Autistic symptoms predict social cognitive performance in patients with schizophrenia.

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Abstract

Schizophrenia spectrum disorders and Autism Spectrum Disorders (ASD) share many similarities. Among those features, social cognitive impairment is recognized as a key characteristic of both ASD and schizophrenia. In this study, the role of ASD symptoms, measured with the PANSS Autism Severity Score (PAUSS), was investigated as a predictor of social cognitive performance in patients with Schizophrenia spectrum disorders. Existent databases from 2 studies (SCOPE Phase 3 and SCOPE Phase 5), in which a total of 361 patients (mean age 41.7 years; 117 females) were assessed with tests of mental state attribution and emotion recognition, were analyzed. Less severe

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ASD symptoms, as well as younger age, better premorbid IQ, and neurocognition were identified as individual predictors of better social cognitive performance. These results suggest a role of ASD symptoms in affecting social cognitive performance in schizophrenia.

Keywords

Schizophrenia; schizoaffective; autism spectrum disorder; social cognition; PAUSS; neurocognition

1. Introduction

In recent years, a growing interest for the issue of the overlap between autism spectrum disorders (ASD) and schizophrenia emerged. The earliest conceptions of schizophrenia (Bleuler, 1950) focused on autistic features as a central element of schizophrenia, before ASD was defined as a separate entity. Several specific ASD features, such as difficulties in social interaction, communication, emotion processing, and motor abnormalities have often been found in patients with schizophrenia (Cheung et al., 2010; King and Lord, 2011; Kästner et al., 2015). In fact, a number of studies highlighted the similarities between ASD and schizophrenia spectrum disorders, regarding pathophysiological, genetic, neuroimaging, and clinical characteristics (Barlati et al., 2016; Sasson et al., 2011). Since then, the existence of ASD features in patients with schizophrenia has been investigated (Barlati et al., 2019), and instruments for the assessment of autistic symptoms in schizophrenia have been developed. In particular, the PANSS Autism Severity Score (PAUSS) (Kästner et al., 2015) , a scale derived from the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987), for the measurement of autistic symptoms in patients with schizophrenia, has been used in genetic studies, to demonstrate the association between the autistic genotype and phenotype (Ehrenreich et al., 2018; Stepniak et al., 2015), and in neuroimaging studies, to demonstrate the association between autistic symptoms and structural and functional imaging features (Oliveira et al., 2018; Parellada et al., 2017). As such, autistic features in schizophrenia reflect a potential alternative strategy for conceptualizing symptoms, with some overlap between a limited set of features of disorganized behavior (e.g., mannerisms and posturing) and negative symptoms (e.g., emotional withdrawal) that form the definitional core of ASD.

In a recent study by our group (Deste et al., 2018), the use of the PAUSS allowed us to corroborate the hypothesis, already tested in a previous study performed with more complex and time consuming autism scales (Barlati et al., 2019), of the existence of related cognitive characteristics of patients with schizophrenia and ASD features. In particular, patients with schizophrenia and ASD features were found to manifest lower IQ and poorer performance in a number of cognitive domains, including processing speed, working memory, and executive functions. However, in that study, including patients with schizophrenia, poor performance in face emotion recognition, a domain of social cognition, was not detected in the group of patients with ASD features, and emerged only at a trend level.

Nevertheless, the issue of the relation between ASD and social cognition in schizophrenia still represents a relevant topic of interest. In fact, as reported in the DSM-5 (American Psychiatric Association, 2013), autism is characterized by the presence of deficits in social

interactions across multiple contexts, including deficits in social reciprocity and understanding relationships, and social cognitive deficits are recognized in patients with ASD (Baxter et al., 2015; Lai et al., 2014; Zwick, 2017). However, impairment in social cognition is not only present in ASD, but it's also considered a key feature in schizophrenia (Pinkham, 2014), both for its implication in the pathophysiology of the condition (Sergi et al., 2007), and for its impact on functioning (Harvey et al., 2018; Harvey and Penn, 2010).

