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Theory of mind in schizophrenia: An examination of its nonsocial cognitive underpinnings

HOVEDOPPGAVE

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Abstract

Social cognition has been established as a mediator between nonsocial cognition and functional outcome in schizophrenia. However, the empirical relationship between specific nonsocial cognitive and social cognitive domains is less clear. The aim of this study was to investigate which specific nonsocial cognitive tests best predict theory of mind (ToM) performance in a sample of 91 individuals with schizophrenia. We indexed ToM by a composite score of the video-based Movie for the Assessment of Social Cognition test (MASCtot). Nonsocial cognition was measured by way of the nonsocial cognitive subtests of the MATRICS Consensus Cognitive Battery (MCCB) and the Wechsler Abbreviated Scale of Intelligence (WASI IQ). To investigate the relationship between MASCtot and specific nonsocial cognitive variables, bivariate and multiple regression analyses were applied. We found statistically significant associations between MASCtot and five nonsocial cognitive tests within the domains of speed of processing, intelligence, verbal and visual memory, and non-verbal working memory in the bivariate correlation analysis. However, in the regression analysis none of the five tests made significantly unique predictions to MASCtot. Together, all the nonsocial cognitive variables accounted for 17% of the variation in MASCtot. This implies that nonsocial cognition and ToM are associated, albeit distinct, constructs. Furthermore, our results suggest that improved ToM is not to be expected from training of nonsocial cognition, alone.

Keywords: Schizophrenia, Social cognition, Theory of mind (ToM), Nonsocial cognition, MASC, MCCB

Sammendrag

Sosial kognisjon er etablert som en medierende faktor mellom ikke-sosial kognisjon og funksjonsutfall hos personer med schizofreni. Imidlertid er forholdet mellom spesifikke ikke-sosial kognitive funksjoner og sosial kognitive domener mindre klart. Formålet med denne studien var å utforske hvilke spesifikke ikke-sosiale kognitive tester som best predikerer theory of mind (ToM), i et utvalg av 91 personer med schizofreni. ToM ble målt ved bruk av en samlet skåre fra en videobasert test, the Movie for the Assessment of Social Cognition (MASCtot). Ikke-sosial kognisjon ble målt ved bruk av de ikke-sosiale kognitive subtestene i the MATRICS Consensus Cognitive Battery (MCCB) og the Wechsler Abbreviated Scale of Intelligence (WASI IQ). For å undersøke forholdet mellom MASCtot og spesifikke ikke-sosial kognitive variabler, ble bivariat korrelasjonsanalyse og standard multippel regresjonsanalyse benyttet. Det ble funnet en signifikant assosiasjon mellom MASCtot og fem av de ikke-sosial kognitive testene innen domene prosesseringshastighet, visuell og verbal hukommelse, ikke-verbal hukommelse, og intelligens i korrelasjonsanalysen. Imidlertid var det ingen av disse testene som predikerte MASCtot, da de ikke hadde et signifikant unikt bidrag i regresjonsanalysen. Til sammen utgjorde alle de ikke-sosial kognitive testene 17% av variansen i MASCtot. Dette indikerer at ikke-sosial kognisjon og ToM er assosierte, men likevel distinkte konstrukter. Av klinisk relevans impliserer våre funn at forbedret ToM ikke er å forvente av kun trening på ikke-sosial kognisjon.

Nøkkelord: Schizofreni, Sosial kognisjon, Theory of mind (ToM), Ikke-sosial kognisjon, MASC, MCCB

1. Introduction

Schizophrenia is a severe mental illness, the onset of which usually is adolescence or young adulthood. It is related to adverse consequences at the individual as well as the societal level, and represents substantial costs to the health care system (Karlsen and Loberg, 2012). Research has established that both impaired nonsocial cognition and social cognition are core features of schizophrenia (Bora et al., 2016; Green et al., 2019). Nonsocial cognition, also referred to as neurocognition, typically involves speed of processing, attention/vigilance, working memory, verbal learning, visual learning, reasoning, and problem-solving (Green et al., 2019; Nuechterlein et al., 2008). Studies reveal that impairments in nonsocial cognition in individuals with schizophrenia range between 0.75 and 1.5 standard deviations below healthy control individuals. Deficits in long-term memory and speed of processing have emerged as especially pervasive (Green et al., 2019). Social cognition is defined as “the mental operations that underlie social interactions, including perceiving, interpreting and generating responses to the intentions, dispositions and behaviors of others” (Green et al., 2008, p. 1211). Social cognition is a multidimensional construct that encompass several domains. Emotion processing and mentalizing/ ToM are most studied in the schizophrenia literature. Social perception/knowledge and attributional bias are the two other social cognitive domains (Green et al., 2019).

