RESEARCH ARTICLE

Theory of Mind in Eating Disorders and Their Relationship to Clinical Profile

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ABSTRACT

Objective: This study aimed to assess cognitive and affective theory of mind (ToM) in patients with eating disorders and to explore its relationship with the clinical and psychopathological profile.
Method: Theory of mind was assessed in 65 women, consisting of 22 with anorexia nervosa (AN), 19 with bulimia nervosa (BN), and 24 healthy controls (HC), using the Reading the Mind in the Eyes Test and the Faux Pas Test. These tasks evaluate affective and cognitive ToM, respectively. We also examined the correlations between performance on ToM tasks and the clinical psychopathological profile, which was extensively evaluated through self-report instruments and clinical interviews.
Results: Patients with AN had poorer performance than BN patients and HCs had in the affective ToM task, particularly in recognizing negative emotions and emotions in male eyes. Moreover, this deficit showed no correlation with the psychopathological profile. Performance in the BN group was equivalent to that of HCs in both tasks.
Conclusions: In this study, patients with AN showed an impairment in affective ToM, independent of their clinical status. Consistent with other studies, our findings demonstrate a specific difficulty in social cognition in patients with AN. This may be a trait marker in this population and should be considered in treatment. Furthermore, patients with AN and BN have different difficulty profiles in this domain of social cognition.

Keywords
anorexia; bulimia; theory of mind; social cognition; clinical profile

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Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/erv.2247

Introduction

Eating disorders (ED) are severe psychiatric illnesses characterized by disturbances in eating behaviour, associated with alterations in the perception of body image, obsessive preoccupations with weight and body shape, a morbid fear of fatness, psychosocial conflicts, and social cognitive difficulties. Among these features, difficulties in the social–emotional domain appear to play an important role in these diseases.

In the clinical profile of patients, symptoms such as high levels of social isolation, difficulties within the family and in making new friends, fear and avoidance of intense emotions, and difficulty in expressing thoughts and feelings are observed (Schmidt, Tiller, Blanchard, Andrews, & Treasure, 1997; Godart et al., 2004; Tiller et al., 1997). Longitudinal studies suggest that social difficulties can lead to serious problems, such as increased risk of suicide, maintenance and worse prognosis of the illness, and a poor quality of life, and these may persist even in recovered patients and may appear in a premorbid form (Zucker et al., 2007).

Although pure cognition has been extensively studied among patients with ED, it is surprising that social cognition has only recently emerged as an area of interest. Social cognition refers to the set of mental operations underlying social interactions, which include the processes involved in the perception, interpretation, and generation of responses to the intentions, dispositions, and behaviours of others (Ostrom, 1984).

In this study, we investigate the theory of mind (ToM) in patients with anorexia nervosa (AN) and bulimia nervosa (BN). The term 'theory of mind' was introduced by Premack and Woodruff (1978) for the component of social cognition that concerns the ability to understand the mental states of others and oneself and properly interpret and make inferences regarding the intentions and beliefs of other people in social situations.

The few studies on ToM in ED have had discordant results and conclusions, although most tend to observe ToM difficulties in AN. In BN, which is much less studied, no deficits have been observed in most studies, but this result cannot be generalized because of the limited number of researches (Dejong et al., 2011).

Tchanturia et al. (2004) studied ToM in a group of 20 AN patients through two ToM tasks: a story comprehension task (ToM stories and control stories) and a cartoon task (ToM cartoons and control cartoons). They found that the group of AN patients performed worse than the healthy controls (HC) did in both tasks: specific ToM and control. Thus, they found no evidence of specific impairment in ToM. In another study, Russell, Schmidt, Doherty, Young, and Tchanturia (2009) assessed social cognition skills in a group of 22 women with AN, also through the use of two tests on affective and cognitive ToM, namely, the Reading the Mind in the Eyes (RME) Test and Happé's cartoon task, respectively. They found that the group of AN patients performed significantly worse than the HC group did on affective ToM tasks. In Happé's cartoon task, patients were also impaired in both ToM and control elements, which suggests a nonspecific deficit in cognitive ToM. Oldershaw, Hambrook, Tchanturia, Treasure, and Schmidt (2010), studying the stability of ToM difficulties in a group of currently ill AN patients, recovered AN patients, and HCs, found that only those who were currently ill had difficulties, especially at reading positive or negative emotions and suggested that these may be due to the state of starvation.

