



# Emotion perception, non-social cognition and symptoms as predictors of theory of mind in schizophrenia

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## ARTICLE INFO

Available online xxxx

Keywords:

Social cognition  
Emotion perception  
Theory of mind  
Mentalizing

## ABSTRACT

**Background:** Theory of mind (ToM) can be divided into cognitive and affective ToM, and a distinction can be made between overmentalizing and undermentalizing errors. Research has shown that ToM in schizophrenia is associated with non-social and social cognition, and with clinical symptoms. In this study, we investigate cognitive and clinical predictors of different ToM processes.

**Methods:** Ninety-one individuals with schizophrenia participated. ToM was measured with the Movie for the Assessment of Social Cognition (MASC) yielding six scores (total ToM, cognitive ToM, affective ToM, overmentalizing errors, undermentalizing errors and no mentalizing errors). Neurocognition was indexed by a composite score based on the non-social cognitive tests in the MATRICS Consensus Cognitive Battery (MCCB). Emotion perception was measured with Emotion in Biological Motion (EmoBio), a point-light walker task. Clinical symptoms were assessed with the Positive and Negative Syndrome Scale (PANSS). Seventy-one healthy control (HC) participants completed the MASC.

**Results:** Individuals with schizophrenia showed large impairments compared to HC for all MASC scores, except overmentalizing errors. Hierarchical regression analyses with the six different MASC scores as dependent variables revealed that MCCB was a significant predictor of all MASC scores, explaining 8–18% of the variance. EmoBio increased the explained variance significantly, to 17–28%, except for overmentalizing errors. PANSS excited symptoms increased explained variance for total ToM, affective ToM and no mentalizing errors.

**Discussion:** Both social and non-social cognition were significant predictors of ToM. Overmentalizing was only predicted by non-social cognition. Excited symptoms contributed to overall and affective ToM, and to no mentalizing errors.

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## 1. Introduction

The ability to infer the intentions, dispositions and beliefs of others has been labeled theory of mind (ToM) [1]. The term was introduced by Premack & Woodruff [2], and ToM is today considered part of the broader concept of social cognition, often defined as “the mental operations that underlie social interactions, including perceiving, interpreting and generating responses to the intentions, dispositions and behaviors of others” [3]. In addition to ToM, social cognition includes emotion perception, social perception and attributional style [1]. Individuals with schizophrenia (SZ) are impaired in all domains of social cognition [4], and social cognition is an important determinant of real-world outcomes for persons with SZ [1]. Social cognition mediates between

non-social cognition and outcome [5], and ToM seems to be an especially strong predictor of functioning [6].

ToM is a complex cognitive function, not fully developed until adulthood [7]. It can be conceptualized in different ways. For example, ToM can be understood according to a) level of processing [8], b) hot versus cold cognition [9], or c) mentalizing style [10]. According to the first approach, social cognition might best be conceptualized based on level of processing rather than domain of social information [11]. In such a perspective, emotion perception has been considered a lower-level and ToM a higher-level cognitive process [8, 12]. From this follows that (low-level) emotion perception should predict (high-level) ToM [12]. Related, it seems logical that higher level social cognition, such as ToM, is dependent upon non-social cognition. There is empirical evidence for an association between ToM and non-social cognition, such as speed of processing, visual and verbal learning and memory, executive function [13], and IQ [14, 15]. However, other studies do indicate that ToM and non-social cognition can dissociate [16, 17].

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Another approach to social cognition and ToM is the differentiation between “hot” and “cold” [18] or affective and cognitive dimensions of ToM [9]. Whereas cognitive ToM requires cognitive understanding of the difference between the knowledge of the speaker and of the listener (i.e. knowledge about *beliefs*, traditionally assessed with false belief tasks), affective ToM involves an empathic appreciation of another person’s emotional state (knowledge about *emotions*, traditionally assessed with irony or faux pas tasks) [9]. Attribution of another person’s internal state is involved in both cognitive and affective ToM. The difference is the type of internal state that is attributed. Attributions of thoughts, knowledge or action plans make up cognitive ToM, whereas attributions of emotional states like anger or guilt is referred to as affective ToM [19]. Based on theories which separate between cognitive and affective ToM dimensions, one could hypothesize that emotion perception would predict affective ToM, but not cognitive ToM. Instead, non-social cognition would be an expected determinant of cognitive ToM. Differential associations between the characteristic symptoms of SZ and cognitive and affective ToM lend some support to the validity of this distinction. Significant relationships have been reported between cognitive ToM and positive symptoms [9, 19], and between affective ToM and negative symptoms [9]. In one of the studies [19], the association with negative symptoms was significant for both cognitive and affective ToM, but not after controlling for age.