Moreover, deficits in social cognition have been observed and compared between patients with ASD and schizophrenia. A recent review and meta-analysis (Fernandes et al., 2018) including 482 patients with ASD and 558 patients with schizophrenia, in which social cognition performance was compared in patients with schizophrenia and ASD, no significant differences between schizophrenia and ASD patients emerged in most social cognitive tasks analyzed, while better performance in patients with schizophrenia compared to ASD emerged only in the facial emotion perception domain (8 studies analyzed), but this effect was mediated by age, with greater effect sizes observed in studies including younger patients.

Furthermore, it has been also demonstrated that the severity of deficits in social cognition is variable in people with schizophrenia, being more pronounced in older people, with less education, poorer cognitive performance and with lower functioning (Hajdúk et al., 2018). This evidence leads to the interesting hypothesis that in patients with schizophrenia and ASD features, poorer social cognitive performance, and other specific characteristics, may be identified. Indeed, different clinical aspects, such as not only the already mentioned poorer cognitive performance, but also earlier age of onset, lower IQ and lower education levels have been found to be associated with ASD features in patients with schizophrenia (Deste et al., 2018, Kästner et al., 2015).

In this study, we wanted to investigate the association between ASD symptoms and social cognitive performance in a sample of patients with schizophrenia spectrum disorder. We hypothesize that ASD symptoms could be, among other factors, an individual predictor of poorer social cognitive performance in patients with schizophrenia.

2. Methods

2.1. Participants

Data for this study were gathered from two datasets, originally composed for two previous studies, in which patients with schizophrenia and schizoaffective disorder were assessed with clinical, psychosocial, neuro- and social-cognitive measures. These studies are part of the Social Cognition Psychometric Evaluation (SCOPE) research project: SCOPE Phase 3 (Pinkham et al., 2016), and SCOPE Phase 5 (Pinkham et al., 2018). Patients included in the first dataset were recruited for the third phase of the research program (SCOPE Phase 3). The study took place at 2 sites, Southern Methodist University and the Miami Miller School of Medicine. A total of 179 patients were recruited for this study. Patients included in the second dataset were recruited for a later phase of the research program (SCOPE Phase 5). This study took place at 3 sites, the University of Texas at Dallas, the University of Miami Miller School of Medicine, and the University on North Carolina at Chapel Hill. A total of

218 patients were recruited for this study. Inclusion and exclusion criteria were identical for both studies. Inclusion criteria were: (I) diagnosis of Schizophrenia or Schizoaffective Disorder, according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV, (American Psychiatric Association, 1994) criteria. The diagnoses were confirmed by a clinical interview with the Mini International Neuropsychiatric Interview (Sheehan et al., 1998), and the Structured Clinical Interview for DSM Disorders Psychosis Module (First et al., 2002), (II) patients had to be clinically stable and they could not have any hospitalization within the last two months, and had to be on a stable medication regimen for a minimum of 6 weeks, with no dosage changes for a minimum of 2 weeks. Exclusion criteria were: (I) presence or history of pervasive developmental disorder or mental retardation, defined by an IQ < 70, according to DSM-IV criteria, (II) presence or history of medical or neurological conditions that could interfere with central nervous system functioning, such as seizures, central nervous systems tumors, autoimmune inflammatory disorders affecting the central nervous system, (III) presence of sensory limitations, in particular visual or hearing impairment, that could limit the performance of the patient or interfere with the assessment, (IV) no or very scarce proficiency with English language, limiting the patient's performance on the evaluation tests, (V) presence of substance abuse in the past month, (VI) presence of substance dependence not in remission for the past 6 months. Since the tests administered in the two studies were only partially overlapping, when the databases from the two studies were joined, only those measures of social cognition that were used in both studies were included. Patients who participated to both SCOPE Phase 3 and Phase 5 studies, were omitted from the Phase 5 database. This resulted in a smaller sample size than the sum of the two SCOPE studies.

2.2 Measures

All patients were assessed at the beginning of the studies (SCOPE, Phases 3 and 5) with measures of social cognition, neurocognition and clinical symptoms. The following demographic variables were collected and included in the analyses: age, sex and years of education. As for social cognition, the following tests were used in the present analyses. The *Bell Lysaker Emotion Recognition Task* (BLERT) (Bryson et al., 1997) is a test designed to measure the ability to correctly identify emotional states. Seven basic emotions are represented: happiness, sadness, fear, disgust, surprise, anger, or no emotion. The test is composed of a series of 21 video clips, presenting a male actor providing dynamic facial, vocal-tonal, and upper-body movement cues. Participants have to identify the emotion expressed by the actor after each videoclip. Performance is rated as the total number of correctly identified emotions, with the total score ranging from 0 to 21. The BLERT total score was included in the analyses.