Harrison, Sullivan, Tchanturia, and Treasure (2009) investigated the recognition of emotions in 20 AN patients compared with HCs, through the RME. They concluded that women with AN have difficulties in this domain. A later study involving 50 AN patients, 50 BN patients, and 90 HCs, also using the RME, found difficulties only in restrictive AN (Harrison, Sullivan, Tchanturia, & Treasure, 2010).

On the other hand, in a recent study of social cognition and social functioning in AN, Adenzato, Todisco, and Ardito (2012) found preserved ToM skills with impaired social functioning. Medina-Pradas, Navarro, Álvarez-Moya, Grau, and Obiols (2012) used the RME to investigate the emotional ToM (eToM) in patients with AN, BN, and ED not otherwise specified (EDNOS). They found that only patients with BN and EDNOS had poorer eToM ability compared with HCs. This study also investigated the emotional valence of the items of the RME and found that BN patients had a lower score than HCs when reading positive emotions and cognitive/neutral states. The EDNOS group also presented poorer scores than HCs in cognitive/neutral states. The AN group showed no differences relative to HCs. However, in one of the few studies on ToM in BN and EDNOS-BN, Kenyon et al. (2012) found through the RME and the Reading the Mind in the Films test that the performance of the patients was similar to that of the HCs.

Besides the noncomplete convergence between studies and their main consideration being AN, in most of them, the clinical symptomatology that may be associated with deficits has not been investigated in depth. Oldershaw et al. (2011) argued that 'state' variables such as depression, anxiety, body mass index (BMI), duration of illness, effect of psychotropic medication, and personality traits could affect the performance in ToM tasks and that investigation on this subject is limited. Although most of the studies control some of these clinical features, the relationships between them and ToM have seen little investigation and remain unknown. Motivated by this, the present study also aimed to analyse the impact of clinical symptoms on the performance of patients with ED in measures of ToM.

Our first hypothesis is that people with ED (AN and BN) should present poorer performance than healthy controls in ToM tasks. Our second hypothesis is that such performance would be independent of the clinical–psychopathological profile. This statement is motivated by evidence from previous studies that did not find an association between ToM and clinical symptoms (Russell et al., 2009; Oldershaw et al., 2010; Medina-Pradas et al., 2012). The present work sought to collect evidence to support these hypotheses. Thus, we assessed ToM in ED patients and explored its relationship with clinical status and psychopathological profile.

Materials and methods

Participants

A total of 65 Spanish-speaking female participants took part in this study. They were divided into three groups: AN (n = 22), BN (n = 19), and HC (n = 24). 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.

For inclusion in the AN or BN group, participants were categorized by a trained ED specialist according to DSMIV (American Psychiatric Association, 2000) diagnoses of restrictive (n = 8) or binge–purge (n = 1) AN subtypes or EDNOS-AN type (n = 13) for the AN group and binge–purge (n = 13) or no binge–purge (n = 2) BN subtypes or EDNOS-BN type (n = 4) for the BN group.

The decision to include an EDNOS AN type and an EDNOS-BN type was based on the findings from a meta-analysis indicating that EDNOS patients who satisfy all criteria for AN with a more lenient weight criterion and without amenorrhoea are very similar to individuals who meet all diagnostic criteria for AN. In the same way, EDNOS patients who satisfy all criteria for BN except binge frequency are very similar to strict diagnostic BN (Thomas, Vartanian, & Brownell, 2009).

The exclusion criteria for both clinical groups were developmental disorders, bipolar disorder, psychosis spectrum disorder, and organic brain syndrome or substance dependence. For the HC group, participants had to have no eating disorder, as measured by the Eating Disorder Inventory II (EDI-II) drive for thinness subscale (Garner, 1998), where the scores should be below the cut-off of 14. The EDI-II manual (Garner, 1998) suggests a cut-off point of 14 on this subscale for screening purposes. Furthermore, HC participants were excluded from the study if they had a BMI (kg/m^2) outside normal parameters (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.

Procedure

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

All the social cognition measures were administered in the same session in the following order: RME (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) and the Faux Pas Test (Baron-Cohen, O'Riordan, Stone, Jones, & Plaisted, 1999). Questionnaires were completed a week before or after the testing session.

Two participants from the BN group did not return all or part of the questionnaires. In spite of that, the other main measures were included in the analysis.

Measures

Clinical measures

In a clinical interview, BMI (weight/height squared) was calculated on the basis of the weight and height of participants, measured on the day of testing. Participants were asked to report menstruation frequency and pattern during the past year.