Several studies find that nonsocial cognition and social cognition to some extent overlap and as such are related constructs (Green et al., 2015). Results from a meta-analysis indicate that nonsocial cognition can account for 5–11% of social cognition (Ventura et al., 2013). In accordance with these findings, Fanning et al. (2012) found that nonsocial cognition explained 10–20% of the variance in social cognition. This suggests that nonsocial cognitive abilities, such as perception and working memory, to a certain degree, are necessary to process socially relevant information (Allen et al., 2007; Pinkham et al., 2003; Sergi et al., 2007; van Hooren et al., 2008), and that nonsocial cognition confounds and operates as a building block for social cognition. Furthermore, adequate social cognition rarely appears simultaneously with poor nonsocial cognition, which indicates that nonsocial cognition is a necessity for optimal social cognitive abilities (Fanning et al., 2012). Despite the overlap between the two constructs, several studies find that nonsocial cognition and social cognition must be regarded as distinct cognitive domains (Allen et al., 2007; Hoe et al., 2012; Pinkham et al., 2003; Sergi et al., 2007; van Hooren et al., 2008).

Functional outcome in schizophrenia is considered as a principal focus for clinical interventions (Fett et al., 2011; Schmidt et al., 2011), and both nonsocial cognition and social cognition have been established as important determinants of functional outcome (Combs et al., 2011; Couture et al., 2006; Fett et al., 2011; Ludwig et al., 2017; Mehta et al., 2014). Research indicates that nonsocial cognition only accounts for a relatively modest portion of the impaired functional outcome observed in schizophrenia (Deckler et al., 2018; Green et al., 2004); a recent meta-analysis reported that social cognition was accountable for 16% of the variance in functional outcome, while nonsocial cognition explained 6% of the variance (Green et al., 2019). Several studies find that social cognition mediates the relationship between nonsocial cognition and functional outcome (Fett et al., 2011; Halverson et al., 2019; Schmidt et al., 2011). Taken together, these findings indicate a distinct, but yet related link between nonsocial cognition, social cognition and functional outcome (Brekke et al., 2005; Schmidt et al., 2011; Vauth et al., 2004).

A large meta-analysis investigated the degree of impairment in five social cognitive domains, and concluded that ToM was one of the domains most severely affected in patients with schizophrenia (Savla et al., 2013). Mentalizing/ToM refers to “the ability to infer the intentions, dispositions, and beliefs of others” (Green et al., 2019, p. 148), and can be understood as a complex cognitive function (Fretland et al., 2015). Moreover, ToM has been a subject of attention because this social cognitive domain is found to be an especially strong predictor of functional outcome (Fett et al., 2011; Halverson et al., 2019).

Several studies have found positive correlations between impaired ToM and specific nonsocial cognitive functions, such as memory and attention (Drury et al., 1998; Greig et al., 2004). Mehta et al. (2014) found that executive functions (EF) and visual and verbal memory were significant predictors of ToM. More recent studies reported a correlation between deficits in ToM and impaired verbal memory (Mike et al., 2019). Deckler et al. (2018) found associations between ToM performance and impaired verbal memory, verbal working memory, and speed of processing. Intelligence (i.e., IQ) has been found to be moderately correlated with ToM (Fretland et al., 2015; Ventura et al., 2013). There are, however, studies that have not found significant associations between ToM and nonsocial cognition (Oh et al., 2010; Parola et al., 2018; Pickup, 2008). For example, one study explored the relationship between ToM, IQ and EF in schizophrenia, finding that ToM deficits remained even after controlling for IQ and EF (Abdel-Hamid et al., 2009). Similarly, other experimental studies, as well as a meta-analysis (Sprong et al., 2007) have found only minor effects of IQ on ToM (Janssen et al., 2003; Pickup and Frith, 2001; Sprong et al., 2007).

Overall, there are inconsistent findings regarding the relationship between ToM and nonsocial cognition in the empirical literature.