The *Penn Emotion Recognition Test* (ER-40) (Kohler et al., 2003) is a test in which a set of 40 color pictures of static faces is used. Each picture presents one of 4 basic emotions (happiness, sadness, anger, or fear) or a neutral expression, and are balanced for model's sex, age, and ethnicity. For each emotion category, 4 high-intensity and 4 low-intensity emotion expressions are provided. Participants observe one picture at a time and have to identify the emotion presented. The ER-40 total score (total number of correct responses, ranging from 0 to 40) was included in the analyses.

The *Reading the Mind in the Eyes Test* (Eyes) (Baron-Cohen et al., 2001) is used to evaluate the ability to discriminate the mental state of other people, by observing the expression in the eye region of the face. It is composed of 36 pictures of the eye region of different faces. After viewing each picture, participants have to identify the mental state presented, among 4 possible options. Patients are also provided with a brief glossary of mental state terms for reference. The Eyes total score, calculated as the sum of the correct responses, ranging from 0 to 36, was included in the analyses.

The Awareness of Social Inferences Test (TASIT) (McDonald et al., 2003) is a task for the assessment of the ability to identify different social exchanges, such as lies and sarcasm. It is composed by a series of short videoclips presenting everyday social interactions. After watching each video, participants have to answer four standard questions aimed to assess the understanding of intentions, beliefs, and meaning of the speakers and their interactions. The TASIT total score (number of correct responses, ranging from 0 to 64) was included in the analyses.

The *Hinting Task* (Hinting) (Corcoran et al., 1995) is a test designed to assess the ability to infer the true intent of indirect speech. A series of ten short passages, describing an interaction between two characters, is read aloud by the experimenter. Each passage ends with one of the two characters dropping a hint, and the participant is asked what the character truly means. If the participant provides an incorrect answer, a second hint is presented, allowing the participant to earn partial credit. The Hinting total score (ranging from 0 to 20) was included in the analyses.

As for the neuropsychological assessment, the following tests from the MATRICS Consensus Cognitive Battery (MCCB) (Nuechterlein et al., 2008) were administered: Trail Making Test - Part A (TMT-A); BACS Symbol Coding; BACS Category Fluency (Animal Naming); Letter-Number Span; and Hopkins Verbal Learning Test - Revised (HVLT-R). These tests assess different cognitive domains, among those recognized to be impaired in schizophrenia (Nuechterlein et al., 2004) , such as processing speed, working memory, verbal memory (Dickinson et al., 2007; Knowles et al., 2010; Lee and Park, 2005). A mean global cognitive composite score was calculated, by averaging the t-scores of the single tests (Nuechterlein and Green, 2006). The mean global cognitive composite score was included in the analyses.

In order to assess the estimated patients' premorbid IQ, the Wide Range Achievement Test-3 Reading subscale (WRAT-3) (Weickert et al., 2000) was administered to all patients. The WRAT-3 Standard Score was included in the analyses.

For clinical assessment, patients were evaluated with the Positive And Negative Syndrome Scale (PANSS) (Kay et al., 1987), which allows for the calculation of the PANSS Autism Severity Score (PAUSS), a scale for the measure of autistic symptoms in patients with schizophrenia (Kästner et al., 2015). The PAUSS is derived from the Positive and Negative Syndrome Scale by performing the sum of the following PANSS items: N1 ("blunted affect"), N3 ("poor rapport"), N4 ("social withdrawal"), N5 ("difficulties in abstract thinking"), N6 ("lack of spontaneity and flow of conversation"), N7 ("stereotyped

