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# Emotional Intelligence deficits in schizophrenia: The impact of non-social cognition

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## Abstract

**Background—**Previous studies using the Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT) revealed significant performance deficits across all areas of Emotional Intelligence (EI) in schizophrenia patients compared to healthy controls. However, none of these studies has investigated a potential influence of non-social cognition on these findings.

**Methods—**56 schizophrenia outpatients and 84 control subjects were investigated using the MSCEIT and the Brief Assessment of Cognition in Schizophrenia (BACS). Analyses of covariance were performed with adjustment for the BACS composite score and education. To investigate this issue in more detail, a mediation analysis was conducted.

**Results—**Patients showed significantly lower EI and non-social cognition levels compared to healthy controls. After adjustment for BACS composite score and education, only the group difference in the “managing emotions” branch and thus in the “strategic” EI part of the MSCEIT remained statistically significant, whereas for all other MSCEIT branches (perceiving, using, understanding emotions) statistical significance was lost. The mediation analysis revealed that the difference between schizophrenia patients and controls regarding the MSCEIT total score was almost fully attributable to the mediating effect of non-social cognition.

**Conclusions—**Our findings suggest that in schizophrenia patients EI is largely influenced by non-social cognitive functioning. Only the “managing emotions” branch was found to be independent of non-social cognition. Consequently, non-social cognitive performance was mainly responsible for the observed differences in EI between schizophrenia patients and controls. This has to be taken into account when interpreting MSCEIT data in this population.

### Keywords

Emotional Intelligence; Schizophrenia; MSCEIT; Non-social cognition; Mediation analysis

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**Conflict of interest**

Beatrice Frajo-Apor has received travel reimbursements from AOP Orphan, Lundbeck, Eli Lilly and Janssen-Cilag.
Anna Welte has received travel reimbursements from AOP Orphan, Astra Zeneca and Pfizer.
Alex Hofer has received a research grant from Janssen-Cilag. He has received speaker's or consultancy fees from AOP Orphan, BMS, Janssen-Cilag, and Lundbeck as well as reimbursements for travel and meeting expenses from AOP Orphan, Janssen-Cilag, Lundbeck, Pfizer, and Roche.
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## 1 Introduction

Social and non-social cognitive deficits are core features of schizophrenia and exert a major influence on a patient's psychosocial functioning and well-being (Addington et al., 2006; Schaefer et al., 2013). Non-social cognition includes mental abilities like attention or memory, whereas the term ‘social cognition’ comprises cognitive processes underlying the processing of social stimuli and includes the following areas: theory of mind, attributional bias, social perception, and emotion processing, i.e. perceiving and using emotions (Barrett and Salovey, 2002; Green et al., 2008).

While the bulk of research has focused on emotion perception, the present study concentrates on the concept of “Emotional Intelligence” (EI) as introduced by Salovey and Mayer, who define EI as “the subset of social intelligence that involves the ability to monitor ones' own and others feelings and emotions, to discriminate among them, and to use this information to guide one's thinking and actions” (Salovey and Mayer, 1990). From the perspective of this “ability model”, EI is understood as a combination of emotion-specific abilities: perceiving, using, understanding, and managing emotions.

The Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) is an established instrument to measure EI-performance (Mayer et al., 2003) and has been used in schizophrenia studies before (Dawson et al., 2012; Eack et al., 2010; Fanning et al., 2012; Green et al., 2011a; Horan et al., 2011; Kee et al., 2009). Overall, previous studies have revealed significant performance deficits in all MSCEIT branches in schizophrenia patients compared to healthy controls. Importantly, these deficits have been shown to persist across phases of illness (Green et al., 2011b) and to be stable over time (Horan et al., 2011).