The third approach to ToM is of relevance for SZ symptomatology. This approach differentiates between mentalizing styles, i.e. the processes underlying incorrect ToM responses. Incorrect ToM performance can be due to overmentalizing, undermentalizing or a lack of mentalizing. To overmentalize is to excessively attribute intentions or self-referential meaning to others. Undermentalizing refers to a diminution in the ability to understand and attribute mental state, whereas a lack of mentalizing refers to a thinking style where no attributions are made to the mental state of another. A focus on mentalizing styles may help explain some of the inconsistencies found in the literature regarding associations between clinical symptoms and ToM [14]. Whereas some studies did not reveal significant associations between ToM and positive and negative symptoms [6, 20], others have found associations between ToM and disorganized, negative and positive symptoms [21, 22]. A meta-analysis [23] found medium effect size relationships with disorganization and negative symptoms, but not with reality distortion. The fact that ToM is a broad construct, consisting of different components could be one explanation for the inconsistent results. For example, different mentalizing styles appear to have different predictors. Whereas overmentalizing has been found to be associated with positive symptoms [15, 19] and attention/working memory [24], lack of mentalizing has been reported to be associated with negative symptoms [19], and undermentalizing (including lack of mentalizing) with emotion perception and verbal memory [24].

A related term is metacognition, or the ability to reflect on thoughts and feelings and connect these events into detailed representations of oneself or others [25]. One of four metacognitive domains, the ability to understand the mind of others, clearly overlaps with ToM. Indeed, metacognition shows many of the same characteristics as social cognition: it is related to cognition [26, 27] and negative symptoms [27, 28] and mediates between non-social cognition and functional outcome [29]. But whereas metacognition involves a synthesis of discrete processes into complex representations of others or oneself [30], social cognition make up some of these discrete processes. If we are to understand the details of how metacognition or social cognition relates to functional difficulties in schizophrenia, we need to disentangle how different discrete processes relate to each other. This can subsequently inform us of relevant treatment targets.

Knowledge of predictors of ToM is important when tailoring clinical interventions in SZ. Whereas social cognition training can lead to significant improvements in real-world outcome [31, 32], effects are small. One among several possible explanations is that social cognition training programs do not target the most relevant functions. If we can unveil

the predictors of impaired ToM, an important determinant of functional outcome, we may also unveil important treatment targets. Currently, it remains unknown whether interventions are more likely to bring positive effects if they target low versus high-level processes, or whether a focus on non-social cognition is likely to benefit those receiving the training. This is the first study to concurrently investigate the impact of clinical and cognitive predictors of ToM, an important determinant of functional outcome, using well-validated measures and a large representative sample of individuals with SZ.

Our first research aim is to examine whether persons with SZ perform worse than healthy control participants (HC) on an ecological valid ToM measure, the Movie for the Assessment of Social Cognition (MASC) [33]. We hypothesize reduced performance for the total score, as well as for both cognitive and affective ToM. We also expect that the SZ group will commit significantly more errors, regardless of type, than the HC group.

Our second research aim is to examine predictors of ToM performance in participants with SZ. We hypothesize that emotion perception and non-social cognition will contribute significantly to overall ToM. Because of the mixed findings in the literature, we make no hypotheses concerning the predictive power of clinical symptoms on overall ToM. Further, we hypothesize that emotion perception and negative symptoms will predict affective ToM, and that non-social cognition and positive symptoms will predict cognitive ToM. Finally, based on previous findings, we expect overmentalizing errors to be predicted by non-social cognition and positive symptoms; undermentalizing errors to be predicted by non-social cognition, emotion perception, as well as by disorganized and negative symptoms; and no mentalizing errors to be predicted by non-social cognition, emotion perception and negative symptoms.

## 2. Method

### 2.1. Participants

Ninety-one individuals with a diagnosis of schizophrenia ( $n = 69$ ) or schizoaffective disorder ( $n = 22$ ) were recruited from hospitals in the greater Oslo area. All were participants in the Thematically Organized Psychosis (TOP) Study at the Norwegian Centre for Mental Disorders Research (NORMENT) at Oslo University Hospital. Inclusion criteria were Norwegian as mother tongue or all compulsory schooling conducted in Norway and age between 18 and 55 years. Exclusion criteria were  $IQ \leq 70$  assessed with the 2-subtest Wechsler Abbreviated Scale of Intelligence (WASI) [34]; neurological disease, or head trauma causing hospitalization. Healthy control participants (HC:  $n = 71$ ) from the same geographical area were randomly selected from national statistical records and invited by letter. Before inclusion, HC were screened for symptoms of severe mental illness and excluded from the study if mental, neurological or somatic disorder was confirmed or suspected on the Primary Care Evaluation of Mental Disorders interview (PRIME-MD) [35]. Demographic and clinical information is displayed in Table 1. Participants in both groups were in their late 20s and slightly biased toward the male sex. The HC group was, as expected, characterized by longer education and higher IQ. For SZ, Global Assessment of Functioning (GAF) [36] scores indicate symptoms and functioning typical of a mostly outpatient population.

### 2.2. Measures

#### 2.2.1. Clinical measures

Diagnoses were based on the Diagnostic and Statistical Manual for Mental Disorders [37] using the Structured Clinical Interview for DSM-IV (SCID-I) [38]. Clinical data was collected by trained clinical psychologists or medical doctors and included the Positive and Negative Syndrome Scale (PANSS) [39] and the split GAF [36]. Symptoms were assessed using Wallwork’s five-factor PANSS model [40] as several

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