thinking"), G5 ("mannerism"), G15 ("preoccupation"). Its validity in identifying ASD symptoms in patients with schizophrenia has been already demonstrated, and was found to be satisfying, with the PAUSS strongly correlating with other more established diagnostic tools for the assessment of ASD (Kästner et al., 2015), and showing even better sensitivity than such scales in detecting ASD symptoms in patients with schizophrenia (Deste et al., 2018). Being the PAUSS derived from PANSS items, the two scales share a number of characteristics, also due to the rigor needed for the administration of the PANSS. In fact, the PANSS is performed after a structured interview and the scoring also takes into account information collected from standardized objective clinical observation. In the SCOPE study, the PANSS scales were performed by expert psychiatrists with good inter-rater reliability. The PAUSS total score was included in the analyses as a measure of ASD symptoms. The PANSS total score was also included in the analyses as a measure of symptoms severity.

2.3 Statistical analysis

To identify predictors of performance in specific domains of social cognition, multivariate linear regression analyses were performed, including specific social cognition measures as dependent variables, and demographic variables, PAUSS total score, and global cognitive score variables used as potential predictors. Potential predictors were included in the regression if they were found to be significant in univariate exploratory analyses, performed by correlating continuous variables with dependent variables, and by using t-test for dichotomous potential predicting variables (sex). Multiple linear regressions followed a backward procedure, excluding at each step, the less significant independent variable, to identify the most parsimonious model.

Statistical analyses were performed using SPSS 14.0 software. P-values <0.05 (2 tailed) were considered significant.

3. Results

The characteristics of the sample are presented in Table 1. The univariate correlations are shown in Table 2. No differences in any of the social cognition tests analysed emerged between male and female patients at the univariate t-tests, as shown in Table 3. Table 4 shows the predictors of social cognitive tests.

Potential predictors of better emotion processing performance, as measured by the ER40, that emerged at the univariate analysis were younger age, more education years, higher premorbid IQ, better performance in global cognition and less severe ASD symptoms (PAUSS score).

Individual predictors of better emotion processing performance, as measured by the ER40, were younger age (p=0.002), higher premorbid IQ (WRAT-3) (p<0.001), better performance in global cognition (p<0.001) and less severe ASD symptoms (PAUSS) (p=0.002) (Model F = 27.031, R^2 = 0.241, p<0.001).

Potential predictors of better mental state attribution, as measured by the Hinting task, that emerged at the univariate analysis were more education years, higher premorbid IQ, better

performance in global cognition, less severe ASD symptoms (PAUSS score) and less severe schizophrenia symptoms (PANSS total score).

Better mental state attribution, as measured by the Hinting task, was predicted by better performance in global cognition (p<0.001) and less severe ASD symptoms (PAUSS) (p<0.001) (Model F = 35.770, R^2 = 0.173, p<0.001).

Potential predictors of better mental state attribution, as measured by the Eyes task, that emerged at the univariate analysis were younger age, more education years, higher premorbid IQ, better performance in global cognition and less severe ASD symptoms (PAUSS score).

Mental state attribution, as measured by better scores on the Eyes task, was predicted by younger age (p=0.049), higher premorbid IQ (p<0.001) and better performance in global cognition (p<0.001) (Model F = 87.362, R^2 = 0.434, p<0.001).

Potential predictors of better emotion processing performance, as measured by the BLERT, that emerged at the univariate analysis were younger age, more education years, higher premorbid IQ, better performance in global cognition and less severe ASD symptoms (PAUSS score).

Better emotion processing performance, as measured by the BLERT, was predicted by younger age (p<0.001), higher premorbid IQ (p<0.001) and better performance in global cognition (p<0.001) (Model F = 70.269, R^2 = 0.381, p<0.001).

Finally, potential predictors of better mental state attribution, as measured by the TASIT, that emerged at the univariate analysis were more education years, higher premorbid IQ, better performance in global cognition, less severe ASD symptoms (PAUSS score) and less severe schizophrenia symptoms (PANSS total score). Better mental state attribution, as measured by the TASIT, was predicted by younger age (p<0.001), higher premorbid IQ (p<0.001), better performance in global cognition (p<0.001) and less severe ASD symptoms (PAUSS) (p<0.001) (Model Model F = 43.784, R^2 = 0.340, p<0.001).

