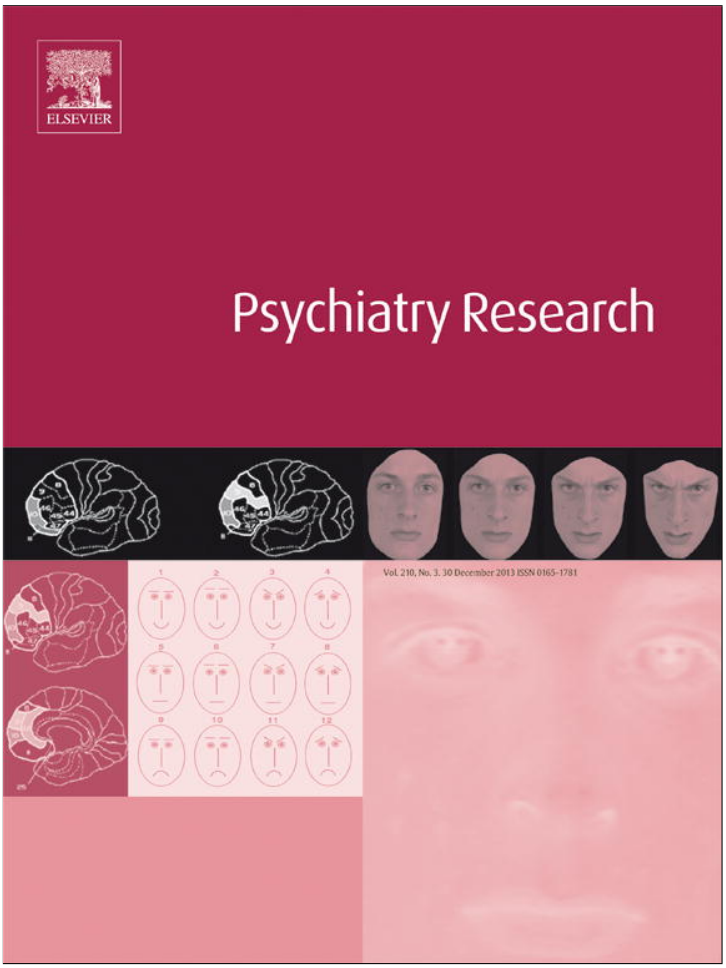

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Theory of mind and central coherence in eating disorders: Two sides of the same coin?

Fernanda Tapajóz P. de Sampaio [a,b,d,*], Sebastian Soneira [c], Alfredo Aulicino [d], Graciela Martese [e], Monica Iturry [e], Ricardo Francisco Allegri [a,b]

[a] CONICET – Consejo Nacional de Investigaciones Científicas y Técnicas, Buenos Aires, Argentina
[b] Department of Cognitive Neurology, Neuropsychology and Neuropsychiatry, Instituto de Investigaciones Neurológicas Raúl Carrea – FLENI, Buenos Aires, Argentina
[c] Nutrition and Health Clinic, Instituto "Dr. Cormillot", Buenos Aires, Argentina
[d] Section of Eating Disorders, Hospital General Cosme Argerich, Buenos Aires, Argentina
[e] Laboratory of Memory, Hospital General Abel Zubizarreta, Buenos Aires, Argentina

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ABSTRACT

The aim of this study was to evaluate central coherence and theory of mind (ToM) and explore the relationships between these domains in patients with eating disorders (ED). ToM and central coherence were assessed in 72 women [24 with anorexia nervosa (AN), 24 with bulimia nervosa (BN) and 24 healthy controls (HC)]. The Reading the Mind in the Eyes (RME) and the Faux Pas Test (FPT) to measure ToM, and the copy strategy of the Rey–Osterrieth Complex Figure Test to assess central coherence were used. It was observed that patients with ED had a decrease in central coherence skills compared with the control group; that patients with anorexia had a poor performance on RME ToM task compared with BN patients and HCs, and also that these measures were related in both clinical groups. The statistically significant correlation between them suggests that the central coherence and ToM measures might involve common cognitive processes. These results provide a better understanding of the nature of the socio-cognitive deficits observed in patients with eating disorders.

1. Introduction

The goal of this study is to investigate the relations between central coherence and theory of mind – a component of social cognition – in patients with eating disorders (ED). Central coherence (CC) is a term introduced by Frith (1989) from autism literature to describe the spontaneous tendency of typically developing individuals to process incoming information in a comprehensive, gestalt and inclusive form. In fact, a weak central coherence, mainly characterized by poor global integration and superior detail processing, is one the three main neurocognitive theories of autism to explain its characteristic behavioral impairments (Oldershaw et al., 2011). More recently, it was extensively observed that patients with anorexia and bulimia present a poor central coherence (Southgate et al., 2008; C. Lopez et al., 2008; C.A. Lopez et al., 2008b). Since this feature persists even in recovered patients, it is considered as a trait associated with the disease and a maintenance factor (Lopez et al., 2009).

