Original

Cognitive insight in first-episode psychosis: Exploring the complex relationship between executive functions and social cognition

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ABSTRACT

Social cognition (SC) and executive function (EF) have been described as important variables for social functioning and recovery of patients with psychosis. However, the relationship between SC and EF in first-episode psychosis (FEP) deserves further investigation, especially focusing on gender differences.
Aims: To investigate the relationship between EF and different domains of SC in FEP patients and to explore gender differences in the relationship between these domains.
Methods: A cross-sectional study of 191 patients with new-onset psychosis recruited from two multi-center clinical trials. A comprehensive cognitive battery was used to assess SC (Hinting Task, Face Test and IPSAQ) and EF (TMT, WSCT, Stroop Test and digit span – WAIS-III). Pearson correlations and linear regression models were performed.
Results: A correlation between Theory of Mind (ToM), Emotional Recognition (ER) and EF was found using the complete sample. Separating the sample by gender showed different association profiles between these variables in women and men.

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Conclusions: A relationship between different domains of SC and EF is found. Moreover, women and men presented distinct association profiles between EF and SC. These results should be considered in order to improve the treatment of FEP patients and designing personalized interventions by gender.

Introduction

Social cognition (SC) is defined as a set of neurocognitive processes related to the understanding, recognizing, processing, and appropriate use of social stimuli in one's environment. Moreover, SC is also considered to be the collection of mental processes underlying people's capacity to perceive, process and comprehend social information.[1] SC includes different subdomains, such as Theory of Mind (ToM), Emotional Recognition (ER) and attributional style, most of which have been found to be impaired in people with psychosis.[2,3]

ToM refers to the cognitive ability to represent one's and others' mental states, in terms of thinking, believing, or pretending.[4] Most studies report that people with FEP perform worse than healthy controls in ToM tasks.[5]

ER is the ability to interpret the emotions of others based on facial expressions.[6] Several studies have found pronounced problems in ER in established schizophrenia, especially with negative emotions.[7] These deficits are already present in people at clinical high-risk and in the early stages of psychosis.[8,9]

Attributional style refers to how individuals explain the causes of events, and it has been shown that individuals who tend to explain negative events as due to external causes seem more prone to develop delusional beliefs.[10] Several studies suggest that attributional biases may be an important feature of psychosis.[11,12] Often, studies have described two attributional biases: an externalizing bias (outsourcing blame for negative events) and a personalizing bias (blaming others for the negative events). In general, patients with psychosis are slightly more prone to showing a self-serving attributional style, especially when in a state of active persecutory delusions or paranoia.[13]

Executive function and psychotic disorders

Executive function (EF) is a general construct that encompasses the high-level cognitive processes that enable individuals to regulate their thoughts and actions during goal-directed behavior.[14] These processes include working memory, verbal fluency, flexibility, inhibitory control and problem solving.

Among the well-demonstrated impairments in neurocognitive domains in both FEP and established psychosis,[15] a large body of evidence suggests that executive dysfunction is a core feature of schizophrenia, as it is the most commonly altered cognitive domain in psychosis,[16] and this impairment is already apparent at the FEP stage.[17]

Social cognition and executive function

Although the processing of socially relevant information requires neurocognitive capacities (memory, attention and EF), a review by Mehta et al.[18] showed that SC and neurocognition are largely independent domains. Some studies have suggested a possible association between neurocognitive performance and SC in FEP,[19] as people with FEP show cognitive deficits and impaired SC that interfere with the course of the disease.[2,20]

However, previous research results have been inconsistent. While some studies suggest that ToM impairments are associated with poorer general neurocognition[21] and working memory,[22] other studies have not found this association with EF.[23,24] Regarding ER, data suggest that there may be a relationship between EF and ER.[18] As for other social cognitive subdomains, personalizing bias for negative events appears to be associated with perseverative errors on the Wisconsin Card Sorting Test; and inhibitory control has been associated with internal attributions for negative events in patients with paranoid schizophrenia.[25]

However, both EF and SC have been described in psychosis as variables that are important for patients' social functioning and recovery,[26] and therefore, it seems that further understanding of their potential associations may be beneficial to developing better treatment so as to prevent functional decline.

Gender

A number of studies have examined gender differences in psychosis. Evidence is still inconsistent regarding neurocognition, as some studies have found gender differences in performance,[27] while others have found no differences between men and women.[28]

Similarly, results in SC are still inconclusive, as most studies have failed to find gender differences,[29,30] while others have reported a trend to significance in emotional processing[31] and better ToM in women.[32] Additionally, clusters of patients based on SC with FEP describe different profiles in men and women.[33]

To the best of our knowledge there are only two studies that have investigated SC, neurocognition and its relationship with gender,[29,34] although neither of them focused specifically on EF.

Thus, this study's hypothesis is that a relationship between EF and SC will be found, particularly in ToM and ER. Additionally, the effect of gender on this relationship will be explored, hypothesizing that different variables of EF will explain differences in SC domains between men and women.

Aim of the study.

This study aimed to:

I. Explore the relationship between EF and different domains of SC in FEP patients.
II. Explore gender differences in the relationship between these domains.