In order to adjust for our previously reported finding of overlap between social cognition and neurocognition, we ran a forced entry regression analysis. After entering neurocognition as the first step, where it was found to be a significant predictor for all 5 social cognition variables (all t>4.01, all p<0.001), we entered PAUSS scores, age, and WRAT scores to the equation. PAUSS scores were found to be significant predictors of scores on the ER-40 (t= −3.05, p= 0.019), Hinting Task (t=−3.70, p=0.031), and the TASIT (t=−4.03, p=0.028) after consideration of all other variables.

In order to further exclude the possibility that the PAUSS could represent an indirect proxy of clinical severity, a post-hoc analysis was performed, in which a clinical construct, calculated by subtracting the PAUSS total score to the PANSS total score (PANSS-minus-PAUSS), was included in the regressions and was not found to be a significant individual predictor of any social cognitive performance measure.

4. Discussion

The mean PAUSS total score of the sample was 15.3 (SD = 5.4). This value (15) was proposed as the cut-off yelding an optimal balance between sensitivity (0.723) and specificity (0.711) for ASD, while a PAUSS total score of 30 has been proposed as a cut-off for "autistic schizophrenia" (Kästner et al., 2015). This reflects the characteristics of the particular sample of patients included in this study, representative of clinically stable patients referring to the U.S. academic and clinical psychiatric services of Texas, Florida, and North Carolina (Pinkham et al., 2016; 2018). In fact, in this study, a presence or history of pervasive developmental disorder was an exclusion criterion, and participants included in this sample should thus be considered patients with psychosis with sub-clinical levels of ASD symptoms.

In general, social cognition, as measured by different tests used for the assessment of specific social cognitive domains, was predicted by younger age, better premorbid IQ, better global cognitive performance, and less severe autistic symptoms. Less severe ASD symptoms were identified as individual predictors of social cognitive performance, measured with tests of mental state attribution and emotion processing, two key domains of social cognition (Penn et al., 2008). In particular, PAUSS score emerged as an individual predictor of social cognition in 3 out of 5 models, when the ER40, the TASIT and the Hinting tasks were included in the analyses, but not when the Eyes and the BLERT were used. This predictive effect of the PAUSS on social cognitive performance, should be considered a specific effect of ASD symptoms rather than an indirect proxy of symptoms severity, because we included both scales in the analyses, to exclude the possibility that the PAUSS could only represent an indirect proxy of symptoms severity, rather than an individual predictor of social cognition. However, the PANSS total score emerged as a potential predictor at the univariate analyses only for two social cognitive tests, and did not emerge as an individual predictor of social cognition in any model. Moreover, a post hoc analysis allowed to further demonstrate the specificity of the PAUSS, compared to other PANSS.

These results are in line with literature about ASD patients showing deficits in emotion processing and mental state attribution (Golarai et al., 2006; Kana et al., 2009). In a study by Eack SM et al., (2013), in which neurocognition and social cognition were assessed in people with schizophrenia, ASD, and healthy controls, similar levels of impairment in emotion recognition were demonstrated in ASD and in schizophrenia, and such social cognitive deficits were among the most relevant in both ASD and schizophrenia.

In a meta-analysis by Bliksted et al., (2016), mental state attribution ability was demonstrated to be more impaired in people with ASD compared to patients with schizophrenia, being even poorer in people with chronic schizophrenia compared to first episode patients.

It has been hypothesized that the deficits in emotion recognition in ASD patients may be mediated by impaired visual attention, with evidences indicating an eye-gaze fixation to the

mouth region but not to the eye region in patients with ASD and impaired emotion recognition compared to healthy controls (Wieckowski and White, 2017).

Moreover, in a meta-analysis by Peñuelas-Calvo et al. (2018), patients with ASD showed a poorer performance in the Eyes Task, compared to healthy controls, and the performance in such task was predicted by full scale and verbal IQ and age in healthy controls, and was negatively correlated with performance IQ in people with ASD.

These results are in contrast with those of Vaskinn and Abu-Akel (2018), that found, in a sample of 81 people with schizophrenia or schizoaffective disorder, a better performance in Theory of Mind in patients with higher PAUSS scores and more severe positive psychotic symptoms.