On the other hand, it was observed in recent studies that patients with anorexia have difficulties in social cognition, mainly on theory of mind (Russell et al., 2009; Harrison et al., 2009, 2010; Oldershaw et al., 2010; Tapajóz Pereira de Sampaio et al., 2013), although this research is in its initial stage and some divergent results have been reported (Adenzato et al., 2012). 'Theory of mind' (ToM) refers to the ability to attribute or infer the mental states, feelings and thinking of others, in order to predict their behavior, beliefs and intentions and use this information to guide social behavior (Premack and Woodruff, 1978).

The specific relationship between neurocognition and social cognition has been little explored in eating disorders (Harrison et al., 2012). Particularly, it is an important and unexplored question to know if these primary alterations in the style of processing information and difficulties in ToM are in any way related, given that some aspects of the processing of social information demands global integration, such as the ability to process faces, or language comprehension. It is natural to expect that this weakness in central coherence should affect the subject's ability to make a proper inference about social situations, such as the intentions of other people, as this requires the integration of different sources of information.

In the autism field, it has been questioned whether the deficit in ToM is due to this primary weak central coherence. In this sense,

* Correspondence to: Department of Cognitive Neurology, Neuropsychology and Neuropsychiatry, Instituto de Investigaciones Neurológicas Raúl Carrea – FLENI, Montañeses 2325 8th floor, C1428AQK Buenos Aires, Argentina. Tel.: +54 11 5777 3200x2818; fax +54 11 5777 3209.
E-mail address: fetapajoz@hotmail.com (F. Tapajóz P. de Sampaio).

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potential links between central coherence and theory of mind were explored by Happé (1997), and her results suggest that a deficit in CC can coexist with some degree of competence in theory of mind tasks; hence, it supports the hypothesis that deficits in ToM are independent of weak central coherence. However, she emphasized that relations between these domains deserve further empirical exploration.

In contrast, in an investigation of children with autism, Jarrold et al. (2000) found that poor ToM performance was related to more detailed processing of information, and speculated that this style of processing information could affect the development of ToM. Baron-Cohen and Hammer (1997) reported that fast times on the Embedded Figures Test was related with poor performance on the Reading the Mind in the Eyes – an advanced ToM test – and suggested that "weak CC may go hand in hand with impaired mind-reading" (p. 550). Similarly, Burnette et al. (2005) in an investigation of the relationship between the weak central coherence hypothesis, theory of mind skills, and social–emotional functioning in a group of high functioning children with autism, concluded that central coherence and ToM were moderately related, although socio emotional functioning is a separate domain.

In the field of eating disorders, Harrison et al. (2012) studied social–emotional functioning and cognitive styles (central coherence and set shifting), and found that this variables were psychometrically separated.

Although the literature discussed presents conflicting results, most of this evidence indicates overlapping deficits in central coherence and theory of mind in patients with autism and eating disorders. Thus based on that, and mainly on the findings on autism that show a possible association between CC and ToM, our first hypothesis is that people with ED (anorexia and bulimia) should present a poorer performance on tasks of ToM and central coherence than healthy controls (HC); and the second one is that central coherence and ToM measures might reflect common cognitive processes, and thus, they should be correlated.

In order to probe these statements, this study is going to evaluate the central coherence and the theory of mind in patients with eating disorders, and then explore the relations between these domains.

2. Method

2.1. Participants

The present study involved a total of 48 Spanish speaking female women diagnosed with eating disorders according to DSM IV (American Psychiatric Association, 2000) and 24 healthy controls. The participants were divided into three groups: the AN group (n=24) consists of eight individuals with a restrictive subtype, one with binge-purge subtype and 15 with ED not otherwise specified (EDNOS) – AN type; the BN group (n=24) consists of 15 participants with purging subtype, three with non-purging subtype and six with EDNOS – BN type; and the HC group (n=24) consists of properly matched women healthy controls. The patients were recruited from the Service of Eating Disorders at the Hospital General Cosme Argerich, Hospital General Abel Zubizarreta and Instituto "Dr. Cormillot", Argentina. Experienced psychiatrists of the respective staffs made the diagnosis.

Exclusion criteria for both clinical groups were developmental disorders, bipolar disorder, psychosis spectrum disorder, organic brain syndrome or substance dependence, and additionally for the healthy controls group, the absence of an eating disorder, measured by EDI-II, drive for thinness subscale, where the scores should be below the cut-off 14. According to the EDI-II manual a cut-off point of 14 on this subscale was suggested for screening purposes (Garner, 1998). Furthermore, HCs participants were excluded from the study if they had the Body Mass Index (BMI=kg/m^2) outside of the established normal range (18.5–24.9) according to the World Health Organization.