While it has been demonstrated that social and non-social cognition are related but distinct constructs (Ventura et al., 2013), the associations between ability-based EI and non-social cognition in schizophrenia have not yet been sufficiently investigated. Fanning et al. reported on a small to moderate association between the neurocognitive composite score of the MATRICS Consensus Cognitive Battery (MCCB) (Green and Nuechterlein, 2004) and different social cognitive measures including the “managing emotions” branch of the MSCEIT (Fanning et al., 2012). In contrast, Dawson et al. found a positive correlation between the understanding emotions branch of the MSCEIT and the Brief Assessment of Cognition in Schizophrenia (BACS) (Keefe et al., 2004) composite score (Dawson et al., 2012), whereas in Eack et al.'s study all MSCEIT branches correlated with non-social cognition in moderate effect sizes (Eack et al., 2010). Interestingly, none of these studies investigated whether the observed difference in EI between schizophrenia patients and healthy controls may be fully or partly attributable to group differences in non-social cognition (in other words, whether non-social cognition may act as a mediator between diagnostic group and EI). Accordingly, the present study was conducted to bridge this gap.

## 2 Methods

All procedures contributing to this work complied with the standards of the local Ethics Committee and were conducted according to GCP standards on human experimentation and

the Helsinki Declaration of 1975, as revised in 2008. All participants signed informed consent forms. Study procedures were performed by a trained research team.

### 2.1 Participants

The study sample consisted of patients suffering from paranoid schizophrenia from a specialized outpatient unit of the Department for Psychiatry, Psychotherapy and Psychosomatics of the Medical University Innsbruck and of healthy control subjects from the community. A brief medical screening interview was used to exclude subjects with any physical or neurological illness or any condition affecting neural or cerebrovascular function. In patients, diagnosis was confirmed by means of the *Mini Mental Neuropsychiatric Interview* (*M.I.N.I.*) (Sheehan et al., 1998). They had to be clinically stable without hospitalization for at least 6 months and had to be on stable medication for at least three months. Psychopathology was assessed by means of the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987). Exclusion criteria included any other axis I disorder as well as axis II disorders as assessed by the *Structured Clinical Interview for Axis-II-Disorders* according to DSM-IV (*SCID II*) (Wittchen et al., 1996).

Comparison subjects had to be unremarkable in the M.I.N.I. and the SCID II. They were excluded, if they had a family history of schizophrenia, other psychotic disorders, or bipolar disorder among first-degree relatives.

### 2.2 Emotional Intelligence

To assess EI, the German pencil-and-paper version (Steinmayr et al., 2011) of the Mayer-Salovey-Caruso-Emotional-Intelligence Test (MSCEIT) (Mayer et al., 2002a, 2002b) was used. This instrument consists of 141 items and provides eight task scores that measure the four branches of EI: perceiving, using, understanding, and managing emotions. Whereas the “perceiving emotions” part measures the ability to recognize emotions accurately in faces and pictures, the “using emotions” part is about using emotions to enhance cognitive processes. The “understanding emotions” part tests the knowledge how emotions interact with each other and change over time and the “managing emotions” part measures the ability to deal with and regulate emotions. The test contains different kinds of tasks: for example, subjects have to indicate to which degree specific emotions are expressed in a photograph of a human face, or they are asked to evaluate the usefulness of certain emotions in specific situations. The MSCEIT also contains vignettes with descriptions of different emotional states in combination with “solutions” to cope with these emotions. In succession, subjects have to indicate how effective each solution is (effectiveness ranges from “1” very ineffective, to “5” very effective). These branches cover all aspects of EI and can be assigned to the areas of emotional experiencing (=“experiential EI”; perceiving + using emotions) and emotional reasoning (= “strategic EI”; understanding + managing emotions). Similar to other intelligence tests, the average score is 100 with a standard deviation of 15.

The test is both content and structurally valid (overall reliability r = 0.93) besides showing discriminate validity from measures of analytic intelligence and many personality constructs (Brackett and Salovey, 2006).

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### 2.3 Non-social cognition

Non-social cognition was measured with the Brief Assessment of Cognition in Schizophrenia (BACS) (Keefe et al., 2004). This battery covers a broad range of neurocognitive functions (verbal memory, working memory, motor speed, attention, executive functioning, and verbal fluency) and requires less than 35 min to complete. The composite score can be calculated by standardizing the average of those 6 measures by dividing that average by the standard deviation of the average in the normative sample.

### 2.4 Statistical methods

Statistical analysis was performed by means of the statistical package SPSS, version 22.