Materials and methods

Design

We performed a cross-sectional study based on data from two multicenter clinical trials (PI11/01347 and PI14/00044). More details on the design of the original study are described in the source article.[35]

Sample

The sample was composed of outpatients with recent-onset psychosis treated at one of these participating mental health centers: Servicio Andaluz de Jaén, Málaga and Motril (Granada), Salut Mental Parc Taulí (Sabadell), Hospital de la Santa Creu i Sant Pau (Barcelona), Parc Salut Mar (Barcelona), Centro de Higiene Mental de les Corts (Barcelona), Institut d'Assistència Sanitària Girona, Institut Pere Mata (Reus), Fundación Jímenez Díaz (Madrid), Hospital Clínico Universitario de Valencia and Parc Sanitari Sant Joan de Déu (Coordinating center). A total of 191 patients were included in this study.

Inclusion criteria were: (1) a diagnosis of schizophrenia, psychotic disorder not otherwise specified, delusional disorder, schizoaffective disorder, brief psychotic disorder, or schizophreniform disorder (according to DSM-IV-TR); (2) <5 years from the onset of symptoms; (3) a score ≥3 in delusions, grandiosity or suspicions on the Positive and Negative Syndrome Scale (PANSS) during the previous year; and (4) age between 16 and 45 years. Exclusion criteria were: (1) traumatic brain injury, dementia, or intellectual disability (premorbid IQ ≤70); (2) substance dependence according to DSM-IV-TR criteria; and (3) PANSS ≥5 in hostility and uncooperativeness and ≥6 in suspiciousness.

Assessments

All patients received a complete sociodemographic, clinical, neuropsychological and social cognitive assessment. Assessments were carried out on two different days.

Assessment of social cognition included:

- The Hinting Task was used to assess ToM.[36,37] This task uses short stories with two characters. After each story, participants interpret the meaning behind a character's hint. In the current study two samples were used: a subset of the sample was assessed with three or six stories. A composite measure has been used dividing the total score by the number of items, resulting in a 0–2 measure. Cronbach's alpha of the Spanish version of the instrument was 0.64.
- ER was assessed with the Emotional Recognition Test Faces,[38,39] comprised of 20 photographs that express 10 basic and 10 complex emotions. Higher scores indicate better ER. Psychometric properties of the Spanish version show a Cronbach's alpha of 0.75.
- The attributional style was assessed with the Internal, Personal and Situational Attributions Questionnaire (IPSAQ).[12,40] The IPSAQ has 32 items which describe 16 positive and 16 negative social situations. For each item the respondent is required to write down a single most likely causal explanation for the situation described. Two cognitive bias scores are derived from the six subscale scores: externalizing bias (EB) and personalizing bias (PB). The psychometric characteristics of the scale indicated a Cronbach's alpha was 0.719 for the externalizing bias and 0.761 for the personalizing bias.

Assessment of executive function included the following test with standardized scores:

- The Trail Making Test (TMT) is a test integrating two parts: part A measures the speed of processing and part B measures mental flexibility. We used TMT-B and the time taken to finish the task as a measure of cognitive flexibility.[41] Is important to note that in this study, there was an inverse interpretation of the results for this task: the longer time taken to finish the task, the lower the degree of cognitive flexibility.
- Computerized version of Wisconsin Card Sorting Test (WCST)[42] was used to assess EF in clinical settings. Total errors, perseverative and non-perseverative errors were used as a measure of cognitive flexibility.[43]
- Color-Word Stroop Test (Stroop Test Golden version, Spanish adaptation) was used to assess inhibitory response.[44] Interference is calculated and together with word-color (WC) scores is used as an inhibitory control measure.
- The digit subtest of Wechsler Adults Intelligence Scale (WAIS-III)[45] is comprised of two separate tasks: digit span forward task and digit span backwards. We used the digit span backwards task as a measure of working memory (WM).[46]
- The Vocabulary subtest from Wechsler Adults Intelligence Scale (WAIS-III)[45] was demonstrated to be a measure of crystallized intelligence accurate enough to estimate premorbid IQ in FEP.[47]

Ethical aspects:

The study was approved by the Research and Ethics Committees of Sant Joan de Déu (protocol code PIC-73-11 and date of approval 22nd November 2011). The research and ethics committees of every participating center in the study evaluated the project. Participants were informed about the aims of the study and signed informed consent for participation in the study. The mains studies were registered in the Clinical Trials registry with numbers of identifier: NCT02340559 and NCT04429412.

Statistical analysis

Descriptive statistics were used to explore the sample. To compare mean differences between the variables, Student's *t*-tests were carried out for continuous variables and Chi-square tests to compare categorical variables. Associations between SC and EF were obtained using Pearson correlations. Finally, significant variables were included in the linear regression model using the stepwise method and adjusted by all variables found to be different between genders: level of education, age, diagnosis, and marital status. Symptoms were not included as no gender differences were found. The Statistics Program SPSS (version 26) was used for all analyses.

Results

Sociodemographic and clinical characteristics of the sample

Table 1 shows no gender differences in employment status, antipsychotic dose or estimated premorbid IQ. However, there were differences between women and men in age, marital status, level of education and diagnosis. Results show that the number of men with schizophrenia was higher than women while women had higher prevalence of schizoaffective, delusional or schizophreniform disorders. Women were significantly older ($p = 0.003$) and had better performance in TMT-B than men ($p = 0.02$).