The HCs were recruited from a variety of sources (hospital staff, university personnel, and local community) in order to have an age-matched female control group of comparable educational background.

2.2. Procedure

The study was approved by the Hospital General Cosme Argerich, Hospital General Abel Zubizarreta and Instituto "Dr. Cormillot" bioethics committees. Written informed consent was collected from all participants, and written parental consent was requested for participants under 18 years old.

The evaluation was carried out in two sessions. In the first meeting, the clinical interview and the evaluation of central coherence were held.

In the second session, the ToM assessment was conducted in this order: Reading the Mind in the Eyes (Baron-Cohen et al., 2001) and "Faux Pas" Test (Baron-Cohen et al., 1999). Questionnaires were completed 1 week before or after the testing session.

In the BN group four participants did not answer part of the variables. In spite of that, the other main measures were included in the analysis.

2.3. Measures

2.3.1. Clinical measures

A previous clinical interview was performed in all participants that consisted of: to explain the objectives of research and sign informed consent; request any additional information to that already existing in the medical records; weighing and measuring participants to calculate BMI; inquire about menstruation frequency and pattern during the past year; to confirm the age of onset of the eating pathology and duration of illness. All the interviews and neuropsychological assessment was performed only by one of us (FTPS), who is clinical neuropsychologist and a member of eating disorders service at Cosme Argerich Hospital.

In addition, the following self-report instruments were administered to all participants (in all scales higher scores indicate higher traits studied):

Beck depression inventory (BDI) (Beck et al., 1961; Beck et al., 2006): a 21-question multiple-choice self-report inventory to assess the existence and severity of symptoms of depression.

State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1982): a 40-item measure that indicates the intensity of feelings of anxiety. It distinguishes between state of anxiety (i.e., a temporary condition experienced in specific situations) and trait anxiety (i.e., a general tendency to perceive situations as threatening).

Obsessive Compulsive Inventory – Revised (OCI-R) (Foa et al., 2002; Martínez-González et al., 2011)**:** an 18-item self-report measure of symptoms of obsessive-compulsive disorder (OCD) on six dimensions: Checking, Washing, Ordering, Hoarding, Obsessing, and Neutralizing.

Eating disorder inventory-two (EDI-II) (Garner, 1998): a 91-item inventory that evaluates the symptoms and the psychological characteristics of eating behavior disorders. It is composed of 11 subscales: drive for thinness, bulimia, body dissatisfaction, perfectionism, interpersonal distrust, social insecurity, interoceptive awareness, ineffectiveness, maturity fears, asceticism, and impulse regulation.

To evaluate the reliability of the items of the BDI, STAI-state, STAI-trait, OCI-R (total) and EDI-II (total) was calculated Cronbach's alpha coefficient. The value obtained is 0.778.

To determine the estimated IQ, the Word Accentuation Test – Buenos Aires Version (Burin et al., 2010; Sierra et al., 2010) was completed by all participants, and to screen for cognitive functions, the Mini Mental State Examination (Folstein et al., 1975) was administered.

Word Accentuation Test (Burin et al., 2010; Sierra et al., 2010): consists of a card with 50 words of low frequency of use. The participant is asked to read them aloud, without regard to the meaning. Each word read correctly with grapheme-phoneme transcription and correct accentuation is scored 1, the maximum score is 50. Then, the total score is transformed to IQ scores.

Mini Mental State Examination (MMSE) (Folstein, 1975)**:** a brief test of 30-point questionnaire that is widely used to screen for cognitive impairment. It evaluates the following cognitive areas: spatial temporal orientation (10 points), registration (3 points), attention and calculation (5 points), recall (3 points), language (8 points) and visual construction (1 point). Higher scores indicate better performance.

2.3.2. Theory of mind measures

Reading the mind in the Eyes – affective ToM (Baron-Cohen et al., 2001): consists of 36 photos of the area of the eyes of people of both sexes (19 male and 17 female), whose eyes reflect complex mental states or emotions. The participants were asked to choose between four options the word that best describes how the person in the photograph is feeling or thinking (RME total, maximum score 36). A glossary is provided if the participant does not know the meaning of a word. In addition, as control task (RME control, maximum score 36) the participants were asked to identify the gender of the eyes pairs of the photo. We used the Spanish language adaptation made by the Laboratory of Memory, Hospital Zubizarreta (Serrano, 2006a).

"Faux Pas" Test – affective and cognitive ToM (Baron-Cohen et al., 1999): we used a shortened version consisting of five stories that the participant reads where a character said something that did not correspond to the social situation (in ignorance or misunderstanding), wounding the feelings of another person but

without the intent to harm. To understand that there was a faux pas (FP), the participant should be able to answer the following questions: (1) A FP screening question: (a) Did anyone say something he should not have said? If the FP is identified, three questions are asked: (2) FP comprehension questions: (a) Who committed the FP? (b) Why should he not have said what he said? (c) Why do you think he said that? (3) A control question to assess the general understanding; (4) A question to assess empathy: how do you think he felt? One point is given for each correct FP answer (maximum score 30).