The Shapiro–Wilk test was employed to investigate metric variables, in particular subscales of the MSCEIT and the BACS, for deviations from normality. Group comparisons (schizophrenia versus control) with respect to socio-demographic and clinical variables were performed by means of the t-test, Mann–Whitney U-test and Fisher's exact test, depending on the variable type (normally distributed, non-normally distributed metric, and dichotomous variables, respectively). The Mann–Whitney U-test was also employed for group comparisons with regard to EI and non-social cognition, as the majority of the subscales of the MSCEIT and the BACS showed significant deviation from a normal distribution. In order to assess if differences in EI between schizophrenia patients and controls are fully or partly accounted for by differences in non-social cognition, analyses of covariance were performed with adjustment for the BACS composite score. To investigate this issue in more detail, a mediation analysis was conducted with group as the independent variable, EI as the dependent variable, and non-social cognition (BACS composite score) as a potential mediator between the two variables, using the approach proposed by Preacher and Hayes, 2008. Following Preacher and Hayes, unstandardized regression coefficients were used as path coefficients. In the case of a dichotomous independent variable these coefficients allow a simple interpretation as mean group differences and are therefore more meaningful than standardized regression coefficients or correlation coefficients.

## 3 Results

### 3.1 Sample characteristics

56 schizophrenia patients and 84 healthy control subjects without any axis I or axis II disorder according to DSM-IV were included into the study. Demographic and clinical characteristics are summarized in Table 1. The two groups were comparable with respect to age and sex but differed with regard to education.

### 3.2 Emotional Intelligence and non-social cognition

MSCEIT scores were available for 56 schizophrenia patients and 84 control subjects. Compared to general population norms, patients scored below average in the “understanding” and “managing emotions” branches and thus in the “strategic” EI part of the MSCEIT. They performed significantly worse than controls in all MSCEIT branches except for “perceiving emotions”, where no significant group difference was found (Table 2).

BACS scores were available for 44 schizophrenia patients and 84 controls. Twelve patients were not able to complete the BACS. All BACS subscores were significantly lower in the patient group compared to healthy controls (Table 2).

Adjustment for educational level left significant differences in MSCEIT and BACS scores almost unchanged. The only exception was the “experiential EI” branch of the MSCEIT, in which only a trend level significance ($p = 0.053$) could be detected after adjustment, while all other “adjusted” p-values stayed below 0.002.

### 3.3 Effects of non-social cognition on Emotional Intelligence

After adjustment for the BACS composite score and education, only the group difference in the “managing emotions” branch of the MSCEIT remained statistically significant, whereas statistical significance was lost for all other MSCEIT branches (Table 3). Consequently, only “strategic EI”, composed of the branches “understanding” and “managing emotions”, differed between schizophrenia patients and control subjects. There was no significant interaction between group and BACS composite score for any of the MSCEIT branches and also not for the MSCEIT total score.

### 3.4 Mediation analyses

Mediation analysis revealed that the difference between schizophrenia patients and controls regarding the MSCEIT total score was almost fully attributable to the mediating effect of non-social cognition, as quantified by the BACS composite score (Fig. 1). Due to the mediation by non-social cognition the mean difference in the MSCEIT total score between schizophrenia patients and controls was reduced from 18.3 points (total effect, c) to 7.0 points (direct effect, $c'$).

For Strategic EI, the difference between schizophrenia patients and controls was only partially mediated by non-social cognition. The group effect (schizophrenia vs. controls) was reduced in size (from 27.6 to 13.3 points) but remained significant, as illustrated in Fig. 2.

Results of the mediation analysis for the MSCEIT branch “managing emotions” are shown in Fig. 3. For this variable, the group difference was only slightly reduced by the mediator BACS composite score (from $c = 20.4$ to $c' = 15.4$) and the mediation effect of non-social cognition did not attain statistical significance.

### 3.5 Additional correlation analyses

For completeness, correlations between EI and non-social cognition (BACS composite score) were investigated separately in schizophrenia patients and controls (Table 4). In schizophrenia patients, the BACS composite score correlated highly with the MSCEIT branch “understanding emotions” and to a lesser extent with “using emotions”, while the correlations with the two other branches did not reach significance. The MSCEIT total score and the area score “strategic EI” also showed significant correlations with the BACS. In healthy controls, correlations between BACS and MSCEIT were generally lower than in patients (details in Table 4). Only the correlation of the BACS with the MSCEIT

"understanding emotions" branch attained significance and the correlation with the area score on "strategic EI" reached trend-level significance ($p < 0.1$).