Regarding symptom severity, there were no gender differences and recruited patients showed clinical stability, considering their PANSS scores were linked with low percentiles of symptoms. An exception was TMT-B: results showed differences in the performance of this test between women and men, with men having statistically significant worse performance.

Relationship between executive function and social cognition

The correlation between each domain of EF and SC is shown in Table 2. ToM was associated with cognitive flexibility (TMT-B $p \leq 0.001$), with WSCT total errors ($p = 0.022$) and with WSCT perseverative errors ($p = 0.015$). ToM was also related to inhibitory control as assessed by the Stroop Test; word/color ($p = 0.007$) and interference ($p = 0.004$). Regarding attributional style, none of the two biases (personalizing or externalizing) were related

Table 1

Sociodemographic and clinical characteristics of the sample.

Variable	Women (n = 62)		Men (n = 129)		p value
	n	%	n	%	
Marital status					0.015
Single	45	72.6	115	89.1	
Married	9	14.5	8	6.2	
Divorced	6	9.7	6	4.7	
Widow	2	3.2	0	0	
Level of education					0.004
Primary	12	19.4	36	27.9	
Secondary	25	40.3	70	54.3	
University	25	40.3	23	17.8	
Employment status					0.807
Work	7	11.3	20	15.5	
Student	12	19.4	19	14.7	
Incapacity	15	24.2	28	21.7	
Unemployed	14	22.6	37	28.7	
Other	14	22.6	25	19.4	
Diagnosis					0.001
Schizophrenia	15	24.2	60	46.5	
Brief psychotic disorder	7	11.3	11	8.5	
Non-specified psychotic disorder	16	25.8	39	30.2	
Schizoaffective disorder	11	17.7	8	6.2	
Delusional disorder	7	11.3	4	3.1	
Schizophreniform disorder	6	9.7	4	3.1	

	Women (n = 62)		Men (n = 129)		p value
	Mean	SD	Mean	SD	
Age	30.18	7.90	26.78	6.79	0.003
Antipsychotic dose, mg/d*	398.20	330.10	537.56	718.49	0.276
BDI total	15.93	9.51	14.97	9.06	0.504
PANSS positive	13.15	5.13	14.36	6.11	0.178
PANSS negative	14.06	5.75	15.59	6.45	0.116
PANSS general	29.47	8.55	29.34	8.56	0.924
GAF	61.68	12.56	61.08	12.94	0.815
Estimated premorbid IQ	99.77	16.57	95.34	14.36	0.072
WAIS. Digits reverse order	54.72	14.731	53.10	15.77	0.508
TMT-B	67.21	19.16	77.04	28.99	0.02
WSCT total errors	44.39	13.15	45.98	13.75	0.473
WSCT perseverative errors	44.79	13.69	47.38	13.60	0.246
WSCT non-perseverative errors	44.64	13.17	45.25	13.53	0.78
Stroop word/color	44.05	14	46.22	14.39	0.34
Stroop interference	52.94	10.77	54.66	10.83	0.321

BDI: Beck Depression Inventory (BDI-II); PANSS: Positive and Negative Syndrome Scale; TMT: Trail Making Test; WSCT: Wisconsin Card Sorting Test; estimated premorbid IQ calculated by vocabulary subtest WAIS-III.

* Antipsychotic drug doses are expressed as chlorpromazine equivalence.

Table 2

Correlation between social cognition and executive functions.

Social cognition	Trail Making Test		Digits WAIS		Wisconsin Card Sorting Test						Stroop Test			
	TMT-B		Digits reverse order		TE*		PE**		nPE***		Word/color		Interference	
	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value
Attributional style														
Externalizing bias	0.067	0.377	−0.023	0.764	0.074	0.341	0.016	0.840	0.106	0.175	0.045	0.556	0.032	0.676
Personalizing bias	0.014	0.856	−0.006	0.941	−0.010	0.899	0.002	0.977	−0.021	0.790	−0.044	0.566	−0.018	0.808
Theory of Mind														
Hinting Task	−0.269	0.000	0.126	0.091	0.176	0.022	0.187	0.015	0.128	0.096	0.202	0.007	0.217	0.004
Emotional Recognition														
Face Test	−0.311	0.000	0.209	0.004	0.152	0.047	0.153	0.046	0.119	0.120	0.143	0.055	0.101	0.177

* Total errors.
** Perseverative errors.
*** Non-perseverative errors.

to EF. ER was linked to cognitive flexibility measured by the TMT-B ($p \leq 0.001$), WSCT total errors ($p = 0.047$) and perseverative errors ($p = 0.046$). Additionally, ER correlated with working memory, measured with the digit subtest in reverse order ($p = 0.004$).

Relationship between executive function and social cognition by gender

Table 3 shows the correlations between EF and SC split by gender. In the female sample, an association between the Hint-

Table 3
Correlation between social cognition and executive functions split by gender.