The participant should also read five control stories randomly interspersed with the previous ones where there were no inappropriate social situations. Two points are given for each correct answer (maximum score 10). Finally, the patient must answer two questions about the stories (maximum score 20). These questions assess memory, such as the name of one of the characters. We used the Spanish-language adaptation made by the Laboratory of Memory, Hospital Zubizarreta (Serrano, 2006b).

2.3.3. Central coherence measures

To assess visuospatial central coherence the copy of the Rey–Osterrieth Complex Figure Test (RCFT) was used according to the method of Booth (2006). The RCFT is a classic neuropsychological test that traditionally assesses visual episodic memory and visuospatial skills. The accuracy of the copy and recalls is evaluated by dividing the figure into 18 parts. For each part is given a score of 0–2 (total score=36) according to qualitative criteria (Rey, 1964, 2003). For the purposes of this study we used only the copy of the figure. In this test, it was observed that a global or gestaltic strategy of the copy favors the recollection of the same. Booth (2006) developed a quantitative method to evaluate the degree of coherence of the copy of the figure, which provides three indices (C. Lopez et al., 2008; C.A. Lopez et al., 2008b):

1. Order of Construction (OC) Index (mean range 0–3.3): Evaluates the order of construction of the copy, that is, if the participant begins with global elements or peripheral elements. Higher scores are given when the participant begins the copy with the global elements rather than the details.
2. Style (S) Index (mean range 0–2): Evaluates the style of the copy between continuous or fragmented. Higher scores indicate more continuity in the drawing style rather than a fragmented style.
3. Central Coherence (CC) Index (mean range 0–2) was obtained by adding the proportion of the total possible scores in order (score/3.3) and style indices (score/2). A higher score in the coherence index means a more coherent drawing style.

C. Lopez et al. (2008) and C.A. Lopez et al. (2008b) first used this approach of assessment in the eating disorder literature and it was later reported in many studies (Harrison et al., 2012).

Participants were presented with the RCFT, a sheet of paper, colored pencils, and asked to copy it in the best possible way. Simultaneously the evaluator was changing pencils when the participant completed any element of the figure.

2.4. Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 19 for Windows. All variables were assessed for normality of distributions by using a Shapiro Wilk Test and for homogeneity of variance using Levene's test.

Parametric assumptions were not met for demographic and clinical variables, for "Faux Pas" test, for RME control and for central coherence indexes, so Kruskal–Wallis tests were used. In the cases where there were significant differences, orthogonal contrasts were performed for comparisons of interest. The first contrast was between the control and treated groups, and the second one was between the treated groups. These contrasts decompose the test statistic Kruskal–Wallis into two orthogonal components, each with a χ^2 distribution with 1 d.f. This partition allows controlling of type I error (Cochran's theorem) (Marascuilo and McSweeney, 1977).

Parametric assumptions were met for only RME total, so ANOVA was used followed by Bonferonni corrected *post hoc* tests. To explore the relationship between ToM, central coherence and clinical demographic variables, Spearman´s rank (rs) correlation was used. All correlation analyses were conducted separately in each group. All tests were conducted at the 5% level of statistical significance.

3. Results

3.1. Demographic and clinical characteristics

The results on demographic and clinical characteristics of the participants are shown in Table 1.

The three groups were comparable in age, years of education, estimated IQ and Mini Mental State Examination. As expected, there were statistically significant differences for the BMI between groups. The AN group presented a significantly lower weight than

