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# Inter-individual variability of social perception and social knowledge impairments among patients with schizophrenia

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ABSTRACT

Deficits in social perception and knowledge and their negative impact on social functioning, have been repeatedly reported among patients with schizophrenia. However, earlier studies have focused on an overall assessment of social perception and social knowledge, without exploring their sub-components nor the inter-individual variation of the deficit. This study aims to refine the exploration of this deficit and to assess its interindividual variation. Twenty-nine patients with schizophrenia and 24 healthy controls, matched for age and gender, completed a validated and integrated social perception and knowledge task (i.e. the PerSo test). Patients with schizophrenia had reduced performance in all PerSo subtests, namely contextual fluency, interpretation and social convention. However, these deficits were not correlated with the severity of clinical symptoms, and individual profiles analyses showed a marked heterogeneity among patients on their abilities. Our study confirms the existence of deficits in social perception and knowledge and underlines their considerable heterogeneity. Therefore, it is necessary to test and rehabilitate individually social perception and knowledge.

## 1. Introduction

Social cognition can be globally defined as the ability to use psychological and cognitive resources to efficiently detect, understand, regulate, and react to stimulations emerging from interpersonal environment and social interactions (Green et al., 2008). A dominant theoretical framework underlying social cognition research in schizophrenia has been offered by Green and colleagues (2008), dividing these abilities into five subcategories, namely (1) Theory of Mind (i.e., the use of interpersonal signals to infer others' mental states, thoughts or emotions, and to anticipate their behaviors); (2) emotional processing (i.e., the efficient perception, interpretation and reaction to the emotional states expressed by others through their face, voice or posture, and the correct decoding and regulation of one's own affective states); (3) attributional bias (i.e., the propensity to consider that the events occurring in one's life are mostly due to internal/personal or external/interpersonal causes); (4) social perception (i.e., the aptitude to interpret verbal and non-verbal stimuli to infer individuals' role and current relationships in equivocal interpersonal contexts) and (5) social knowledge (i.e., the understanding of the rules and conventions during social interactions).

Deficits in social cognition have been repeatedly reported among patients with schizophrenia and people at-risk for psychosis (Barbato et al., al.,2015; Lavoie et al., 2013; Savla et al., 2013; Pinkham et al., 2014; Peyroux et al., al.,2018), leading to deleterious effects on their social, professional and interpersonal functioning. These social cognition components thus constitute an essential clinical target in the context of psychosocial rehabilitation of patients with schizophrenia. However, most social cognition research in schizophrenia has focused on Theory of Mind, emotion processing and attributional biases (Bora et al., 2009; 2016; Granato et al., 2009; Hargreaves et al., 2016; Kohler et al., 2009; Savla et al., 2013; song et al., 2015), and the two

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other components have been far less explored. Indeed, social perception and social knowledge have only been measured in scattered studies using heterogeneous tasks with limited psychometric qualities (Green et al., 2008; Pinkham et al., 2014; Yager and Ehmann, 2006). This is particularly unfortunate, as the ability to decode and interpret verbal or non-verbal social cues and to determine the interpersonal rules at stake in social groups (i.e., the assigned roles and goals to which individuals are committed in a specific social context) are key components of social cognition, needed for efficient interpersonal functioning and adapted social skills (Couture et al., 2006; Fett et al., 2011; Sergi et al., 2006). They could thus constitute core features of schizophrenia, and hence, may be a crucial target for interventions designed to enhance functional rehabilitation (Green et al., 2008; 2012).

The present study thus centrally aimed at exploring, for the first time, social perception and social knowledge deficits in schizophrenia, through the use of a specific task targeting these subcomponents of social cognition. We therefore wanted to: (1) determine the presence and extent of the social cognition deficits specifically related to social perception and knowledge subcomponents in schizophrenia; (2) explore the inter-individual heterogeneity of these deficits, to determine whether these deficits are a common feature observed in all patients with schizophrenia or are conversely highly variable across patients.