Regarding correlations of EI with disease severity, as measured by the PANSS, all MSCEIT branches except for "experiential EI" correlated significantly with the PANSS total score (from $r = -0.31$, $p = 0.022$ for Using Emotions to $r = -0.42$, $p = 0.001$ for Understanding Emotions). Note that this finding parallels the result reported above that schizophrenia patients and controls differed significantly on all MSCEIT branches except "experiential EI" (see Table 2).

## 4 Discussion

With the present study we aimed to shed a light on the influence of non-social cognition on EI in schizophrenia patients. To this end, we assessed EI and non-social cognition in schizophrenia patients and control subjects using the MSCEIT as well as the BACS and performed correlation and mediation analyses.

As expected, schizophrenia patients achieved significantly lower BACS (sub)scores than healthy control subjects. Similarly, patients showed significantly lower MSCEIT total scores and also performed significantly worse compared to controls in three out of four MSCEIT branches. These findings are largely in line with previous studies, where patients had shown an impaired performance in all MSCEIT branches (Dawson et al., 2012; Green et al., 2011b; Kee et al., 2009). However, those studies are not entirely comparable with ours. We investigated EI in a large sample of chronically ill but stable schizophrenia outpatients with a mild degree of symptomatology, whereas earlier studies had either a smaller sample size (Dawson et al., 2012) or mixed patient samples (schizophrenia, schizoaffective and schizophreniform disorder) (Green et al., 2011b; Kee et al., 2009).

Notably, adjustment for BACS composite score and education substantially diminished the difference in EI performance between patients and controls leaving only the difference in the "managing emotions" branch and in the "strategic EI" part of the MSCEIT significant. Accordingly, only the "managing emotions" branch was found to be independent of non-social cognition. Interestingly, the MSCEIT "managing emotions" subscale is also part of the MATRICS Consensus Cognitive Battery (MCCB). It was chosen to cover social cognition because of "*its relatively stronger relationship to functional status*" (Nuechterlein et al., 2008). In the light of our findings the decision to integrate this subscale of the MSCEIT in the MCCB appears to be even more prudent.

When performing a mediation analysis, the difference in theMSCEIT total score detected between schizophrenia patients and controls was almost fully attributable to the mediating effect of non-social cognition. In other words, non-social cognition was largely responsible for the poorer performance of schizophrenia patients in the MSCEIT. This should be taken into account in future studies using the MSCEIT in schizophrenia and possibly also other patient groups.

The current study also has some limitations. Firstly, we used only a single test to investigate EI. In addition, the MSCEIT has been criticized for measuring social knowledge rather than

performance based EI (Brody, 2004). Although the interaction of social and non-social cognition is generally well established (Sergi et al., 2007), further studies using other EI measures are needed to investigate the relationship between EI and non-social cognition. In addition, future studies should assess the motivation of patients and controls to complete the MSCEIT vs. the BACS. Secondly, due to the broad array of applied treatments we were not able to account for a potential influence of medication. However, given the fact that secondary analyses of CATIE found no differences between antipsychotics with respect to social cognition such a confounding influence seems unlikely (Penn et al., 2009). In addition, adverse events such as sedation may have impacted upon the reported results. At the time of study inclusion all patients were on a stable medication regimen for at least three month, but not all were symptomatically remitted. Indeed, mean PANSS scores (53.9 ± 13.0) indicated only mild symptom severity levels. Lastly, although none of the patients had received psychotherapy specifically targeting social cognition we cannot rule out a possible influence of more generic psychotherapeutic or psychosocial interventions in patients. In summary, the present study clearly points out that in schizophrenia patients ability-based EI is largely influenced by non-social cognitive functioning. This has to be considered, when interpreting MSCEIT data in this population.