One explanation for the diverse findings may be due to the use of various ToM tasks, in which different ToM tests are characterized by different test characteristics. This creates a heterogeneity concern. ToM tasks may vary in which nonsocial cognitive processes they rely on, such as deficits in working memory, EF and attention (Bora et al., 2009). Hence, it might be difficult to obtain consensus regarding ToM and its nonsocial cognitive underpinnings, due to the heterogeneity in test characteristics.

A second possible explanation for variation in the findings, is that although ToM includes both affective and cognitive components, few studies have distinguished between affective and cognitive ToM. The affective component of ToM relates to the concept of empathy and the understanding of other people's emotional states (usually assessed with irony or *faux pas* tasks). The ability to differentiate between the speaker's and the listener's knowledge about beliefs, requires a cognitive understanding, and refers to the cognitive component of ToM (usually assessed with false belief tasks) (Shamay-Tsoory et al., 2007).

Another concern regarding the variety of different measures is that several of the tests used to assess ToM lack ecological validity (Feyerabend et al., 2018). The experimental settings of the tests are often unrelated to real-life experiences and interactions (Bora et al., 2009; Montag et al., 2011). For example, the Reading the Mind in the Eyes Task (Baron-Cohen et al., 1997) use static stimuli, such as a single picture with the purpose of reflecting a specific emotion, rather than dynamic stimuli with the purpose of reflecting complex emotions in real life interactions (Feyerabend et al., 2018). False-belief tasks are the most common measures of ToM (Bora et al., 2009; Fernandez-Gonzalo et al., 2013). However, many of these tasks are static, such as the False Belief picture sequencing. Other tasks, such as the False Belief stories, only use verbal stimuli (Bora et al., 2009). Lack of ecological validity might lead to difficulties in capturing the complexity of ToM, in which decoding of dynamic stimuli differs from that of static stimuli (Adolphs et al., 2003; Weyers et al., 2006).

One measure, that has both better ecological validity and provides scores for cognitive and affective ToM is the Movie for the Assessment of Social Cognition (MASC) (Andreou et al., 2015; Feyerabend et al., 2018). This is a relatively new instrument to assess ToM, and is found to be a reliable measure with high interrater reliability, internal consistency, and test-retest stability. The MASC includes ToM concepts such as irony, sarcasm, metaphor, persuasion, *faux pas*, deception, as well as first and second order false belief (Dziobek et al., 2006). Compared to other ToM tests, MASC encompasses dynamic stimuli, (i.e., real persons in interaction), and displays everyday life situations (Andreou et al., 2015; Feyerabend et al., 2018). A further advantage of MASC is that it consists of a more multidimensional approach than most other instruments, which often use dichotomous (right/wrong) response alternatives (Montag et al., 2011). Through a multiple-choice response format, MASC measures not only an overall score of total correct mentalizing responses (MASCtot), but also different types of mentalizing errors. These include undermentalizing, overmentalizing, and no mentalizing errors (Dziobek et al., 2006). Using MASC may as such contribute to a more precise understanding of ToM impairment in schizophrenia.

There seems to be discordant findings in the field concerning which specific nonsocial cognitive processes might be of significance for ToM performance. Clarifying this relationship might contribute to advances in treatment measures in clinical practice for schizophrenia, for example cognitive-remediation therapies, that may improve functional outcome (Mehta et al., 2014; Ventura et al., 2015).

To our knowledge, four previous studies have explored the relationship between MASC performance and measures of nonsocial cognition in schizophrenia. Andreou et al. (2015) found that patients with schizophrenia differed from healthy controls and patients with personality disorder primarily by making significantly more undermentalizing errors on the MASC. These errors were related to verbal memory, facial emotion recognition and pre-morbid IQ, but not to attention or cognitive flexibility. They did not report MASCtot. Fretland et al. (2015) reported that MASCtot score was associated with IQ, but did not investigate other nonsocial cognitive variables. Catalan et al. (2018) found that MASCtot was associated with processing speed, visual memory and EF, but not with IQ. Vaskinn et al. (2018) reported that all MASC measures (total ToM, cognitive ToM, affective ToM, overmentalizing, undermentalizing, and no mentalizing) were associated with a composite score comprised of the nonsocial cognitive tests of the MATRICS Consensus Cognitive Battery (MCCB), and that cognition accounted for only about 17% of the variance in MASCtot.