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

1. Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; Beck, Steer, & Brown, 2006; Brenlla & Rodríguez, 2006): a 21-question multiple-choice self-report inventory to assess the existence and severity of symptoms of depression.
2. State–Trait Anxiety Inventory (Spielberger, Gorsuc, & Lushene, 1982; Leibovich de Figueroa, 1991): a 40-item measure that indicates the intensity of feelings of anxiety. It distinguishes between the 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).
3. Obsessive–Compulsive Inventory—Revised (Foa et al., 2002; Martínez-González, Piqueras, & Marzo, 2011; Fullana et al., 2005): an 18-item self-report measure of symptoms of obsessive–compulsive disorder on six dimensions including checking, washing, ordering, hoarding, obsessing, and neutralizing.
4. Barratt Impulsiveness Scale (Barratt, 1985; Oquendo et al., 2001; Folino, Escobar Córdoba, & Castillo, 2006): a self-report questionnaire to assess impulsivity, consisting of 30 items grouped into four subscales including cognitive impulsivity, motor impulsivity, unplanned impulsivity, and total impulsivity.
5. NEO Five-Factor Inventory (Costa & McCrae, 1999; Cupani, Vaiman, Font, Pizzichini, & Saretti, 2012): a 60-item self-report questionnaire developed to provide a concise measure of the five basic personality factors including neuroticism, extraversion, openness to experience, kindness, and responsibility.
6. EDI-II (Garner, 1998; Rutsztein et al., 2006): a 91-item inventory that evaluates the symptoms and the psychological characteristics of eating behaviour 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. For the purposes of this study, we used the first six subscales.

To determine the estimated IQ, the Word Accentuation Test, Buenos Aires Version (Burin, Jorge, Arizaga, & Paulsen, 2010; Sierra, Torralva, Roca, Manes, & Burin, 2010), was completed by all participants. To screen for cognitive functions, the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975; Butman et al., 2001) was administered.

Theory of mind measures

This study assessed social cognition in ED by examining performance in two ToM tasks:

1. Reading the Mind of the Eyes—affective ToM (Baron-Cohen et al., 2001): This test was developed to assess social perception and affective theory of mind. It consists of 36 photos of the area of the eyes of people of both sexes (19 men and 17 women), whose eyes reflect differing emotions. The participant must detect the correct one, choosing one option in four. A glossary is available if the participant does not know the meaning of a word. A control task component is also included, in which the participant should also detect the gender of the person in each of the 36 photographs. Performance can be also analysed according to valence accuracy (accuracy for positive, negative, and neutral/cognitive states) and the accuracy to detect the gender of the look (Oldershaw et al., 2010). This is considered an advanced test of ToM, because it requires the participant to guess what the other person may have in mind. The test requires processing at three levels: automatic perception of a look; attribution of valence to it, which influences the interpretation of mental state; and conscious processing to choose which of the four options best suits the task (Butman, 2007). We used the Spanish-language adaptation made by the Laboratory of Memory, Zubizarreta Hospital (Serrano, 2006a).
2. Faux Pas Test—cognitive ToM (Baron-Cohen et al., 1999): This test assesses cognitive ToM. We used a shortened version consisting of five stories that the participant reads. In the stories, a character says something that does not correspond to the social situation (in ignorance or misunderstanding), which hurts 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. An 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? This last question measures the ability to recognize that whoever committed the FP did not intend to hurt his listener.
3. A control question to assess the general understanding.
4. A question to assess empathy: How do you think he felt? The participant must understand how the hurt character feels.

One point is given for each correct FP answer (maximum score of 30).

The participant should also read five control stories randomly interspersed with the previous ones. These control stories have no inappropriate social situations. Two points are given for each correct answer (maximum score of 10). This is performed to

prevent the participant from responding automatically that someone did something inappropriate and to assure that the answers represent the true ability to detect the different social situations. Finally, the patient must answer two control questions about the stories (maximum score of 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, Zubizarreta Hospital (Serrano, 2006b).

Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (IBM Corporation, Endicott, NY), version 19 for Windows. All variables were assessed for normality of distribution by using the Shapiro–Wilk test and for homogeneity of variance.

Parametric assumptions were not met for demographic and clinical variables, for the Faux Pas Test and the RME (control, accuracy for female eyes, and accuracy for negative and neutral emotions). Thus, Kruskal–Wallis tests were used with Mann–Whitney *U* tests for *post hoc* comparisons. Parametric assumptions were met for the RME (total, accuracy for male eyes, and accuracy for positive emotions), so analysis of variance was used followed by Bonferroni-corrected *post hoc* tests.