Table 1
Clinical characteristics of participants

	AN		BN		HC		*Statistics*	*P*	*Post Hoc*
	Mean (S.D.)	*n*	*Mean* (S.D.)	*n*	*Mean* (S.D.)	*n*			
Age (years)	24.5 (7.6)	24	24.4 (6.0)	24	25.2 (6.9)	24	$H(2)=0.4$	0.81	ns
Years of education	14.1 (2.8)	24	14.2 (2.1)	24	15.1 (2.9)	24	$H(2)=1.8$	0.39	ns
Body Mass Index (Kg/m²)	18.1 (1.8)	24	25.0 (6.5)	22	21.5 (1.8)	24	$H(2)=36.5$	0.000	AN < HC*BN=HC AN < BN*
Age of onset of illness	16.8 (4.8)	24	16.6 (3.7)	24	na		$U=274.5$	0.77	ns
Duration of illness (years)	7.8 (5.9)	24	7.7 (6.3)	24	na		$U=285.5$	0.95	ns
Mini Mental	29.1 (0.9)	24	29.3 (0.7)	24	29.6 (0.5)	24	$H(2)=4.1$	0.12	ns
Estimated IQ	102.5 (19.8)	24	96.5 (16.0)	24	100.2 (15.2)	24	$H(2)=1.7$	0.41	ns
BDI	21.0 (11.3)	24	21.9 (8.1)	20	5.8 (4.4)	24	$H(2)=34.2$	0.000	AN > HC**BN > HC**AN=BN
STAI- State	32.2 (13.0)	24	31.1 (12.7)	20	17.9 (9.9)	24	$H(2)=16.3$	0.000	AN > HC**BN > HC**AN=BN
STAI- Trait	36.6 (14.0)	24	37.4 (9.2)	20	19.8 (8.2)	24	$H(2)=25.6$	0.000	AN > HC**BN > HC**AN=BN
OCI-R (total)	18.7 (16.2)	24	22.5 (16.8)	20	13.8 (9.5)	24	$H(2)=2.2$	0.31	ns
EDI-II Drive for thinness	11.3 (6.5)	24	14.5 (4.6)	20	1.3 (2.7)	24	$H(2)=40.1$	0.000	AN > HC**BN > HC**AN=BN
EDI-II Bulimia	2.0 (3.8)	24	10.9 (6.7)	20	0.1 (0.6)	24	$H(2)=41.6$	0.000	AN > HC**BN > HC**AN < BN**
EDI-II Body dissatisfaction	11.7 (7.7)	24	15.4 (6.1)	20	3.5 (3.6)	24	$H(2)=29.8$	0.000	AN > HC**BN > HC**AN < BN*
EDI-II Ineffectiveness	11.7 (9.3)	24	10.5 (5.9)	20	1.9 (2.8)	24	$H(2)=25.0$	0.000	AN > HC**BN > HC**AN=BN
EDI-II Perfectionism	7.4 (4.5)	24	7.8 (4.5)	20	5.7 (3.9)	24	$H(2)=2.7$	0.25	ns
EDI-II Interpersonal distrust	5.1 (3.8)	24	7.4 (4.6)	20	3.3 (3.4)	24	$H(2)=10.1$	0.006	AN > HC** BN > HC**AN < BN*
EDI-II Interoceptive awareness	9.5 (6.9)	24	11.2 (5.7)	20	2.1 (2.7)	24	$H(2)=28.2$	0.000	AN > HC**BN > HC**AN=BN
EDI-II Maturity fears	10.6 (5.9)	24	7.8 (4.1)	20	4.8 (4.8)	24	$H(2)=13.5$	0.001	AN > HC**BN > HC**AN=BN
EDI-II Asceticism	4.7 (3.5)	24	9.7 (4.3)	20	1.5 (2.0)	24	$H(2)=35.1$	0.000	AN > HC**BN > HC**AN < BN**
EDI-II Impulse Regulation	8.4 (6.8)	24	9.1 (5.9)	20	2.1 (2.8)	24	$H(2)=21.3$	0.000	AN > HC**BN > HC**AN=BN
EDI-II Social insecurity	7.3 (5.1)	24	8.8 (5.4)	20	2.8 (2.6)	24	$H(2)=17.7$	0.000	AN > HC**BN > HC**AN=BN
EDI-II Total	90.4 (44.9)	24	113.3 (34.1)	20	29.6 (18.6)	24	$H(2)=36.5$	0.000	AN > HC**BN > HC**AN < BN*

AN=Anorexia Nervosa, BN=Bulimia Nervosa, HC=Healthy Controls, BDI=Beck Depression Inventory, STAI=State-Trait Anxiety Inventory, OCI-R=Obsessive Compulsive Inventory Revised, EDI-II=Eating Disorder Inventory-Two, na=not aplicable, ns=not significant.

* $P<0.05$.

** $P<0.01$.

the BN and HCs group (both $P<0.05$). No differences between BN and HC groups were observed.

There were no differences between the clinical groups with respect to age of onset and duration of illness.

The AN and BN patients had greater levels of depression and anxiety than HCs (both $P<0.01$). The level of obsessive compulsive symptoms assessed by OCI-R inventory did not differ between groups.

In the AN group 13 (54.2%) were taking psychoactive medication. Those using psychotropic drugs performed better in the style index of the RCFT ($U=35.0$, $P<0.05$). In the other measures there were no differences between groups (OC index, $U=47.5$; CC index, $U=43.0$; RME total, $U=69.0$; FP stories, $U=69.0$; FP control, $U=61.5$; FP total, $U=67.0$, not significant).

