive abilities with increasing levels of psychopathy, the decline was arrested at extreme levels of psychopathy—occurring within the range of the cut-off point used for the diagnosis of psychopathy. While the relatively small sample of our study prevents us from drawing strong conclusions, the moderate to large effect sizes observed suggest that our findings have practical significance. Moreover, it is noteworthy that the relative preservation of metacognitive abilities in schizophrenia patients with high levels of psychopathy is consistent with their ability to commit premeditated and goal directed acts of violence. However, as pointed above, the absence of this effect on the Mastery domain suggests that psychosocial treatments that specifically target this domain in schizophrenia patients with comorbid or high levels psychopathy may prove effective in reducing their propensity for violence and offending. Accordingly, there is an obvious need for research to assess the utility of such interventions in this population, and particularly to examine under what conditions may such treatments prove effective. Moreover, given the lack of information on type of offenses committed by our patients, it would be intriguing to examine, in future research, whether the non-linear association between metacognition and psychopathy pertains equally to individuals who predominantly commit impulsive versus premeditated type of offenses. Comparing schizophrenia patients with and without psychopathy, using various research paradigms (of neurocognition, social cognition and

metacognition), is a critical further step to understanding the mechanisms involved in countering the deterioration of metacognitive abilities in schizophrenia patients with comorbid psychopathy.

**Author Note:** The authors declare no conflict of interest.

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## Table/Figure Legends

Table 1. Socio-demographic, clinical and cognitive characteristics of the schizophrenia patients and their correlation with the MAS-A and subscales

**Figure 1**. Figure 1A depicts the negative association between overall psychopathy and the total Metacognitive Assessment Scale-Abbreviated (MAS-A) scores. Figure 1B suggests that linear regression may be a misrepresentation of the depicted association in Figure 1A.

**Figure 2**. Piece-wise regression as a function of the adjusted standardized scores of the total Metacognitive Assessment Scale-Abbreviated (MAS-A) and the Psychopathy Checklist Revised (PCL-R) scores. $\theta=24$ indicates the change point where the association between the scores shifts from negative to positive.

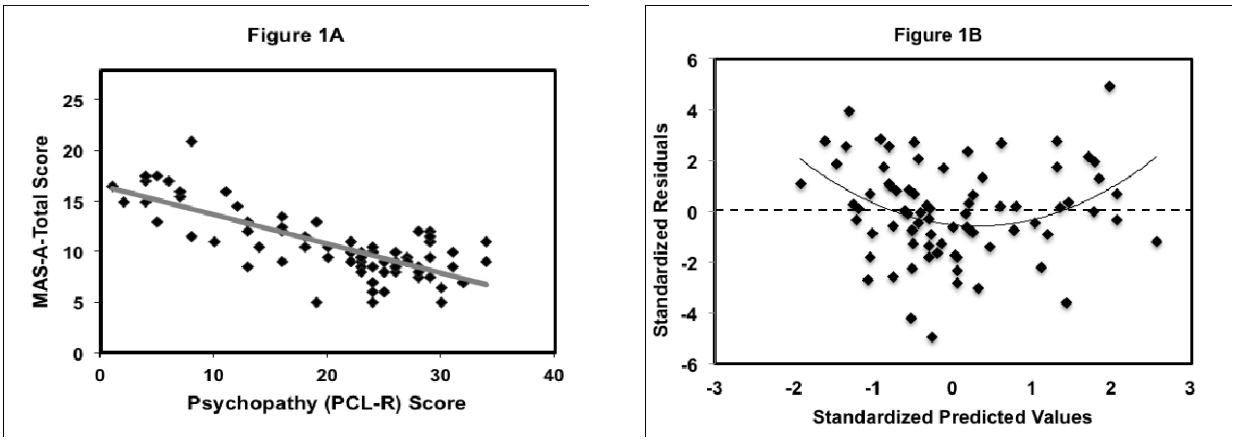
Table 1. Socio-demographic, clinical and cognitive characteristics of the schizophrenia patients and their correlation with the MAS-A and subscales