Social cognition	Trail Making Test		Digits Wais		Wisconsin Card Sorting Test						Stroop Test			
	TMT-B		Digits reverse order		TE*		PE**		nPE***		Word/color		Interference	
	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value
Women														
Attributional style														
Externalizing bias	0.135	0.319	−0.064	0.632	0.112	0.415	0.011	0.936	0.171	0.213	−0.063	0.642	−0.044	0.744
Personalizing bias	0.082	0.542	0.074	0.581	−0.140	0.308	−0.107	0.436	−0.115	0.405	−0.009	0.949	−0.006	0.965
Theory of Mind														
Hinting Task	−0.192	0.153	0.028	0.833	0.091	0.510	0.136	0.324	0.038	0.781	0.279	0.035	0.307	0.020
Emotional Recognition														
Face Test	−0.348	0.007	0.356	0.006	0.049	0.721	0.033	0.811	0.126	0.356	0.358	0.006	0.297	0.023
Social cognition	Trail Making Test		Digits Wais		Wisconsin Card Sorting Test						Stroop Test			
	TMT-B		Digits reverse order		TE*		PE**		nPE***		Word/color		Interference	
	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value	Coef.	p value
Men														
Attributional style														
Externalizing bias	0.065	0.486	−0.006	0.944	0.058	0.545	0.024	0.803	0.074	0.443	0.102	0.272	0.071	0.447
Personalizing bias	−0.024	0.795	−0.036	0.697	0.082	0.395	0.086	0.371	0.047	0.624	−0.075	0.420	−0.049	0.595
Theory of Mind														
Hinting Task	−0.270	0.003	0.157	0.085	0.224	0.017	0.230	0.014	0.172	0.068	0.186	0.042	0.194	0.033
Emotional Recognition														
Face Test	−0.290	0.001	0.151	0.096	0.199	0.034	0.212	0.023	0.118	0.213	0.075	0.411	0.041	0.652

* Total errors.
** Perseverative errors.
*** Non-perseverative errors.

ing Task, used to assess ToM, and inhibitory control assessed by the word/color test ($p = 0.035$) and interference ($p = 0.020$) was found. Regarding ER, this subdomain correlated with cognitive flexibility as measured with the TMT-B ($p = 0.007$), working memory ($p = 0.006$) and inhibitory control, word/color test ($p = 0.006$) and interference ($p = 0.023$).

In the male sample, we found a negative correlation between ToM (Hinting Task) and TMT-B ($p = 0.003$) and positive relationships between the Hinting Task and total and perseverative errors assessed with the Wisconsin Cards Sorting Test ($p = 0.017$ and $p = 0.014$ respectively), both of which measure cognitive flexibility. Moreover, a relationship was also found with inhibitory control (Stroop interference, $p = 0.033$). The same association was found between ER (Face Test) and measures of cognitive flexibility (TMT-B $p = 0.001$, WCST total errors $p = 0.034$ and WSCT perseverative errors $p = 0.023$). Finally in regard to attributional style (IPSAQ), only a negative correlation between internal attribution for negative events and inhibitory response ($p = 0.021$) was found.

No correlations were found between any attributional biases and EF split by gender.

Linear regression model

Table 4 describes the linear regression model with EF variables as predictors and social cognition as the dependent variable.

Age, marital status, and diagnosis were not included as a significant variable in any of the following models.

A total of 7% of ER's variance was explained by TMT-B ($p < 0.001$). A total of 10% of the variance of ToM was explained by TMT-B ($p = 0.002$) and Stroop Test interference ($p = 0.017$). Table 5 shows the linear regression model split by gender.

In the women sample, 9% of the variance in ToM was explained by Stroop Test interference ($p = 0.02$), while 7% of the variance in ToM was explained by TMT-B ($p = 0.004$) in the male sample. The reverse digits explained 12% of the variance in ER ($p = 0.009$) in the sample of women. On the other hand, in the sample of men, 9% of variance in ER was explained by two variables, namely TMT-B ($p = 0.008$), and level of studies ($p = 0.048$).

Discussion

The present study attempts to explore the associations between EF and SC in people with FEP. As a secondary aim, the impact of gender in these relationships was examined.

Regarding our first aim, a relationship between different domains of SC and some domains of EF was found, specifically, we found a relationship between ToM and cognitive flexibility and inhibitory control; and between ER and WM and cognitive flexibility. The results by gender show that there is a different profile of associations between EF and SC for women and men.

In relation to ToM and its relationship with EF, it is important to highlight that abnormalities in the prefrontal cortex (PFC) are present from early stages of psychosis[48] and these abnormalities lead to PFC dysfunction, which could have a negative impact in areas of high cognitive resource consumption necessary in both SC and EF, implying a deficit in the ability to understand others, but also a poor performance in cognitive flexibility and inhibitory control.[25,49]

Relative to ER we found worse performance in cognitive flexibility had a negative effect in ER, which confirms findings by Yang et al.[50] who revealed a correlation between deficits in emotional facial recognition and deficits in cognitive flexibility in people with FEP. Moreover, we found a correlation between ER and WM. Overall, our results are aligned with others that suggest WM could have an impact not only on ER, but also on the daily functioning of people with psychosis.[51,52]

Interestingly, although we obtained modest significant results regarding internal attribution for negative and positive events and inhibitory control, none of the attributional style biases correlated with EF. We speculate that this may be due to the characteristics

Table 4
Linear regression model.