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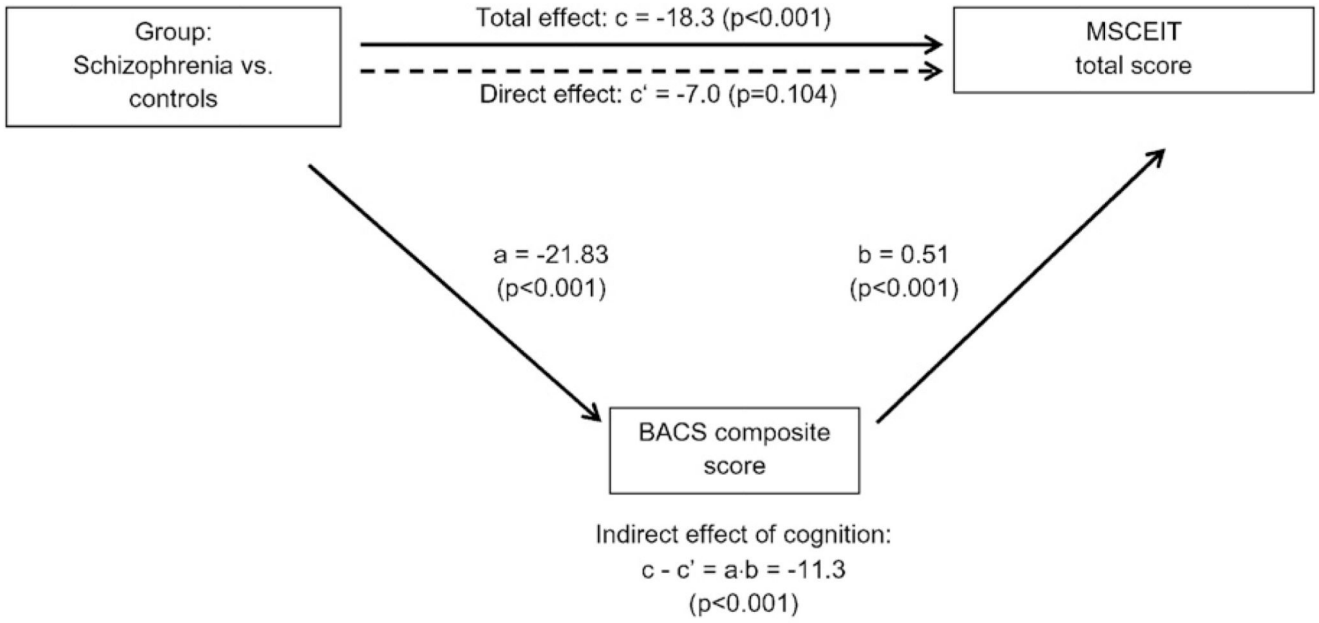


Abbreviations:

MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test; BACS = The Brief Assessment of Cognition in Schizophrenia

a = Effect of the group (schizophrenia vs control) on the mediator BACS composite score

b = Effect of BACS composite score on MSCEIT total score, adjusted for group

c = Total effect of group (schizophrenia vs control) on MSCEIT total score

c' = Direct effect of group on MSCEIT total score, after adjusting for non-social cognition

c - c': Indirect effect of non-social cognition on the relationship between group and MSCEIT total score

**Fig. 1.**

Indirect effect of non-social cognition on the relationship between diagnosis and total Emotional Intelligence: results of mediation analysis. Numbers shown are unstandardized regression coefficients. Solid lines indicate statistically significant effects, dashed lines indicate non-significant effects.