To sum up, there is presently no consensus whether IQ is important for MASC performance. Visual and verbal memory seem important, but whether one or the other is more important for MASC performance is currently not well understood.

This is a follow up study using the same data set as Fretland et al. (2015) and Vaskinn et al. (2018). Those studies found that IQ, measured with the Wechsler Abbreviated Scale of Intelligence (WASI) and a composite nonsocial cognitive score of the MCCB were associated with MASCtot. The aim of the current study is to examine which of the nonsocial cognitive variables, measured with MCCB and WASI, that best predict MASCtot. Based on previous findings, we hypothesize that ToM performance as measured with MASCtot is positively correlated with IQ, visual and verbal memory, processing speed, and executive functions. Second, given the consensus in the literature regarding ToM as a related, yet distinct construct, we predict that the nonsocial cognition measures of the MCCB will account for a small explained variance in MASCtot. We will not make other predictions of which specific nonsocial cognitive processes that best will underlie MASC performance, due to the inconsistency in previous findings.

2. Methods

2.1. Participants

This study followed up Fretland et al. (2015) (same data set, smaller sample) and Vaskinn et al. (2018) (same sample). 91 participants (57 men, 34 women) with schizophrenia (n = 69) or schizoaffective disorder (n = 22) were included. All participants were recruited from hospitals in the greater Oslo area and were all a part of the Thematically Organized Psychosis (TOP) study at the Norwegian Centre for Mental Disorder Research (NORMENT) at Oslo University Hospital. Inclusion criteria for the study involved age between 18 and 55 years, as well as all compulsory schooling conducted in Norway or Norwegian as mother tongue. Criteria for exclusion from the sample were neurological disease or head trauma causing hospitalization and IQ ≤ 70 as measured by WASI. See Table 1 for demographic and clinical information.

2.2. Social cognitive measures

We used the Norwegian version of the MASC test to assess ToM (Dziobek et al., 2006; Fretland et al., 2015). MASC consists of a 15-minute video which follows two men and two women during a dinner party. The video is paused 45 times, and each time the participants are presented with multiple choice questions. Each question consists of four response alternatives. To measure mentalizing ability, the participants are instructed to make inferences regarding the four characters' thoughts, feelings and intentions throughout. The various response alternatives represent different aspects of mentalization (Vaskinn et al., 2018). Because MCCB has been found to predict 8-18% of the variance of all the MASC measures, (Vaskinn et al., 2018), the MASCtot score was used as the dependent variable in our analyses.

2.3. Nonsocial cognitive measures

Nonsocial cognition was measured with WASI and the nine nonsocial cognitive subtests of the MCCB (Nuechterlein et al., 2008): Trail Making Test Part A (TMT-A); Symbol Coding from Brief Assessment of Cognition in Schizophrenia (BACS); Category Fluency Animal Naming (Verbal fluency); Continuous Performance Test—Identical Pairs (CPT-IP), Hopkins Verbal Learning Test— Revised (HVLT-R); Spatial Span from Wechsler Memory Scale, Third Edition (WMS-III), Letter–Number Span (LNS); Brief Visuospatial Memory Test—Revised (BVMT-R); and Mazes from the Neuropsychological Assessment Battery (NAB). The *t*-scores of these nine tests were used in the analyses. Missing data was handled as described in Vaskinn et al. (2018): four participants had missing data for one MCCB subtest, and one participant had missing data for three MCCB subtests. The mean *t*-score of the group for the specific subtests was entered for the statistical analysis.

2.4. Statistical analysis

Several of the nonsocial cognitive variables were non-normally distributed according to the Kolmogorov Smirnov test with Lilliefors Significance Correction. Thus, nonparametric statistics were used. In the first step, the relationship between WASI, the nine MCCB test scores and MASCtot, were investigated with bivariate correlation analysis (Spearman's rho). The strength of all correlations was determined according to Cohen's guidelines (1988), in which small is indicated by $r > .10$, medium $r > .30$ and large $r > .50$. Two-tailed tests were applied to all analyses and p-levels were Bonferroni-corrected *t* (.05/10 nonsocial cognitive tests = new p-level .005). In the second step, nonsocial cognitive variables that were significantly associated with MASCtot at the corrected p-level with a moderate effect size ($r > .30$) were entered as independent variables in a standard multiple regression analysis. To assess collinearity, the correlation coefficients between each of the nonsocial cognitive variables in the bivariate correlation analysis were examined. MASCtot was entered as the dependent variable. Standard multiple regression was chosen since the aim was to investigate which of the nonsocial cognitive variables makes the strongest unique prediction to MASCtot.