In the BN group 15 (62.5%) were taking psychoactive medication, and the performance on the RME total was significantly more accurate in those taking medication (RME total, $U=19.5$, $P<0.05$). In the other measures there were no differences between groups (OC index, $U=62.5$; S index, $U=63.5$; CC index, $U=61.5$; FP stories, $U=44.0$; FP control, $U=48.0$; FP total, $U=44.0$, not significant).

With regard to the symptoms of eating disorders assessed with EDI-II, there were differences in almost all subscales between the clinical groups and the HC group ($P<0.01$), except the perfectionism subscale where, surprisingly, there were no differences between groups. The AN and BN groups differed in the bulimia ($P<0.01$), body dissatisfaction ($P<0.05$), interpersonal distrust ($P<0.05$), asceticism ($P<0.01$) subscales, and total score ($P<0.05$). All of the participants in the HC group were below the cut-off of the drive for thinness subscale, EDI-II ($M=1.3$, S. D.$=2.7$).

3.2. ToM performance

The results of the ToM tests are shown in Table 2.

3.2.1. "Reading the Mind in the Eyes" task

On the RME, the AN group was significantly less accurate than HC ($P<0.01$) and BN ($P<0.05$) groups. The BN group performed similarly to the HC group. In the control task there were no differences between groups.

3.2.2. "Faux Pas Test"

On the Faux Pas Test, the AN group scored significantly lower than the HCs on the stories faux pas ($P<0.1$), stories control ($P<0.05$) and total score ($P<0.05$). The BN group performed significantly lower than the HCs in the stories control ($P<0.05$), but similarly in the stories faux pas and total score. In the memory questions there were no differences between groups.

3.3. Central coherence performance

The results of the CC test are shown in Table 3.

In measures of central coherence, the patients with eating disorders had a poorer performance than the HCs in all indexes ($P\leq0.01$). There were no performance differences between patients with anorexia and bulimia. The accuracy of the copy was similar in the three groups.

3.4. The relationship between ToM and central coherence

Only significant results are described below:

3.4.1. AN group

The correlations analyses are shown in Table 4.

In the AN group, the performance on the RME total correlated with the style index and with the central coherence index of the RCFT (both $P<0.05$). The Faux Pas Test (stories faux pas and total score) correlated with the STAI-state ($P<0.05$).

Table 2
Results of ToM tasks in the three groups

	AN		BN		HC		*Statistics*	*P*	*Post Hoc*
	Mean (S.D.)	*n*	*Mean* (S.D.)	*n*	*Mean* (S.D.)	*n*			
RME total (max=36)	22.3 (3.3)	24	25.1 (3.2)	21	25.9 (2.9)	24	$F(2)=8.3$	0.001	AN < HC** BN=HC AN < BN*
RME control (max=36)	34.9 (0.9)	24	35.1 (1.1)	21	35.0 (0.9)	24	$H(2)=1.0$	0.59	ns
Faux Pas Test (history faux pas) (max=30)	24.0 (5.6)	24	26.1 (4.8)	21	27.4 (3.4)	24	$H(2)=6.1$	0.04	AN < HC*** BN=HC AN=BN
Faux Pas Test (history control) ($_{max}$ =10)	9.6 (0.7)	24	9.2 (1.3)	21	10.0 (0)	24	$H(2)=7.6$	0.02	AN < HC* BN < HC* AN=BN
Faux Pas Test (memory) ($_{max}$= 20)	19.2 (1.1)	24	19.7 (0.4)	21	19.7 (0.6)	24	$H(2)=3.7$	0.15	ns
Faux Pas (total) ($_{max}$= 40)	33.6 (5.6)	24	35.4 (5.1)	21	37.4 (3.4)	24	$H(2)=7.1$	0.02	AN < HC* BN=HC AN=BN

AN=Anorexia Nervosa, BN=Bulimia Nervosa, HC=Healthy Controls, RME=Reading the Mind in the Eyes Test, ns=not significant.

* $P<0.05$.

** $P<0.01$.

*** $P<0.1$.

Table 3
Results of Central Coherence measures in the three groups

	AN		BN		HC		*Statistics*	*P*	*Post Hoc*
	Mean (S.D.)	*n*	*Mean* (S.D.)	*n*	*Mean* (S.D.)	*n*			
RCFT copy (max=36)	33.5 (3.6)	24	33.7 (3.8)	24	34.5 (1.7)	24	$H(2)=0.6$	0.72	ns
RCFT order of construction (max=3.3)	1.9 (0.7)	24	2.0 (0.6)	24	2.4 (0.5)	24	$H(2)=8.6$	0.01	AN < HC** BN < HC** AN=BN
RCFT style (max=2.0)	1.3 (0.3)	24	1.3 (0.3)	24	1.7 (0.2)	24	$H(2)=15.9$	0.000	AN < HC** BN < HC** AN=BN
RCFT central coherence (max=2.0)	1.2 (0.3)	24	1.2 (0.3)	24	1.6 (0.2)	24	$H(2)=14.9$	0.001	AN < HC** BN < HC** AN=BN

AN=Anorexia Nervosa, BN=Bulimia Nervosa, HC=Healthy Controls, RCFT=Rey Complex Figure Test, ns=not significant.