## 2. Methods

### 2.1. Participants

Twenty-nine patients diagnosed with schizophrenia according to DSM-5 criteria, were recruited in four Belgian hospitals (Sanatia Clinic, Brussels; Fond'Roy Psychiatric Hospital, Brussels; Beau Vallon Psychiatric Hospital, Namur; Saint Pierre Clinic, Ottignies). Data collection was performed between May 2017 and March 2018. Depression assessment was not conducted for three patients. All patients were stable on antipsychotic agents (typical and atypical); the mean equivalent chlorpromazine dose was 484.11 (73.23) mg (with a minimum of 125 mg and a maximum of 1500 mg). The psychopathological status was evaluated using the positive and negative symptoms scale (PANSS, Kay et al., 1987). Patients were individually matched for sex and age with 24 healthy controls who were free of any psychiatric disorder or psychoactive substance abuse. All participants were fluent in French and had been living in Belgium for more than 5 years. Exclusion criteria for both groups were a history of current or previous neurological disease (epilepsy, dementia, cerebrovascular accident), drug addiction, and being over 60 years of age. Participants received all the details concerning the study aims and the procedure to be followed and then gave their written informed consent. The study was approved by the Ethics Committee of Brussels-Saint-Luc University Hospital and conducted according to the Declaration of Helsinki.

### 2.2. Procedure and measurements

The Social perception and knowledge Test (PerSo) measures the ability to perceive the social situations and social rules depicted in 4 pictures taken from “the Color Cards-Social behavior material” (Peyroux et al., 2018). The participant is first instructed to describe all the elements contained in the picture for 90 s, to check the absence of attentional or perceptual deficits. This task provides a global “fluency score” (one point assigned per element reported). Then, participants are instructed to freely explain the social situation without cuing, the scoring being based on the presence of three elements respectively related to the description of the context, of the main characters and of their interaction. For each picture, this “non-cued interpretation score” is rated from 0 to 3 (one point per element reported). If an element is missing, a cued question is proposed (i.e. cued interpretation). A “cued interpretation score” is thus also computed (0–3) and a “total interpretation score” is then given (0–6). Finally, participant is asked a question concerning the social convention/rule depicted in the card. A “social knowledge score” (from 0 to 2) evaluates his/her ability to extract social rule or convention from the picture. Before the test phase, participant completes the Beck Depression Inventory (Beck and Steer,1987) to screen for depressive symptoms.

### 2.3. Statistical analyses

Statistical analyses were performed through IBM SPSS Statistics (Version 25.0; IBM Corp., Armonk, NY), and the following strategy was used. First, between group Student *t*-tests were performed on demographic and psychopathological characteristics. Chi-square test was performed for group comparisons on gender. Second, a repeated-measures analysis of variance (ANOVAs) was performed with Group (patients with schizophrenia, healthy controls) as between-subjects factor and PerSo subscores as within-subjects factor, with depressive symptoms, age and gender as covariates. Significant main effects and interactions (corrected using a Greehouse-Geisser procedure when needed) were followed by univariate contrasts (post-hoc independent sample t-tests). Bivariate Pearson's correlations were performed between task performance and clinical parameters, namely age at illness onset, medication (equivalent chlorpromazine dose) and symptoms defined by the PANSS scale. The statistical significance threshold was set at 0.05. Finally, a complementary single case analysis, based on Crawford's method (Crawford and Garthwaite, 2010) was applied to estimate the variability of the social perception and knowledge deficit across patients (i.e. the percentage of patients with social perception and knowledge deficit when compared individually with a subgroup of matched control participants).

**Table 1**
Demographic and psychopathological measures for patients with schizophrenia (SZ) and healthy controls (CP), mean (SD).

| | SZ ($n$ = 29) | CP ($n$ = 24) | Group comparison (NS = non-significant; * = $p<0.001$) |
|---|---|---|---|
| Demographic measures | | | |
| Age (in years) | 45.83 (11.93) | 41.38 (11.79) | NS |
| Gender (female/male) | 10/19 | 8/16 | NS |
| Age at illness onset | 22.76 (6.94) | / | / |
| Psychological measures | | | |
| Beck depression inventory | 9.85 (6.2) | 1.88 (2.89) | * |
| PANSS Positive | 14.72 (8.73) | / | / |
| PANSS Negative | 13.21 (8 .60) | / | / |
| PANSS General | 30.17 (13.99) | / | / |
| PANSS Total | 58.10 (29.10) | / | / |

## 3. Results

### 3.1. Demographic characteristics and psychopathological variables

A significant Group difference was observed for depressive symptoms [$t(48) = 5.73$, $p < 0.001$], patients with schizophrenia presenting higher scores than healthy controls, but not for age [$t(51) = 1.36$, $p = 0.18$] and gender [$\chi2(1,53) = 0.008$, $p = 0.93$)] (Table 1).