3. Results

Table 2 presents participants' MASC and MCCB data. Bivariate correlations between ToM performance (MASCtot) and cognition (MCCB and WASI) are presented in Table 3. Based on Bonferroni corrected p-levels and moderate effect size, BACS, HVLT, WMS, BVMT, and WASI were found to moderately correlate with MASCtot. These five nonsocial cognitive variables were entered as predictors of MASCtot in a standard multiple regression analysis, after controlling for collinearity. None of the variables exceeded $r =.70$, thus the rule of collinearity was not violated, as displayed in Table 3. The regression analysis for predictors of MASCtot is presented in Table 4. Together all the nonsocial cognitive variables explained 17% of the variance. BVMT had the highest beta value, followed by BACS. However, neither of the independent variables made a unique significant contribution to the model.

4. Discussion

The aim of this study was to examine which of the nonsocial cognitive variables, measured with MCCB and WASI, that best predict ToM. None of the nonsocial cognitive variables had a significant, unique contribution in explaining ToM in our study, which suggest that none of these variables alone are prominent in predicting ToM performance.

Our first hypothesis was to some extent confirmed. We expected to find significant associations between ToM on the one side, and IQ, visual and verbal memory, processing speed, and EF respectively. The strongest association was found for processing speed in the medium to large range, as measured by BACS performance. Further, the bivariate correlation analysis yielded moderate correlations with visual memory, IQ and verbal memory. EF was not significantly associated with ToM. The analysis showed a moderate correlation between nonverbal working memory and ToM. This result was surprising, because no other studies have reported a significant association with this nonsocial cognitive measure.

Our second hypothesis was confirmed. In line with the previous study that used the same data set (Vaskinn et al., 2018), a regression analysis showed that the nonsocial cognition measures of the MCCB only accounted for 17% of the explained variance in ToM. This aligns with other previous studies, indicating that ToM and nonsocial cognition are related, yet distinct constructs (Allen et al., 2007; Combs et al., 2011; Hoe et al., 2012; Pinkham et al., 2003; van Hooren et al., 2008; Vaskinn et al., 2018). Note however, that the modest explained variance does not preclude that ToM may be related to something that we have not examined.

As of this matter, a domain of interest is EF. The MCCB is not designed to directly measure this domain, in which only one subtest is thought to measure EF, respectively the Mazes test. Hence, this study does not have an optimal measure of EF (Holmén et al., 2012). EF is suggested to be divided into several different aspects: attention and inhibition, task management, planning, monitoring, and temporal coding (Kerns et al., 2008). The Mazes test addresses some of these functions, in particular, the ability to plan one's actions (Holmén et al., 2012; Mohn et al., 2014). It does not, however, capture the total spectrum of EF. EF encompasses different aspects, which also raise a question whether it is possible for an individual with schizophrenia to display impairment in some aspects of EF, while others are intact (Holmén et al., 2012).

Holmén et al. (2012) investigated how EF best is measured in early-onset schizophrenia. In their study, three tests were assessed, respectively the Mazes test, the Stroop test and Wisconsin Card Sorting task (WCST). They found that the Stroop test best discriminated between patients and controls, and as such was the most adequate measure of EF in the population they analyzed (Holmén et al., 2012, 2010). Moreover, different tests are considered to assess different components of EF (Holmén, et al., 2012). With regards to our study, Holmén's et al. (2012) results may indicate that inclusion of other EF tests, especially the Stroop test, would be beneficial to attain a better measure of EF. It also remains unclear whether other measures of EF would increase the total explained variance in ToM in our study.

In line with Fretland et al. (2015) this study also found IQ to have a moderate correlation with ToM. However, Fretland et al. (2015) found IQ to be a significant predictor for ToM performance. In our study, we found that IQ did not predict ToM performance, and had the lowest beta value. Nevertheless, Fretland et al. (2015) did not investigate other nonsocial cognitive variables, given that their main focus was to address how symptoms relate to ToM performance. In their study, symptoms accounted for 7% of the explained variance of ToM performance and when including IQ, the explained variance increased to 20%.