* $P<0.05$.

** $P<0.01$.

Table 4
Table of correlations in anorexia nervosa group

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. RME total	–						**0.50***	**0.42***		0.49*					
2. RME control		–													
3. FPT (history faux pas)			–		0.98**							0.43*			
4. FPT (history control)				–											
5. FPT (total)					–							0.42*			
6. RCFT order of construction						–	0.59**	0.89**							
7. RCFT style							–	0.86**		0.49*					
8. RCFT central coherence								–		0.52**					
9. Body Mass Index									–						
10. Estimated IC										–					
11. BDI											–	0.89**	0.83**	0.66**	0.86**
12. STAI (state)												–	0.77**	0.69**	0.89**
13. STAI (trait)													–	0.63**	0.79**
14. OCI-R (total)														–	0.69**
15. EDI-II (total)															–

RME=Reading the Mind in the Eyes Test, FPT=Faux Pas Test, RCFT=Rey Complex Figure Test, BDI=Beck Depression Inventory, STAI=State-Trait Anxiety Inventory, OCI-R=Obsessive Compulsive Inventory Revised, EDI-II=Eating Disorder Inventory-Two.

* $P<$ 0.05.
** $P<$ 0.01.

Table 5
Table of correlations in bulimia nervosa group

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. RME total	–					**0.52***		**0.48***							
2. RME control		-													
3. FPT (history faux pas)			–		0.91**										
4. FPT (history control)				–											
5. FPT (total)					–										
6. RCFT order of construction						–	0.54**	0.80**		0.42*	−0.49*				−0.49*
7. RCFT style							–	0.90**			−0.55*				−0.52*
8. RCFT central coherence								–			−0.46*				−0.48*
9. Body Mass Index									–						
10. Estimated IC										–					
11. BDI											–	0.46*			0.69**
12. STAI (state)												–	0.68**	0.69**	
13. STAI (trait)													–		
14. OCI-R (total)														–	
15. EDI-II (total)															–

RME=Reading the Mind in the Eyes Test, FPT=Faux Pas Test, RCFT=Rey Complex Figure Test, BDI=Beck Depression Inventory, STAI=State-Trait Anxiety Inventory, OCI-R=Obsessive Compulsive Inventory Revised, EDI-II=Eating Disorder Inventory-Two.

* $P<$ 0.05.
** $P<$ 0.01.

The estimate IQ correlated with the RME total ($P<0.05$) and with the style ($P<0.05$) and central coherence ($P<0.01$) indexes of the RCFT. The starvation level measured by BMI did not correlate with any of the variables.

As expected, the BDI correlated with STAI (state and trait), OCI-R total and EDI-II total (all $P<0.01$); the STAI (state and trait) correlated with OCI-R total and EDI-II (all $P<$ 0.01); and the OCI-R correlated with EDI-II-total score ($P<0.01$).

3.4.2. BN group

The correlations analyses are shown in Table 5.

In the BN group, the performance on the RME total was correlated with order of construction and central coherence indexes of the RCFT (both $P<0.05$). The order of construction index was also correlated with the estimated IC ($P<0.05$). Interestingly the three central coherence indices were negatively correlated with the BDI and EDI-II total score ($P<0.05$). As in the AN group, the BMI was not correlated with any of the variables.

As also expected, the BDI was correlated with STAI-state ($P<0.05$) and EDI-II ($P<0.01$); and the STAI-state was correlated with OCI-R total score ($P<0.01$).

To evaluate the effect of the use of psychotropic drugs in the results of the correlations between indices of central coherence and RME, we performed analysis of covariance with two factors: (1) Use or non-use of psychotropic drugs, and (2) Diagnosis (AN, BN, and HC) with the three indices of coherence as a covariate. The psychotropic effect was not significant ($F_{(1,\ 64)}=1.59$, $P<.09$).

4. Discussion

The main purpose of the present study was to investigate the theory of mind and the central coherence abilities of women with eating disorders and explore empirical evidence of the possible association between these domains. It was hypothesized that ED patients would present a lower performance in tasks of central coherence and ToM, and mainly, that these two cognitive domains would not be independent.

Our results support the proposal that central coherence deficits are a characteristic feature of eating disorder patients, specifically at the visuospatial level (C. Lopez et al., 2008; C.A. Lopez et al., 2008b; Lopez et al., 2009), given that AN and BN patients showed a low score compared with HCs in the three central coherence indices. The results are furthermore consistent with the most of findings on deficits in affective theory of mind in patients with anorexia, who had poorer performance than HCs and BN in RME test (Russell et al., 2009; Harrison et al., 2009;(A. Harrison et al., 2009) Harrison et al., 2010; Oldershaw et al., 2010; Tapajóz Pereira de Sampaio et al., 2013). However, some conflicting results have also been reported (Andezato et al., 2012; Medina-Pradas et al., 2012).