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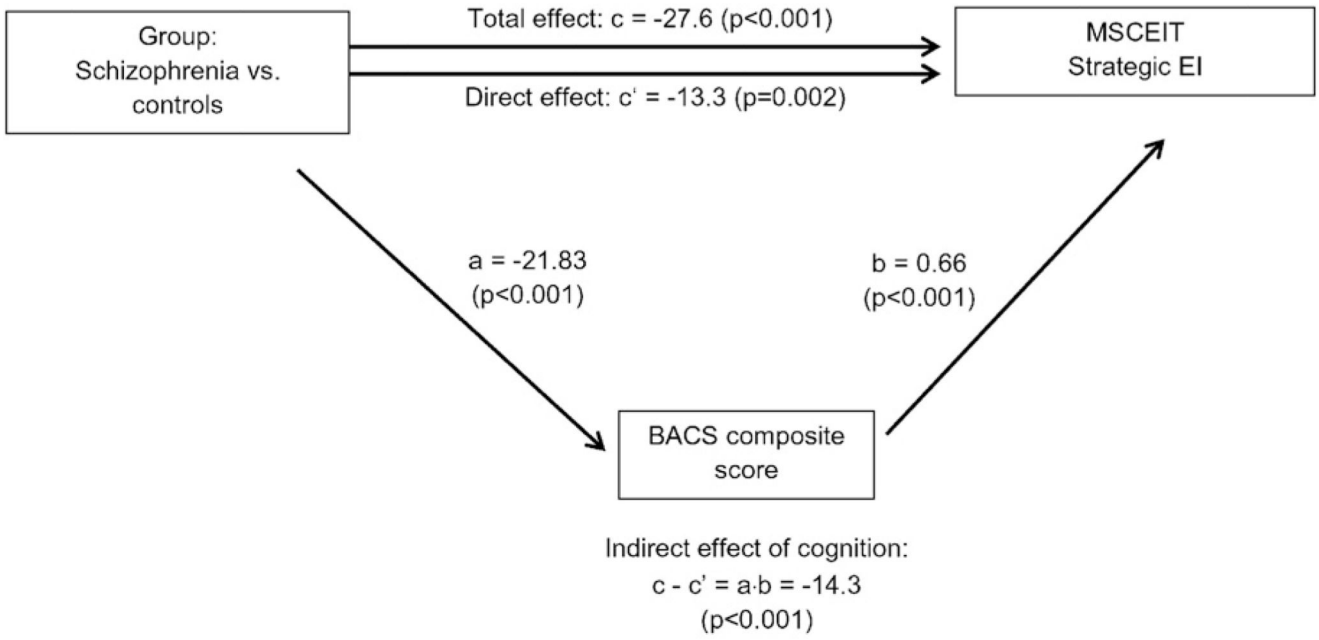


Abbreviations:

MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test; BACS = The Brief Assessment of Cognition in Schizophrenia

a = Effect of the group (schizophrenia vs control) on the mediator BACS composite score

b = Effect of BACS composite score on Strategic EI, adjusted for group

c = Total effect of group (schizophrenia vs control) on Strategic EI

c' = Direct effect of group on Strategic EI, after adjusting for non-social cognition

c - c': Indirect effect of non-social cognition on the relationship between group and Strategic EI

**Fig. 2.**

Indirect effect of non-social cognition on the relationship between diagnosis and strategic Emotional Intelligence: results of mediation analysis. Numbers shown are unstandardized regression coefficients. Solid lines indicate statistically significant effects, dashed lines indicate non-significant effects.

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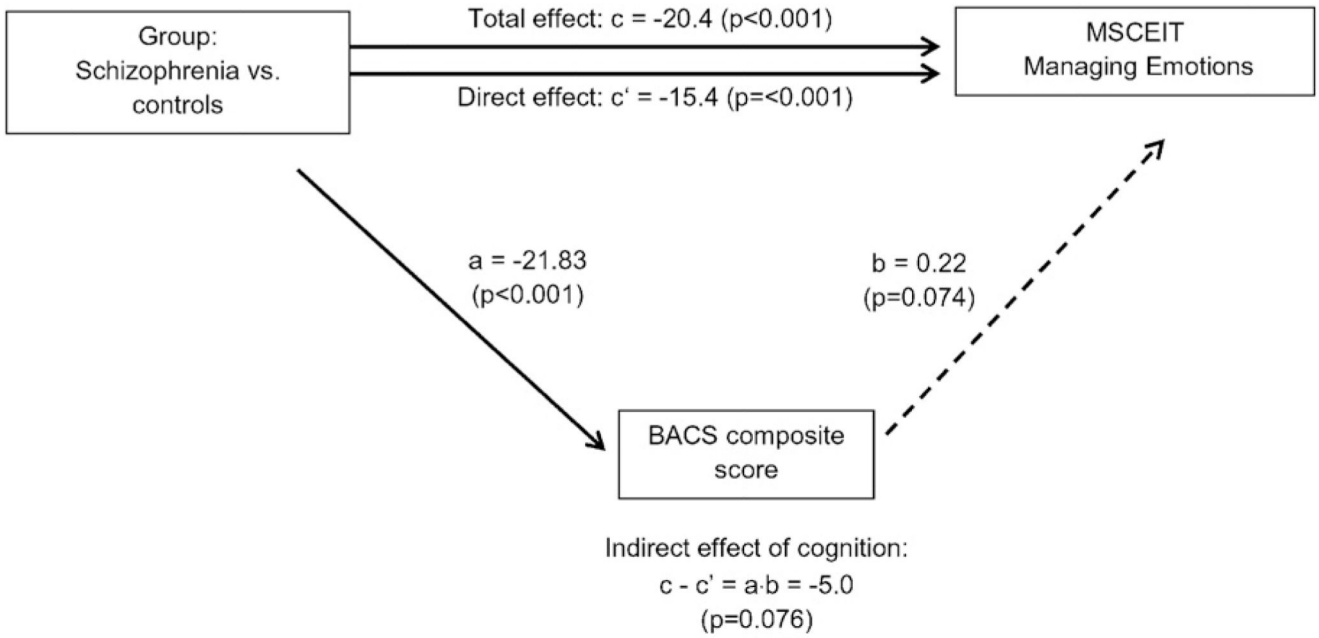