It was observed in the AN group that the estimated IQ was correlated with performance in the RME (total score and accuracy for male eyes, Table 3). However, no significant IQ differences were observed between groups (Table 1). Nevertheless, in order to avoid any confounding factor, analysis of covariance was completed, covarying for IQ for all ToM variables that correlated with RME (which satisfied parametric assumptions). This analysis did not alter the results, so analysis of variance is reported for simplicity of interpretation.

To explore the relationship between ToM and clinical demographic variables, Spearman's correlation (r_s) was used. All correlation analyses were conducted separately in each group. All tests were conducted at the 5% level of statistical significance.

Results

Demographic and clinical characteristics

Table 1 shows the demographic and clinical characteristics of the participants. The three groups were comparable in age, years of education, estimated IQ, and Mini-Mental State Examination score. As expected, there were statistically significant differences in the BMI between groups. The AN group presented a significantly lower weight than the BN and HC groups (both $p < 0.01$), and the BN group presented significantly more weight than the HC group ($p < 0.05$).

Table 1 Demographic and clinical characteristics of participants

	AN (n = 22)	BN (n = 19)	HC (n = 24)			
	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Statistics	*p*	*Post hoc*
Age (years)	24.3 (7.6)	25.3 (6.0)	25.2 (6.9)	$H(2) = 0.7$	.71	ns
Years of education	14.0 (2.8)	14.4 (2.2)	15.1 (2.9)	$H(2) = 2$	.36	ns
Body mass index (kg/m^2)	18.1 (1.8)	25.2 (6.9)	21.5 (1.8)	$H(2) = 33.2$	.001	AN < HC**, BN > HC*, AN < BN**
Age of onset	17.0 (5.0)	16.8 (4.1)	na	$U = 201.0$	.83	ns
Duration of illness (years)	7.4 (5.6)	8.4 (6.8)	na	$U = 189.5$	.60	ns
Mini-mental	29.0 (0.9)	29.2 (0.8)	29.6 (0.5)	$H(2) = 5.8$	.053	ns
Estimated IQ	101.4 (20.4)	95.1 (16.9)	100.2 (15.2)	$H(2) = 1.6$	.42	ns
BDI (21 items)	21.8 (11.3)	21.9 (8.6)	5.8 (4.4)	$H(2) = 33.5$	.001	AN > HC**, BN > HC**, AN = BN
STAI—state	32.4 (13.4)	31.9 (13.2)	17.9 (9.9)	$H(2) = 15.7$	.001	AN > HC**, BN > HC**, AN = BN
STAI—trait	37.8 (13.3)	38.0 (9.5)	19.8 (8.2)	$H(2) = 26.8$	.001	AN > HC**, BN > HC**, AN = BN
OCI-R (total)	20.1 (16.1)	23.4 (17.5)	13.8 (9.5)	$H(2) = 2.7$	.25	ns
BIS-11 (total)	53.7 (16.0)	54.7 (11.9)	47.2 (13.0)	$H(2) = 3.2$	.19	ns
NEO-FFI neuroticism	32.0 (10.3)	30.3 (5.4)	19.8 (6.4)	$H(2) = 23.7$	.001	AN > HC**, BN > HC**, AN = BN
NEO-FFI extraversion	25.8 (9.6)	24.7 (8.8)	31.5 (6.7)	$H(2) = 5.4$	.06	ns
NEO-FFI openness to experience	24.2 (8.8)	24.5 (8.5)	27.7 (7.6)	$H(2) = 2.8$	.23	ns
NEO-FFI kindness	29.1 (10.8)	25.0 (6.7)	30.2 (5.2)	$H(2) = 5.4$	.06	ns
NEO-FFI responsibility	24.7 (7.9)	24.5 (6.3)	32.4 (5.4)	$H(2) = 15.9$	.001	AN < HC**, BN < HC**, AN = BN
EDI-II drive for thinness	11.9 (6.5)	14.6 (4.5)	1.3 (2.7)	$H(2) = 38.1$	.001	AN > HC**, BN > HC**, AN = BN
EDI-II bulimia	2.1 (3.9)	11.7 (6.5)	0.1 (0.6)	$H(2) = 39.7$	.001	AN > HC**, BN > HC**, BN > AN**
EDI-II body dissatisfaction	12.5 (7.6)	15.5 (6.3)	3.5 (3.6)	$H(2) = 28.9$	.001	AN > HC**, BN > HC**, AN = BN
EDI-II perfectionism	7.6 (4.7)	7.7 (4.7)	5.7 (3.9)	$H(2) = 2.7$	.25	ns
EDI-II interpersonal distrust	5.4 (3.8)	7.5 (4.9)	3.3 (3.4)	$H(2) = 9.6$	.01	AN > HC*, BN > HC**, AN = BN
EDI-II social insecurity	7.6 (5.1)	9.3 (5.5)	2.8 (2.6)	$H(2) = 18.7$	.001	AN > HC**, BN > HC**, AN = BN
EDI-II total score	93.9 (44.8)	115.1 (35.6)	29.6 (18.6)	$H(2) = 35.8$	.001	AN > HC**, BN > HC**, AN = BN