### 3.2. Social perception & knowledge abilities

#### 3.2.1. Group analyses

A main Group effect was observed [$F(1,51) = 38.62$, $p < 0.001$] showing that patients had lower abilities than healthy controls. There was also a main Perso subscores effect [$F(4192) = 23.68$, $p < 0.001$)], which was only due to the scoring procedure and was thus not further analyzed. Importantly, a significant Group x PerSo subscores interaction was observed [$F(4192) = 23.48$, $p < 0.001$], with post-hoc t-tests showing that patients with schizophrenia had reduced social perception and knowledge abilities for contextual fluency [$t(51) = 7.33$, $p < 0.001$], total interpretation score [$t(51) = 9.63$, $p < 0.001$] as well as its non-cued [$t(51) = 9.44$, $p < 0.001$)] and cued [$t(51) = 7.02$, $p < 0.001$] components, and social knowledge score [$t(51) = 7.24$, $p < 0.001$)] (Table 2). No significant effect or interaction involving covariates were found (all $F < 0.4$, all $p > 0.8$).

#### 3.2.2. Individual analyses

Crawford single case analysis showed that 41.38% (12/29) of patients with schizophrenia presented contextual fluency deficits, 82.76% (24/29) had deficits in non-cued interpretation, 65.52% (19/29) in cued interpretation and 72.41% (21/29) in total interpretation. Concerning social knowledge, 24.14% (7/29) of the sample presented significant deficits.

#### 3.2.3. Correlational analyses

Medication was not correlated with Perso subscores (all $p > 0.05$), except a marginal negative correlation with non-cued interpretation ($r = -0.374$, $p = 0.046$). In the same line, no correlation was observed between Perso subscores and age at illness onset (all $p > 0.05$), nor between Perso subscores and PANSS positive, negative or general scores (all $p > 0.05$).

## 4. Discussion

This study offered the first specific exploration of social perception and social knowledge abilities among patients with schizophrenia through the PerSo task. Indeed, while current models of social cognition (Green et al., 2008) clearly distinguish five subcomponents, namely Theory of Mind, emotion decoding, attributional bias, social perception and social knowledge, the research among patients with schizophrenia has nearly exclusively focused on the first three subcomponents, despite the potential role of social perception/knowledge deficits on patients' everyday life. The main insight offered by the present study is thus to unveil a massive deficit for social perception and social knowledge in schizophrenia: At the group comparison level, patients presented a generalized impairment for social perception and knowledge, as they reported significantly less elements of the social situation depicted and presented reduced social interpretation of the context characters and interactions shown in the picture. They also showed a reduced capacity to extract social rules or convention from the pictures. The present results thus offer new data regarding social cognition deficits in schizophrenia by indexing specific deficits for social perception and knowledge when confronted with close to real-life social situations. Indeed, while many earlier studies had identified social cognition deficits in schizophrenia (Addington et al., 2006; Barbato et al., 2015; Champagne-Lavau and Charest, 2015; Corrigan et al.,1993; McCleery et al., 2016; Penn et al., 2002; Peyroux et al.,2018; Savla et al., 2013; Toomey et al., 2002), the present result goes beyond the mere replication by generalizing the description of these impairments to the specific subcomponents of social perception and social knowledge applied to complex interpersonal situations.

We centrally showed that, because of the difficulty that these patients have in integrating social indicators, they were unable to recognize social rules, the representation of social roles, expectations and behavioral adaptation to a context. This deficit might be explained in several ways. First, impaired social perception may be influenced by abnormalities in early aspects of visual processing (Sergi et al., 2006) associated with abnormalities in brain functioning in schizophrenia (Bjorkquist et al., 2013). On the other hand, social perception disorders could result from context processing difficulties. In this case, patients with schizophrenia would not benefit from all the social cues proposed to decode a scene (Penn et al., 2002; Toomey et al., 2002) because of various cognitive disorders (Green et al., 2007) such as attentional difficulties when dealing with indices issued very quickly (Sergi et al., 2003) or presented simultaneously from different modalities (Etchepare, 2017). Finally, social perception and social knowledge deficits could reflect genuine social cognition impairments, being part of a more global reduction of social abilities in schizophrenia (Addington et al., 2006; Champagne-Lavau and Charest, 2015; Matsui et al., 2008; Peyroux et al., 2018).