Abbreviations:

MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test; BACS = The Brief Assessment of Cognition in Schizophrenia

a = Effect of the group (schizophrenia vs control) on the mediator BACS composite score

b = Effect of BACS composite score on MSCEIT subscore Managing Emotions, adjusted for group

c = Total effect of group (schizophrenia vs control) on MSCEIT Managing Emotions

c' = Direct effect of group on Strategic EI, after adjusting for non-social cognition

c - c': Indirect effect of non-social cognition on the relationship between group and MSCEIT Managing Emotions

**Fig. 3.**

Indirect effect of non-social cognition on the relationship between diagnosis and the MSCEIT Subscale Managing Emotions: results of mediation analysis. Numbers shown are unstandardized regression coefficients. Solid lines indicate statistically significant effects, dashed lines indicate non-significant effects.

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## Table 1

Socio-demographic and clinical variables.

| Variable | | Schizophrenia patients (N = 56) | Healthy controls (N = 84) | Statistics | p-Value |
|---|---|---|---|---|---|
| Age, mean ± SD | Years | 45.3 ± 10.2 | 44.8 ± 9.3 | **Z = 0.29** | 0.770[a] |
| Sex (%) | Male | 60.3 | 48.2 | **p = 0.175** | 0.175[b] |
| | Female | 39.7 | 51.8 | | |
| Education, mean ± SD | Years | 12.7 ± 3.1 | 14.7 ± 3.3 | **Z = 3.69** | < 0.001[a] |
| Duration of illness, mean ± SD | Years | 15.5 ± 10.6 | – | | |
| PSP, mean ± SD | | **60.9 ± 13.6** | | | |
| PANSS, mean ± SD | Positive symptoms | 12.4 ± 5.1 | – | | |
| | Negative symptoms | 14.8 ± 5.0 | – | | |
| | General symptoms | 26.8 ± 6.6 | – | | |
| | Total score | 53.9 ± 13.0 | – | | |

Abbreviations: PANSS = Positive and Negative Syndrome Scale; PSP = Personal and Social Performance Scale; Z = Z-value; p = p-value.

[a] Mann–Whitney U-test.

[b] Fisher's exact test.

## Table 2

Emotional Intelligence (MSCEIT, EQ values) and non-social cognition (BACS T-scores).