	Theory of Mind		Emotional Recognition	
	Std β coef.	p value	Std β coef.	p value
TMT-B	−0.239	0.002	−0.276	<0.001
Interference (Stroop color/word test)	0.184	0.017		
R^2		0.105		0.076

Table 5
Linear regression model split by gender.

	Theory of Mind				Emotional Recognition			
	Women		Men		Women		Men	
	Std β coef.	p value	Std β coef.	p value	Std β coef.	p value	Std β coef.	p value
Digits reverse order (WAIS)					0.346	0.009		
Interference (Stroop color/word test)	0.307	0.02						
TMT-B			−0.275	0.004			−0.251	0.008
Level of education							0.184	0.048
R^2		0.094		0.075		0.120		0.096

of our sample. There are studies linking attributional style to the medial prefrontal cortex (mPFC), temporoparietal junction (TPJ) and precuneus.[53] Likewise, the mPFC is related to alterations in EF in patients with longer disease duration.[54] As a result, due to this study's recruitment of patients with a recent onset of psychosis leads us to believe that the above-mentioned structures could be preserved, since the attributional biases studied are not evident, nor did FEP patients have a clinical alteration in the performance of the EF studied. Considering our results as a whole, we believe that more research is needed in order to explain their functional significance in the FEP population.

In addition, the regression analysis found that ToM could be explained by cognitive flexibility and inhibitory control. These results are consistent with those found by Fernandez-Gonzalo et al.,[49] who concluded that a deficit in ToM could be associated with poorer performance on tests assessing cognitive flexibility and inhibitory control. Considering our results, this supports the idea of a key role of ToM as an important mediator in the relationship between neurocognition and social functioning as proposed by authors such as Hajdúk et al.[26] Furthermore, we found that cognitive flexibility could explain a residual part of the variance in ER. To our knowledge, no other studies analyzed the role of cognitive flexibility in ER in FEP, further studies are needed to clarify the implications of these findings.

Regarding our secondary aim, our study also provides evidence in favor of gender differences in the relationship between EF and SC. On the one hand, women with low performance on cognitive flexibility tasks had worse ToM performance, and poor cognitive flexibility performance. WM and inhibitory control was also related to poor performance in ER. On the other hand, men with poorer cognitive flexibility and inhibitory control showed lower performance in ToM. Moreover, poorer performance in the cognitive flexibility subdomain showed low performance in ER in men.

Our results suggest that men and women with FEP may have a different association profile between SC and EF. Previous studies show partial results analyzing the relationship between gender and SC or between this variable and neurocognition. Regarding the relationship between gender and SC, Abu-Akel and Bo[32] found higher global mental abilities in women with schizophrenia compared to their male counterparts. In this line, there are studies that found greater impairment in emotional processing in men than in women,[31] although there are also studies that found no gender differences between different domains of CS.[29,30] In our study, both ToM and ER were altered in women and men, but their relationship with cognitive function was different, which would suggest

that the pathways of the relationship between SC and EF are different in men and women and these differences should be taken into account.

The linear regression model was also applied to the sample divided by gender and showed that in the women subsample, inhibitory control explains a small proportion of the variance in ToM, and ER is modestly explained by working memory. For men, cognitive flexibility explained a residual part of the variance in ToM, and a modest part of the variance of ER was explained by cognitive flexibility and educational level. This sociodemographic finding in the regression analysis is consistent with previous studies reporting that an earlier age of onset has a negative effect on prognosis by preventing patients from achieving socially established goals, such as mandatory education, entering in the labor market or having meaningful social relationships.[55]

To the best of our knowledge, these are the first results to report gender differences in the association between SC and EF. However, this should be further studied as there is evidence of gender differences in response to Metacognitive Training,[56] and thus, differences in neurocognition and SC in men and women may influence their clinical response and treatment needs. Our results could be helpful when designing personalized treatment by considering the specific EF variables impacting each gender as relevant variables to improve psychological treatments addressed to improve SC.

In summary these findings add to the already growing evidence that executive functions play an important role in SC performance, and as Gardner et al.[55] suggests, also have an impact on the daily life of people with FEP. In this line, we consider it is important to consider the relationship between SC and EF, not only in people with FEP and cognitive impairment, but also in patients with below-average cognitive performance as this study and other authors[17,29] found worse performance in tasks used to measure EF correlate with poorer performance in tasks used to assess SC. This was true in both the complete sample and in the two gender samples in this study. In this line, and in agreement with other studies,[57,58] the influence of psychotic symptomatology on the results of the cognitive assessment is also ruled out, given that the results of the PANSS reflect clinical stability in both positive and negative symptoms. These findings could be of great relevance for the design of therapeutic interventions that take executive functioning into account in SC training programs for FEP patients even without any cognitive deficit. Finally, it is also important to take into account the differences between women and men in the relationship between EF and

SC in order to address the specific needs of each gender during the intervention.