| Variable | Schizophrenia Sample (N=79) | Correlations with MAS-A Total and subscales† | | | |
|---|---|---|---|---|---|
| | | MAS-A-Total | MAS-A-Self | MAS-A-Other | MAS-A-Mastery |
| Gender (M, F) †† | 15, 64 | -- | -- | -- | -- |
| Age (years) | 36.86±10.37 | .01 | -.003 | -.03 | .08 |
| Duration of Illness (months) | 97.60±72.09 | -.01 | -.01 | .08 | .12 |
| WAIS (Vocabulary) | 8.73±1.97 | .39** | .40** | .33** | .24* |
| PANSS Negative | 5.61±2.80 | -.03 | -.08 | -.01 | -.07 |
| PANSS Positive | 5.71±2.99 | -.29** | -.21 | -.26* | -.28* |
| GAF | 41.54±6.69 | .33** | .19 | .23* | .39** |
| PCL-R Total | 20.58±8.74 | -.65** | -.55** | -.63** | -.51** |
| MAS-A Total | 11.66±3.16 | -- | .81** | .77** | .79** |
| MAS-A-Self | 3.99±1.16 | -- | -- | .67** | .50** |
| MAS-A-Other | 4.42±1.18 | -- | -- | -- | .37** |
| MAS-A-Mastery | 3.23±1.53 | -- | -- | -- | -- |

*p<.05. **p<.01

† Correlations are Spearman's rho. †† Female patients scored higher than male patients on the MAS-A-Total and the MAS-A-Mastery (see text).

WAIS= Wechsler Adult Intelligence Scale; GAF= Global Assessment of Functioning; PANSS= Positive and Negative Syndrome Scale (PANSS); PCL-R= Psychopathy Checklist-Revised; MAS-A= Metacognitive Assessment Scale-Abbreviated.

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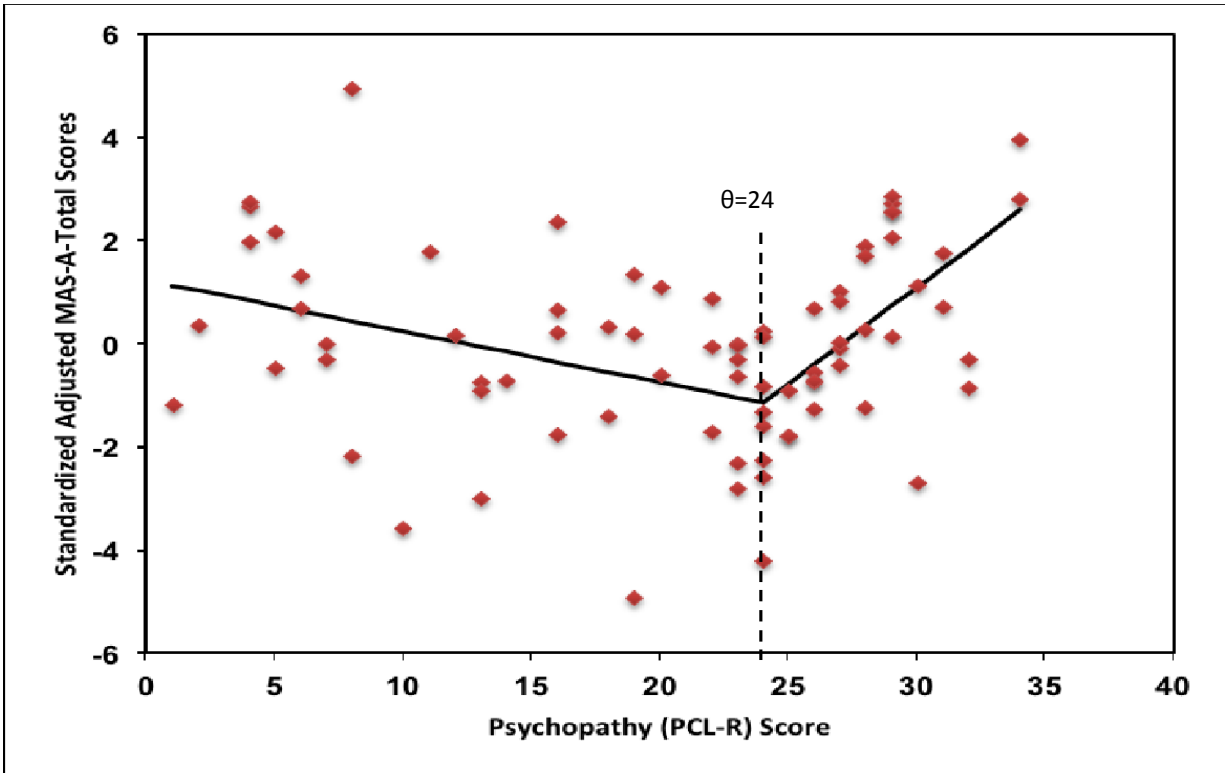


**Figure 2**. Piece-wise regression as a function of the adjusted standardized scores of the total Metacognitive Assessment Scale-Abbreviated (MAS-A) and the Psychopathy Checklist Revised (PCL-R) scores. θ=24 indicates the change point where the association between the scores shifts from negative to positive.