Literature concerning ASD features and social cognitive abilities in patients with schizophrenia is limited. However, neuro- and social cognitive deficits in ASD and schizophrenia spectrum disorders show remarkable similarities, with some domains, such as processing speed or emotion recognition, that are particularly impaired in both disorders (Abdi and Sharma, 2004; Eack et al., 2013). Interestingly, similarities in deficits of mirror neuron systems of ASD and schizophrenia have been identified (King and Lord, 2011), and could partly explain the relationship between ASD features and social cognitive deficits in patients with schizophrenia.

Even though in most models the PAUSS emerged as an individual predictor of social cognitive performance, this was not the case in two of the models analyzed. This could be due to the characteristics of the social cognition tests used, in fact, the PAUSS emerged in other models, including different tests used for the measure of the same social cognitive domains. Also, in the case of the BLERT not being predicted by the PAUSS, it could be due to the fact that it uses multiple modalities, thus offering participants many sources of information to use when making a decision. Indeed, the BLERT task requires participants to recognize the presented emotion in a series of short videos, thus offering different and dynamic modalities such as facial, verbal, vocal-tonal, and body movement cues, whereas the ER-40 is based only on static pictures, with no additional information.

As for the EYES task, its performance in patients with autism has been already demonstrated to be also related to other factors such as age and IQ (Peñuelas-Calvo et al., 2018) and performance on that task in this schizophrenia sample shared 35% of the variance with an intelligence measure (Pinkham et al., 2016; 2018).

Premorbid IQ emerged as a predictor of most of the social cognitive abilities analyzed. This is in line with the notion, already demonstrated in literature, of the close relationship between IQ and different social cognitive domains in schizophrenia (Bliksted et al., 2014; Akiyama et al., 2016), as well as the often-reported lower levels of intelligence in many individuals with ASD.

This study has limits: first, it was not designed for the specific purpose of assessing the impact of ASD symptoms on social cognitive abilities; second, the specific characteristics of the sample, including patients with schizophrenia and schizoaffective disorder, with a

relatively low mean PANSS total score, may limit the possibility to apply these results to a wider population of patients with psychotic disorders; third, the choice to join two already existing datasets limited the number of social cognitive tasks assessed to those that were already present in both phases 3 and 5 of SCOPE; fourth, being an exploratory study, and in order to avoid type II errors, all the potential predictors emerged at the univariate analyses were included in the regressions, regardless of possible collinearity, as they all were considered of clinical interest; finally, another possible limitation is represented by the fact that the variance accounted for by the PAUSS, among the various predictors, is small. However, patients were not selected for having elevations on the PAUSS, which could be an important goal for future research.

Even with these limitations, the results of this study suggest a relevant role of ASD symptoms in affecting social cognitive dysfunctions in schizophrenia, such that those individuals with more ASD symptoms are likely to show greater difficulties. Previous work has indicated that the presence and severity of social cognitive impairment in schizophrenia varies at the level of the individual (Hajdúk et al., 2018), and it now seems likely that ASD symptoms may contribute to this variation.

These results, if confirmed by more specific studies, may have possible clinical implications, as far as ASD features emerge as a relevant first-line assessment target, given their potential role in as predictors of key clinical features, also potentially implied in real-life outcomes. This perspective could be pursued due to the practicality of the use of the PAUSS in the clinical practice.

Additional work should continue to examine factors that can help to predict who will be likely to show social cognitive impairment, and to explore the impact of ASD symptoms in other key features of schizophrenia.

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Table 1 -

Characteristics of the Sample

Variable	N, Mean±SD
N	361
M:F	244:117
Age (Years)	41.7±12.0
Education (Years of Education)	12.9±2.3
WRAT-3 Standard Score (Premorbid IQ)	94.4±15.2
PANSS total score (Symptoms Severity)	61.9±15.2
PAUSS total score (Autism)	15.3±5.4
Global Cognitive Composite Score (t-score)	38.2±7.1

Table 2 -

Correlations between social cognition and demographic, ASD, and neurocognitive variables (Pearson's correlations).