Concerning Faux Pas Test, we observed that AN patients had low performance in FP tasks as in control tasks, constituting a non-specific deficit. A possible explanation for it was speculated to be a basic difficulty in comprehension of texts (Tapajóz Pereira de Sampaio et al., 2013), which could be associated with a weak central coherence. Previously, Tchanturia et al. (2004) also had found deficits in ToM and control conditions using a '*Story Comprehension*' and a '*Cartoon tasks*'.

On the other hand and contrary to our expectations, we found that patients with bulimia had similar performance to controls on ToM tasks, in agreement with previous works (Kenyon et al., 2012) but in contrast with the study of Medina-Pradas et al., 2012.

The main observation of our study was that the performance on measures of visuospatial central coherence and affective theory of mind were moderately correlated in both clinical groups. Then, it was noticed that difficulties in integrating the information in a context and difficulties in making a correct reading of the mind seem to be associated. Moreover, since we did not observe correlations between central coherence indices and RME control, we can infer that the correlation found between central coherence indices and affective ToM (RME total) concerns specifically to the mental state conveyed by the eyes. Some attempts to explain this association may be outlined, mainly through the literature of autism (Jarrold et al., 2000; Burnette et al., 2005).

One possible explanation is that the RME as well as most social situations require central coherence mechanisms. For example, to obtain a good performance on the RME is necessary to integrate several subtle details such as the direction of gaze, the position of the eyebrows, etc., in order to get an appropriate interpretation of the look. Then, those with a good visual central coherence perform better in this task.

Another point of view is that central coherence (at its most basic level of processing) would be an important element in the early development of ToM. It is speculated that to acquire a full ToM, the ability to address and integrate information from various sources is needed. For example, the ability to attend to what another person is also attending, in order to obtain a global model of the social situation, would be an important step in the acquisition of theory of mind (Jarrold et al., 2000).

Burnette et al. (2005) have suggested that weak central coherence in the early stages of life may alter the early development of social information processing, which in turn contribute to impaired social cognitive skills in children with autism.

On the other hand, it might be the case that the performance on tasks of central coherence and theory of mind share similar cognitive processes. In the literature of autism Burnette et al. (2005) has speculated that executive functions could provide a link between these measures.

It must be pointed out, however, that no significant associations were found between central coherence and the Faux Pas Test. This is probably due to the different nature of the two tasks. The Faux Pas is a verbal test, and in this work we only used measures of visuospatial central coherence. It would be interesting to correlate the Faux Pas with measures of verbal central coherence to better understand the relations between them. Besides, it would allow to verify the speculation mentioned above about the bad performance in both, control and FP tasks in AN group (Tapajóz Pereira de Sampaio et al., 2013), and to check if it is due to a poor verbal central coherence that may cause a difficulty in understanding the text.

Regarding the possible influences of demographic and clinical variables on measures of visuospatial central coherence and ToM, we observed only the influence of the IQ in the RME and central coherence measures in the AN group. In the BN group it was also noted the influence of the IQ in the order of construction index of the RCFT. The starvation level, measured by BMI, did not correlate with any other of the variables studied; therefore it does not justify the observed deficits.

Another important observation of this study was the inverse correlation of the three measures of central coherence with the symptoms associated with eating disorders (represented by EDI-II) in the group of patients with bulimia. This shows the relationship between cognition and behavior; and in particular, how the difficulty to contextualize information influences the clinical and behavioral symptomatology of patients with bulimia.

Despite having met its objectives, this study has some limitations. The first one is the small size of the sample, and the second one is that only one visuospatial test was used to assess central coherence. Ideally, we should use other measures to also evaluate verbal coherence. Another limiting factor is the effect of psychotropic drugs on the patients' performance on tasks. Furthermore, future work will be needed in order to explore the nature and extent of the relationship between CC and ToM in eating disorders patients more deeply.

Nevertheless, to the best of our knowledge this study is one of the few to empirically examine the links between CC and ToM in the same sample of patients with eating disorders. This study attempted to contribute to the understanding of the relationship between neurocognition and social cognition, a field that is little explored in these pathologies. Evidence supporting that the two major cognitive characteristics present in patients with ED are associated might constitute a significant observation towards the description of the neuropsychological profile of these patients.

The findings of this work strongly suggest the importance of cognitive rehabilitation for patients with eating disorders, and indicate that the improvement of cognitive status, such as a better central coherence, could directly impact on the socio emotional functioning of patients (Tchanturia et al., 2013).

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