Limitations

Although the present study has a strong experimental design with a large sample of subjects with FEP, results must be interpreted within certain limitations. The first limitation is that our data stems from two sources, each of which with a different number of items in the Hinting Task. Although we transformed the variable for comparison, it is possible that the different number of items may have affected the sensitivity of the test to true performance. Secondly, we did not include a control group, and in its absence, we cannot determine whether our results are specific to the FEP population. Thirdly, although the distribution of the sample in the study was not equitable with respect to gender, and it is a clear limitation of the study, it is representative of the clinical reality with respect to the sociodemographic characteristics of the patients attended. However, in the regression models by gender we found that the power of variables that explain SC in women and men are similar, though even higher in women. Our study had a cross-sectional design, so it would be interesting to include in the future follow-up studies that will allow us to assess causality between variables explored. Finally, results suggest that social functioning was not different between the women and men in the sample, however, this was assessed with the Global Assessment of Functioning (GAF) scale. So further studies should include more precise scales to assess psychosocial functioning and to explore the relationship between this concept, EF and SC.

Beyond these weaknesses, our study had a large sample of people with FEP, and to our knowledge, no other studies have focused in understanding the relationship between different domains of EF and SC, nor investigated whether there are gender differences in this relationship.

Conclusions

Our study shows a relationship between SC and EF, especially between ToM, emotion recognition and cognitive flexibility. While ToM is also related to inhibitory response, ER is related to WM. The main biases of attributional style do not seem to be related to EF.

We found that these patterns of associations are different for men and women.

Finally, we found that EF alone are modest but significant predictors of SC ability.

Therefore, these results should be considered when administering social cognitive interventions to people with psychosis, as people with specific deficits may benefit from including neurocognitive remediation focused on EF. Gender differences in the relationship between EF and SC should be taken into account in order address the specific needs of women and men in intervention programs.

Conflict of interest

The authors declare no conflict of interests.

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Appendix. Spanish Metacognition Study Group

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References

1. Adolphs R. Social cognition and the human brain. *Trends Cogn Sci*. 1999;3:469–479.
2. Healey KM, Bartholomeusz CF, Penn DL. Deficits in social cognition in first episode psychosis: a review of the literature. *Clin Psychol Rev*. 2016;50:108–137. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0272735816302549.
3. Joseph Fortuny J, Navarra-Ventura G, Fernández-Gonzalo S, et al. Cognición social en pacientes con un primer episodio psicótico. *Rev Psiquiatr Salud Ment*. 2020.
4. Brüne M. "Theory of mind" in schizophrenia: a review of the literature. *Schizophr Bull*. 2005;31:21–42.
5. Bora E, Pantelis C. Theory of mind impairments in first-episode psychosis, individuals at ultra-high risk for psychosis and in first-degree relatives of schizophrenia: systematic review and meta-analysis. *Schizophr Res*. 2013;144:31–36. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0920996412007062.
6. Ekman P. Facial expression and emotion. *Am Psychol*. 1993;48:384–392.
7. Kohler CG, Walker JB, Martin EA, Healey KM, Moberg PJ. Facial emotion perception in schizophrenia: a meta-analytic review. *Schizophr Bull*. 2010;36:1009–1019, http://dx.doi.org/10.1093/schbul/sbn192.
8. Barkl SJ, Lah S, Harris AWF, Williams LM. Facial emotion identification in early-onset and first-episode psychosis: a systematic review with meta-analysis. *Schizophr Res*. 2014;159:62–69.
9. Larsson C, Lee M, Lundgren T, et al. Facial affect recognition in first-episode psychosis is impaired but not associated with psychotic symptoms. *Heliyon*. 2022;8.
10. Garety PA, Freeman D. The past and future of delusions research: from the inexplicable to the treatable. *Br J Psychiatry*. 2013;203:327–333.
11. Bentall RP, Corcoran R, Howard R, Blackwood N, Kinderman P. Persecutory delusions: a review and theoretical integration. *Clin Psychol Rev*. 2001;21:1143–1192.
12. Kinderman P, Bentall RP. A new measure of causal locus: the internal, personal and situational attributions questionnaire. *Pers Individ Dif*. 1996;20:261–264. Available from: https://linkinghub.elsevier.com/retrieve/pii/0191886995001867.
13. Müller H, Betz LT, Bechdolf A. A comprehensive meta-analysis of the self-serving bias in schizophrenia spectrum disorders compared to non-clinical subjects. *Neurosci Biobehav Rev*. 2021;120:542–549. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0149763420305820.
14. Berberian AA, Gadelha A, Dias NM, et al. Component mechanisms of executive function in schizophrenia and their contribution to functional outcomes. *Rev Bras Psiquiatr*. 2019;41:22–30.
15. Aas M, Dazzan P, Mondelli V, Melle I, Murray RM, Pariante CM. A systematic review of cognitive function in first-episode psychosis, including a discussion on childhood trauma, stress, and inflammation. *Front Psychiatry*. 2014;4, http://dx.doi.org/10.3389/fpsyt.213.00182/Abstract.
16. Fett AKJ, Velthorst E, Reichenberg A, et al. Long-term changes in cognitive functioning in individuals with psychotic disorders. *JAMA Psychiatry*. 2020;77:387. Available from: https://jamanetwork.com/journals/jamapsychiatry/fullarticle/2757019.
17. Haatveit B, Vaskinn A, Sundet KS, et al. Stability of executive functions in first episode psychosis: one year follow up study. *Psychiatry Res*. 2015;228:475–481.
18. Mehta UM, Thirthalli J, Subbakrishna DK, Gangadhar BN, Eack SM, Keshavan MS. Social and neuro-cognition as distinct cognitive factors in schizophrenia: a systematic review. *Schizophr Res*. 2013;148:3–11.