Other studies have investigated the relationship between IQ and MCCB, and found a strong association between these two measures (August et al., 2012; Mohn et al., 2014). It seems that working memory, speed of processing, and visual and verbal learning have an especially strong association with IQ (Mohn et al., 2014). This association indicates that WASI, as a measure of IQ, and subtests of the MCCB to some degree overlap. The observed overlap may explain why none of the nonsocial cognitive tests in our study had a unique contribution to ToM. Supportive of this, Mohn et al. (2014) found a strong correlation (r =.60) between full IQ and MCCB in a group of healthy participants. Furthermore, August et al. (2012) found that the composite score of the MCCB was significantly correlated with WASI IQ score in healthy controls and patients with schizophrenia.

According to Rund (2015) it is challenging to operate with a definite distinction between the different nonsocial cognitive domains that characterize impairment in schizophrenia. First, studies use different terminology to identify the same domains. Second, the nonsocial cognitive domains overlap to a great extent, such as EF and working memory. The perspective of Rund (2015) applies to our results, in which none of the nonsocial cognitive variables had a unique significant contribution to predict ToM in the regression analysis. Rund (2015) posits that deficits in nonsocial cognition often reflect a global impairment, hence, a composite score of the nonsocial cognitive variables might be equitable to measure nonsocial cognition in schizophrenia.

Visual memory (as measured by BVMT) yielded the highest beta value in the model, followed by speed of processing (as measured by BACS). MASC is a relatively visual task, in which participants are required to make sense of the visual information and identifying visual features in faces or objects (Green et al., 2019). Given the strong visual aspect, MASC might be more sensitive to deficits in visual memory, thus, BVMT yielded the strongest contribution in the model. Moreover, deficits in speed of processing is a central aspect of schizophrenia, and is a necessity to perceive and comprehend information (Dickinson et al., 2007; Schaefer et al., 2013). MASC consists of interactions between different characters in a normal pace. Impairment in speed of processing might challenge the ability to perceive normal pace interactions, such as apprehending details in the conversations and to distinguish between who said what to whom. Even though BACS did not have a unique significant contribution to ToM, speed of processing is a domain that is more closely related to processing social relevant information, compared to other nonsocial cognitive domains, such as the cognitive demands required by MASC.

4.1. Limitations

The present study has some limitations. As previously mentioned, it does not have an optimal measure of EF. To obtain a better understanding of the relationship between EF and ToM, it is necessary to use EF tests that are not part of the MCCB battery. Furthermore, only the MASC total score was investigated in relation to nonsocial cognitive variables. Investigating various ToM constructs, such as affective and cognitive ToM, or different types of mentalizing errors, may have yielded other results (although earlier work by Vaskinn et al., 2018 suggests otherwise). Lastly, this study was based on single subtests of the MCCB. We did not combine the subtests into nonsocial cognitive domains. Although unlikely, it remains unknown if this would influence our results.

5. Conclusion and clinical implications

In summary, this study found moderate associations between ToM and IQ, speed of processing, and memory. Nonsocial cognition in total accounted for 17% of the variance in ToM. None of the nonsocial cognitive tests were unique predictors of ToM performance. Our findings suggest that differentiating between specific nonsocial cognitive variables may not be necessary and use of a composite score of these variables is equitable, when investigating the relationship between ToM and nonsocial cognition. IQ did not have a significant unique contribution to predict ToM. Previous research finds strong associations between IQ and MCCB (Mohn et al., 2014). To avoid a prolonged testing (Mohn et al., 2014), our results might suggest that a measure of IQ can be left out, given that MCCB is such a comprehensive test battery. Due to the modest explained variance in our study, it would be interesting to further investigate other factors that might influence ToM performance. Moreover, our results support the notion that ToM and nonsocial cognition are distinct constructs. Of clinical relevance, our results imply that improved ToM is not to be expected from training of nonsocial cognition, alone. Thus, it might be better to address them as two different constructs with different treatment implications.

Declarations of interest: None.