| **MSCEIT subscale** | **Schizophrenia patients (N = 56)** | | **Controls (N = 84)** | | **Statistics[a]** | | |
|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Mean** | **SD** | **d** | **Z** | **p-Value** |
| Perceiving emotions | 100.5 | 17.9 | 103.5 | 15.7 | **0.18** | –0.881 | 0.379 |
| Using emotions | 96.2 | 17.7 | 107.4 | 13.1 | **0.74** | –3.979 | <0.001 |
| Understanding emotions | 77.8 | 22.6 | 101.2 | 14.5 | **1.29** | –5.686 | <0.001 |
| Managing emotions | 84.2 | 18.7 | 104.9 | 13.6 | **1.31** | –6.225 | <0.001 |
| Experiential EI | 98.7 | 18.3 | 105.9 | 15.3 | **0.43** | –2.453 | 0.014 |
| Strategic EI | 76.3 | 22.4 | 104.0 | 14.4 | **1.54** | –6.733 | <0.001 |
| MSCEIT total score | 88.0 | 19.6 | 106.3 | 15.3 | **1.07** | –5.371 | <0.001 |
| BACS t-scores | Schizophrenia patients (N = 44) | | Controls (N = 84) | | | | |
| | Mean | SD | Mean | SD | d | Z | p-Value |
| Verbal memory | 43.8 | 12.7 | 57.1 | 11.5 | **1.11** | –5.408 | <0.001 |
| Digit sequence | 44.1 | 12.1 | 56.9 | 7.9 | **1.31** | –5.618 | <0.001 |
| Token motor task | 39.0 | 11.7 | 56.1 | 8.5 | **1.73** | –7.328 | <0.001 |
| Verbal fluency | 42.5 | 11.0 | 56.7 | 11.2 | **1.28** | –5.910 | <0.001 |
| Symbol coding | 35.4 | 12.4 | 50.0 | 8.4 | **1.43** | –6.284 | <0.001 |
| Tower of London | 44.4 | 9.8 | 53.3 | 7.0 | **1.08** | –5.043 | <0.001 |
| Composite score | 36.4 | 13.5 | 58.2 | 9.0 | **1.98** | –7.594 | <0.001 |

Abbreviations: MSCEIT = Mayer–Salovey–Caruso Emotional Intelligence Test; EQ = Emotional Intelligence quotient; BACS = The Brief Assessment of Cognition in Schizophrenia; d = effect size measure Cohen's d.

[a]Mann–Whitney U-test.

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## Table 3

Group differences in Emotional Intelligence (MSCEIT) after adjustment for BACS composite score and education.

| MSCEIT subscale | Uncorrected mean difference[a] | Mean difference adjusted for BACS composite score and education[b] | F[c] | p-Value[c] |
|---|---|---|---|---|
| Perceiving emotions | 3.0 | − 0.8 | 0.04 | 0.851 |
| Using emotions | 11.5 | 3.7 | 0.91 | 0.343 |
| Understanding emotions | 23.4 | 5.7 | 2.08 | 0.152 |
| Managing emotions | 20.7 | 15.5 | 14.82 | <0.001 |
| Experiential EI | 7.2 | 0.0 | 0.00 | 0.995 |
| Strategic EI | 27.7 | 13.3 | 10.21 | 0.002 |
| MSCEIT total score | 18.3 | 7.0 | 2.68 | 0.104 |

Abbreviations: MSCEIT = Mayer–Salovey–Caruso Emotional Intelligence Test; BACS = The Brief Assessment of Cognition in Schizophrenia.

[a] Difference between the mean value of the control group and that of the patient group.

[b] Parameter estimate for the effect of the diagnostic group obtained by analysis of covariance.

[c] Statistical information on the effect of the diagnostic group as obtained by analysis of covariance.

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## Table 4

Association of Emotional Intelligence (MSCEIT) with BACS composite score.

| MSCEIT subscale | Correlation with BACS | | | |
|---|---|---|---|---|
| | Schizophrenia patients (N = 44) | | Controls (N = 84) | |
| | $r_s$ | p | $r_s$ | p |
| Perceiving emotions | 0.09 | 0.552 | 0.10 | 0.382 |
| Using emotions | 0.36 * | 0.019 | 0.07 | 0.501 |
| Understanding emotions | 0.70 ***,a | <0.001 | 0.27 * | 0.012 |
| Managing emotions | 0.27(*) | 0.086 | 0.06 | 0.604 |
| Experiential EI | 0.23 | 0.139 | 0.11 | 0.329 |
| Strategic EI | 0.55 ***,b | <0.001 | 0.19(*) | 0.086 |
| MSCEIT total score | 0.47 ** | 0.002 | 0.16 | 0.137 |

Abbreviation: $r_S$ = Spearman rank correlation coefficients.

[a] Significantly higher correlation in schizophrenia patients than in controls, Z = 3.02, p = 0.002.

[b] Significantly higher correlation in schizophrenia patients than in controls, Z = 2.24, p = 0.025.

* p < 0.05.

** p < 0.01.

*** p < 0.001

(*) p < 0.1.