19. González-Ortega I, González-Pinto A, Alberich S, et al. Influence of social cognition as a mediator between cognitive reserve and psychosocial functioning in patients with first episode psychosis. *Psychol Med.* 2020;50:2702–2710. Available from: https://www.cambridge.org/core/product/identifier/S0033291719002794/type/journal_article.
20. Halverson TF, Orleans-Pobee M, Merritt C, Sheeran P, Fett AK, Penn DL. Pathways to functional outcomes in schizophrenia spectrum disorders: meta-analysis of social cognitive and neurocognitive predictors. *Neurosci Biobehav Rev.* 2019;105:212–219. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0149763419301629.
21. Vidarsdottir OG, Twamley EW, Roberts DL, Gudmundsdottir B, Sigurdsson E, Magnusdottir BB. Social and non-social measures of cognition for predicting self-reported and informant-reported functional outcomes in early psychosis. *Scand J Psychol.* 2019, http://dx.doi.org/10.1111/sjop.12549.
22. Catalan A, Angosto V, Díaz A, et al. The relationship between theory of mind deficits and neurocognition in first episode-psychosis. *Psychiatry Res.* 2018;268:361–367, http://dx.doi.org/10.1016/j.psychres.2018.06.066.
23. Gavilán JM, García-Albea JE. La función ejecutiva en la esquizofrenia y su asociación con las habilidades cognitivas sociales (mentalistas). *Rev Psiquiatr Salud Ment.* 2015;8:119–129.
24. Pickup GJ. Relationship between theory of mind and executive function in schizophrenia: a systematic review. *Psychopathology.* 2008;41:206–213.
25. Berry K, Bucci S, Kinderman P, Emsley R, Corcoran R. An investigation of attributional style, theory of mind and executive functioning in acute paranoia and remission. *Psychiatry Res.* 2015;226:84–90.
26. Hajdúk M, Krajƀoviƀová D, Zimányiová M, KoĜínková V, Heretik A, PeƀeĖák J. Theory of mind – not emotion recognition – mediates the relationship between executive functions and social functioning in patients with schizophrenia. *Psychiatr Danub.* 2018;30:292–298.
27. Vaskinn A, Sundet K, Simonsen C, Hellvin T, Melle I, Andreassen OA. Sex differences in neuropsychological performance and social functioning in schizophrenia and bipolar disorder. *Neuropsychology.* 2011;25:499–510, http://dx.doi.org/10.1037/a0022677.
28. Seeman MV. Schizophrenia psychosis in women. *Women.* 2020;1:1–15.
29. Ayesa-Arriola R, Rodriguez-Sanchez JM, Gomez-Ruiz E, Roiz-Santiáñez R, Reeves LL, Crespo-Facorro B. No sex differences in neuropsychological performance in first episode psychosis patients. *Prog Neuropsychopharmacol Biol Psychiatry.* 2014;48:149–154. Available from: https://linkinghub.elsevier.com/retrieve/pii/S027858461300198X.
30. Verdaguer-Rodríguez M, López-Carrilero R, Ferrer-Quintero M, et al. Are there gender differences in social cognition in first-episode psychosis? *Women.* 2021;1:204–211.
31. Navarra-Ventura G, Fernandez-Gonzalo S, Turon M, et al. Gender differences in social cognition: a cross-sectional pilot study of recently diagnosed patients with schizophrenia and healthy subjects. *Can J Psychiatry.* 2018;63:538–546, http://dx.doi.org/10.1177/0706743717746661.
32. Abu-Akel A, Bo S. Superior mentalizing abilities of female patients with schizophrenia. *Psychiatry Res.* 2013;210:794–799. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0165178113005805.
33. Ferrer-Quintero M, Fernández D, López-Carrilero R, et al. Males and females with first episode psychosis present distinct profiles of social cognition and metacognition. *Eur Arch Psychiatry Clin Neurosci.* 2022. Available from: http://www.ncbi.nlm.nih.gov/pubmed/35802165.
34. Danaher H, Allott K, Killackey E, Hester R, Cotton S. An examination of sex differences in neurocognition and social cognition in first-episode psychosis. *Psychiatry Res.* 2018;259:36–43. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0165178117301737.
35. Ochoa S, López-Carrilero R, Barrigón ML, et al. Randomized control trial to assess the efficacy of metacognitive training compared with a psychoeducational group in people with a recent-onset psychosis. *Psychol Med.* 2017;47:1573–1584.
36. Corcoran R, Mercer G, Frith CD. Schizophrenia, symptomatology and social inference: investigating "theory of mind" in people with schizophrenia. *Schizophr Res.* 1995;17:5–13.
37. Gil D, Fernández-Modamio M, Bengochea R, Arrieta M. Adaptación al español de la prueba de teoría de la mente Hinting Task. *Rev Psiquiatr Salud Ment.* 2012;5:79–88.