Variables	ER40 (Pearson's r)	HINTING (Pearson's r)	EYES (Pearson's r)	BLERT (Pearson's r)	TASIT (Pearson's r)
Age (Years)	−0.214[**]	0.89	−0.188[**]	−0.353[**]	−0.211[**]
Education (Years of Education)	0.215[**]	0.134[**]	0.292[**]	0.305[**]	0.218[**]
WRAT-3 Standard Score (Premorbid IQ)	0.383[**]	0.242[**]	0.596[**]	0.508[**]	0.433[**]
PAUSS total score (Autism)	−0.221[**]	−0.250[**]	−0.144[**]	−0.147[**]	−0.283[**]
PANSS total score (Symptoms Severity)	−0.079	−0.145[**]	−0.102	−0.056	−0.207[**]
Global Cognitive Composite Score (t-score)	0.375[**]	0.374[**]	0.505[**]	0.421[**]	0.466[**]

[*]
p<0.05

[**]
p<0.01

Table 3 -

Social cognitive differences between male and female patients (t-tests).

Social cognitive tests	Males (mean±SD)	Females (mean±SD)	t-test p	Cohen's d
ER 40 (Social Cognition, Emotion Processing)	30.11 ± 5.37	30.49 ± 4.47	0.478	0.077
HINTING (Social Cognition, Mental State Attribution)	13.22 ± 3.82	13.63 ± 3.81	0.336	0.10874
EYES (Social Cognition, Mental State Attribution)	20.81 ± 5.48	20.45 ± 5.49	0.557	0.066
BLERT (Social Cognition, Emotion Processing)	13.57 ± 4.11	13.40 ± 3.79	0.703	0.043
TASIT (Social Cognition, Mental State Attribution)	44.41± 7.55	44.93 ± 7.66	0.543	0.068

Table 4 -

Predictors of social cognitive performance (Backward linear multivariate regressions)

Dependent variables	Individual predictors	Standardized Beta	t	p
ER 40 **(Social Cognition, Emotion Processing)**	Age	−0.154	−3.194	0.002
	WRAT-3 Standard Score (Premorbid IQ)	0.241	4.563	<0.001
	PAUSS (Autism)	−0.150	−3.052	0.002
	Global Cognition	0.220	4.093	<0.001
	Model F = 27.031, R^2 = 0.241, Adjusted R^2 = 0.232			<0.001
HINTING **(Social Cognition, Mental State Attribution)**	PAUSS (Autism)	−0.189	−3.701	<0.001
	Global Cognition	0.324	6.341	<0.001
	Model F = 35.770, R^2 = 0.173, Adjusted R^2 = 0.169			<0.001
EYES **(Social Cognition, Mental State Attribution)**	Age	−0.082	−1.975	0.049
	WRAT-3 Standard Score (Premorbid IQ)	0.443	9.728	<0.001
	Global Cognition	0.311	6.939	<0.001
	Model F = 87.362, R^2 = 0.434, Adjusted R^2 = 0.429			<0.001
BLERT **(Social Cognition, Emotion Processing)**	Age	−0.293	−6.778	<0.001
	WRAT-3 Standard Score (Premorbid IQ)	0.331	6.953	<0.001
	Global Cognition	0.256	5.449	<0.001
	Model F = 70.269, R^2 = 0.381, Adjusted R^2 = 0.376			<0.001
TASIT **(Social Cognition, Mental State Attribution)**	Age	−0.159	−3.548	<0.001
	WRAT-3 Standard Score (Premorbid IQ)	0.263	5.333	<0.001
	PAUSS(Autism)	−0.185	−4.033	<0.001
	Global Cognition	0.292	5.825	<0.001
	Model F = 43.784, R^2 = 0.340, Adjusted R^2 = 0.332			<0.001

ER40: Penn Emotion Recognition Test total score

HINTING: Hinting Task total score

EYES: Reading the Mind in the Eyes total score

BLERT: Bell Lysaker Emotion Recogniton Task total score

TASIT: The Awareness of Social Inferences Task total score

PANSS: Positive and Negative Syndrome Scale total score

PAUSS: PANSS Autism Severity Score (PAUSS) total score

WRAT-3: Wide Range Achievement Test-3 Reading subscale standard score

Global cognition: Global Cognitive Composite Score (t-score)

R^2 refers to the variance of the dependent variable explained by the model.