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Tables

Table 1

Demographics and clinical characteristics in participants with schizophrenia (SZ)

Demographics	SZ (*n*=91)
	Mean (*SD*)
Age	29.1 (*8.4*)
Sex (males/females)	57/34
Education	12.2 (*2.4*)
WASI IQ	100.3 (*13.2*)

Table 2

MASC total correct (max 45) and MCCB performance

	SZ (*n*=91)
	Mean (*SD*)
MASCtot	29.4 (*6.9*)
Trail Making Test	41.5 (*10.5*)
Brief Assessment of Cognition in Schizophrenia	32.5 (*10.0*)
Hopkins Verbal Learning Test	40.9 (*9.0*)
Wechsler Memory Scale	46.9 (*10.4*)
Neuropsychological Assessment Battery, mazes subtest	46.2 (*12.1*)
Brief Visuospatial Memory Test	32.4 (*11.9*)
Category fluency test, animal naming	46.3 (*11.0*)
Continuous Performance Test	37.4 (*10.0*)
Letter-Number Span Test	39.4 (*9.3*)

Table 3

Bivariate associations (Spearman`s rho) between ToM performance and cognition (MCCB and WASI) in participants with schizophrenia (n=91)

	MASCtot	TMT A	BACS	HVLT	WMS	Mazes	BVMT	Verbal fluency	CPT	LNS	WASI
MASCtot	—										
TMT A	.185 (p= .079)										
BACS	**.423 (p= <.001)**	**.611 (p= <.001)**									
HVLT	**.318 (p= .002)**	.184 (p= .081)	**.425 (p= <.001)**								
WMS	**.360 (p=<.001)**	**.483 (p= <.001)**	**.552 (p= <.001)**	**.449 (p= <.001)**							
Mazes	.161 (p= .128)	**.621 (p= <.001)**	**.433 (p= <.001)**	.196 (p= .063)	**.469 (p= <.001)**						
BVMT	**.422 (p= <.001)**	.263 (p= .012)	**.497 (p= <.001)**	**.542 (p= <.001)**	**.520 (p= <.001)**	.278 (p= .008)					
Verbal fluency	.249 (p= .017)	.299 (p= .004)	**.366 (p= <.001)**	**.474 (p= <.001)**	**.437 (p= <.001)**	**.313 (p= .002)**	**.444 (p= <.001)**				
CPT	.165 (p= .118)	**.320 (p= .002)**	**.452 (p= <.001)**	**.355 (p= .001)**	**.393 (p= <.001)**	.196 (p= .063)	**.369 (p= <.001)**	.161 (p= .128)			
LNS	.297 (p= .004)	**.526 (p= <.001)**	**.545 (p= <.001)**	**.440 (p= <.001)**	**.574 (p= <.001)**	**.499 (p= <.001)**	**.458 (p= <.001)**	**.335 (p= .001)**	**.423 (p= <.001)**		
WASI	**.347 (p=.001)**	**.439 (p= <.001)**	**.646 (p= <.001)**	**.463 (p= <.001)**	**.596 (p= <.001)**	**.461 (p= <.001)**	**.620 (p= <.001)**	**.327 (p= .002)**	**.488 (p= <.001)**	**.544 (p= <.001)**	—

Note: **Bold.** Correlation is significant at the Bonferroni-corrected *p*-level (.05/10=.005). MASCtot: The Norwegian version of Movie for the Assessment of Social cognition. TMT-A: Trail Making Test, Part A. BACS: Brief Assessment of Cognition in schizophrenia, symbol coding subtest. HVLT: Hopkins Verbal Learning Test – Revised. WMS: Wechsler Memory Scale, spatial span subtest. Mazes: Neuropsychological Assessment Battery, mazes subtest. BVMT: Brief Visuospatial Memory Test –Revised. Verbal fluency: Category fluency test, animal naming. CPT: Continuous Performance Test. LNS: Letter-Number Span Test. WASI: Wechsler Abbreviated Scale of Intelligence.

Table 4

Regression analysis in participants with schizophrenia (n=91) investigating predictors of ToM performance

	Model					Predictors
	R^2	Adj. R^2	ΔR^2	Sig F change	F (df), *p*	Beta, *p*
ToM: *MASCtot*						
Model 1	.216	.170	.216	.001	4,70 (5, 85), .001	
BACS						.167, *p*=.207
HVLT						.057, *p*=.640
WMS						.109, *p*=.391
BVMT						.199, *p*=.145
WASI						.047, *p*=.747