38. Huerta-Ramos E, Ferrer-Quintero M, Gómez-Benito J, et al. Translation and validation of baron Cohen's face test in a general population from Spain. *Actas Esp Psiquiatr.* 2021;49:106–113.
39. Baron-Cohen S, Wheelwright S, Jolliffe T. Is there a "language of the eyes"? Evidence from normal adults, and adults with autism or Asperger syndrome. *Vis Cogn.* 1997;4:311–331, http://dx.doi.org/10.1080/713756761.
40. Díez-Alegría C, Vázquez-Valverde C. Teorías cognitivas de las creencias delirantes. *Apunt Psicol.* 2006;24:51–82. Available from: https://idus.us.es/bitstream/handle/11441/84944/4.pdf?sequence=1&isAllowed=y.
41. Selnes OA. A compendium of neuropsychological tests: administration, norms, and commentary. *Neurology.* 1991;41:1856, http://dx.doi.org/10.1212/WNL.41.11.1856-a.
42. Tien AY, Spevack TV, Jones DW, Pearlson GD, Schlaepfer TE, Strauss ME. Computerized Wisconsin Card Sorting Test: comparison with manual administration. *Kaohsiung J Med Sci.* 1996;12:479–485. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8774117.
43. Gardizi E, King JP, McNeely HE, Vaz SM. Comparability of the WCST and WCST-64 in the assessment of first-episode psychosis. *Psychol Assess.* 2019;31:271–276, http://dx.doi.org/10.1037/pas0000670.
44. Golden C. *Manual Stroop Test de Colores y Palabras.* 3rd ed. Madrid, España: TEA Ediciones; 2001.
45. Wechsler D. *Wais-III Escala de Inteligencia de Wechsler Para adultos-III: Manual de Aplicación y Corrección.* Madrid, España: TEA Ediciones; 2001.
46. Diamond A. Executive functions. *Annu Rev Psychol.* 2013;64:135–168.
47. Ayesa-Arriola R, Setién-Suero E, Neergaard KD, et al. Evidence for trait related theory of mind impairment in first episode psychosis patients and its relationship with processing speed: a 3 year follow-up study. *Front Psychol.* 2016;7.
48. Bergé D, Carmona S, Rovira M, Bulbena A, Salgado P, Vilarroya O. Gray matter volume deficits and correlation with insight and negative symptoms in first-psychotic-episode subjects. *Acta Psychiatr Scand.* 2011;123:431–439, http://dx.doi.org/10.1111/j.1600-0447.2010.01635.x.
49. Fernandez-Gonzalo S, Jodar M, Pousa E, et al. Selective effect of neurocognition on different theory of mind domains in first-episode psychosis. *J Nerv Ment Dis.* 2014;202:576–582. Available from: https://journals.lww.com/00005053-201408000-00002.
50. Yang C, Zhang T, Li Z, et al. The relationship between facial emotion recognition and executive functions in first-episode patients with schizophrenia and their siblings. *BMC Psychiatry.* 2015;15:241, http://dx.doi.org/10.1186/s12888-015-0618-3.
51. Sabharwal A, Szekely A, Kotov R, et al. Transdiagnostic neural markers of emotion-cognition interaction in psychotic disorders. *J Abnorm Psychol.* 2016;125:907–922.
52. Montaner-Ferrer MJ, Gadea M, Sanjuán J. Cognition and social functioning in first episode psychosis: a systematic review of longitudinal studies. *Front Psychiatry.* 2023;14.
53. Lee J, Horan WP, Wynn JK, Green MF. Neural correlates of belief and emotion attribution in schizophrenia. *PLoS One.* 2016;11:e0165546. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27812142.
54. Frascarelli M, Tognin S, Mirigliani A, et al. Medial frontal gyrus alterations in schizophrenia: relationship with duration of illness and executive dysfunction. *Psychiatry Res.* 2015;231:103–110. Available from: http://www.ncbi.nlm.nih.gov/pubmed/25498920.
55. Gardner A, Cotton SM, Allott K, Filia KM, Hester R, Killackey E. Social inclusion and its interrelationships with social cognition and social functioning in first-episode psychosis. *Early Interv Psychiatry.* 2019;13:477–487, http://dx.doi.org/10.1111/eip.12507.
56. Salas-Sender M, López-Carrilero R, Barajas A, et al. Gender differences in response to metacognitive training in people with first-episode psychosis. *J Consult Clin Psychol.* 2020;88:516–525, http://dx.doi.org/10.1037/ccp0000468.
57. Engen MJ, Vaskinn A, Melle I, et al. Cognitive and global functioning in patients with first-episode psychosis stratified by level of negative symptoms. A 10-year follow-up study. *Front Psychiatry.* 2022;13.
58. Rek-owodziń K, Tyburski E, Plichta P, et al. The relationship between cognitive functions and psychopathological symptoms in first episode psychosis and chronic schizophrenia. *J Clin Med.* 2022;11.