Importantly, our study was the first to explore the inter-individual heterogeneity of this deficit. Single case analysis showed the massive individual variability of the social perception and knowledge deficit across patients, who centrally demonstrated a strong inter-individual heterogeneity in the interpretation score. This may be related to the fact that patients with schizophrenia present heterogeneous disorders marked by several factors such as the early or late illness onset, illness duration and the number of previous hospitalizations. For example, deficits in social perception and knowledge are more often observed in hospitalized patients with schizophrenia than in outpatients (Savla et al., 2013), which might be related to the fact that patients hospitalized for long periods of time are less confronted with complex social situations. Globally, this identification of large inter-individual variations across participants with schizophrenia regarding social cognition abilities should urge future studies to go beyond the classical group comparison approach in order to determine the individual performance profiles of patients with schizophrenia, for what pertains to social cognition but also for other psychological or cognitive abilities.

Finally, it should be underlined that we did not show any significant correlation between social cognition deficits and clinical symptomatology. While this result could be partly explained by the limited sample size of the study, it could also be related to the fact that deficits in social perception and knowledge may constitute a core feature of schizophrenia, independent from current symptomatology, medication or age at illness onset. Social cognition disorders have been documented in the

**Table 2**
Mean scores and group comparisons between patients with schizophrenia (SZ, $n = 29$) and matched healthy controls (CP, $n = 24$) for PerSo subtests.

| Subtests | Participants | M(SD) | Post-hoc *t*-test | *p*-value |
|---|---|---|---|---|
| Contextual fluency | SZ | 53.86 (19.40) | 7.33 | < 0.001 |
| | CP | 103.25 (29.41) | | |
| Non-cued interpretation | SZ | 5.83 (1.87) | 9.44 | < 0.001 |
| | CP | 10.13 (1.33) | | |
| Cued Interpretation | SZ | 8.83 (1.85) | 7.02 | < 0.001 |
| | CP | 11.42 (0.65) | | |
| Total Interpretation | SZ | 14.66 (3.34) | 9.63 | < 0.001 |
| | CP | 21.54 (1.74) | | |
| Social Knowledge | SZ | 1.79 (1.29) | 7.24 | < 0.001 |
| | CP | 4.88 (1.80) | | |

prodromal psychosis phase (Green et al., 2012), among first-degree relatives (Lavoie et al., 2013) as well as among subjects at high risk of psychosis (Barbato et al., 2015), and they are moreover found to be quite stable among patients with schizophrenia (Addington et al., 2006; Barbato et al., 2015; Horan et al., 2012; McCleery et al., 2016), thus suggesting that social cognition impairments should be considered as a trait deficit in this pathology, quite independent from current symptomatology.

As a whole, while our results should be replicated on larger samples, they clearly underline that the social cognition deficits presented by patients with schizophrenia are not limited to Theory of Mind, emotion decoding and attributional biases, as they are generalized to social perception and social knowledge when considered at the group level. However, we also underlined a strong heterogeneity regarding the interpretation of social cues in schizophrenia. This heterogeneity, which does not seem to be strongly related to variations in symptomatology and disease-related factors, promotes the development of individual and tailored evaluation/rehabilitation of social cognition deficits among patients with schizophrenia. Indeed, social cognition remediation programs have already shown their effectiveness in reducing emotional decoding and theory of mind deficits in schizophrenia, leading to improved social functioning and reduced clinical symptoms (Fuentes et al., 2007; Kurtz and Richardson, 2012), and such programs could be extended to social perception and social knowledge.

## CRediT authorship contribution statement

**Germain Manzekele Bin Kitoko:** Conceptualization, Software, Formal analysis, Writing - original draft, Writing - review & editing. **Pierre Maurage:** Conceptualization, Methodology, Software, Writing - original draft, Writing - review & editing. **Samuel Mampunza ma Miezi:** Conceptualization. **Benoit Gillain:** Conceptualization, Supervision, Project administration. **Alain Pierre Kiswanga:** Formal analysis, Visualization. **Eric Constant:** Conceptualization, Resources, Writing - original draft, Writing - review & editing.

## Declaration of Competing Interest

All the authors report no competing financial interest or potential conflicts of interest, and no financial relationships with commercial interests.

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