Note: AN, anorexia nervosa; BN, bulimia nervosa; HC, healthy controls; BDI, Beck Depression Inventory; STAI, State–Trait Anxiety Inventory; OCI-R, Obsessive–Compulsive Inventory—Revised; BIS 11, Barratt Impulsiveness Scale; NEO-FFI, NEO Five-Factor Inventory; EDI-II, Eating Disorder Inventory II; na = not applicable; ns = not significant.
*$p < 0.05$,
**$p < 0.01$.

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 levels of impulsivity and obsessive–compulsive symptoms did not differ between groups.

In the AN group, 12 (54.5%) were taking psychoactive medication, but the performance in ToM measures did not differ significantly from those who were not (RME total, $U = 58.5$; RME male eyes, $U = 59.5$; RME female eyes, $U = 54.5$; RME positive emotions, $U = 55.0$; RME negative emotions, $U = 44.0$; RME neutral emotions, $U = 39.0$; FP stories, $U = 52.0$; FP control, $U = 51.0$; FP total, $U = 50.0$, not significant). In the BN group, 14 (73.7%) were taking psychoactive medication, and the performance in the RME (total and male eyes) was significantly more accurate for those taking medication (RME total, $U = 8.5$, $p < 0.05$; RME male eyes, $U = 9.5$, $p < 0.05$). In the Faux Pas Test, there was no difference due to medication (FP stories, $U = 31.0$; FP control, $U = 30.0$; FP total, $U = 21.0$, not significant).

Personality traits assessed through the NEO Five-Factor Inventory did not differ greatly among the groups. There were only expected differences in the neuroticism subscale, where the AN and BN groups had higher levels than the HCs (both $p < 0.01$), and in the responsibility subscale, where the AN and BN groups had lower scores than HCs (both $p < 0.01$).

Finally, in terms of ED symptoms, there were differences in all subscales (all $p < 0.01$) between the clinical groups and the HC group, except in the perfectionism subscale. It is well established in the literature that patients with anorexia have high levels of perfectionism (Sutandar-Pinnock, Blake Woodside, Carter, Olmsted, & Kaplan, 2003; Lampard, Byrne, McLean, & Fursland, 2012), so it was surprising that there were no differences between the AN and HC groups. Moreover, the AN and BN groups did not differ in all subscales except in the bulimia subscale, where the BN patients scored higher ($p < 0.01$), as expected. All HC participants were below the cut-off of the EDI-II drive for thinness subscale ($M = 1.3$, $SD = 2.7$).

Theory of mind performance

Table 2 shows the results of the ToM tests.

1. *RME task*. On the RME total score, the AN group was significantly less accurate than the HC ($p < 0.01$) and BN ($p < 0.05$) groups. The AN group was also less accurate at recognizing negative emotions and emotions of male eyes than the HC and BN groups were (both $p < 0.01$). The performance of the BN group was similar to that of the HC group on all scores. In the control task, there were no differences between groups.
2. *Faux Pas Test*. On the FP stories, the Kruskal–Wallis test showed a statistical trend ($p = 0.08$) towards a significant difference between groups, and subsequent *post hoc* analysis revealed that the AN group scored significantly lower than the HCs ($p < 0.05$). Moreover, the AN group was significantly less accurate on the control stories ($p < 0.05$) and total score ($p < 0.05$). The BN group performed significantly lower than the HCs in the control stories ($p < 0.01$), but similarly in the FP stories and total score. In the memory questions, there were no differences between groups.

The impact of demographic, clinical, and psychopathological variables on theory of mind performance

Anorexia nervosa group

Table 3 shows the complete results of correlations. Later, we highlight the results that are relevant for the purpose of this study.

In the AN group, the estimated IQ correlated with RME total score ($r_s = 0.51$, $p < 0.05$) and with RME male eyes ($r_s = 0.46$, $p < 0.05$). BMI and other clinical variables were not correlated with performance in tasks of ToM.

Bulimia nervosa group

Table 4 shows the complete results of correlations. Later, we highlight the results that are relevant for the purpose of this study.

Table 2 Results of theory of mind tasks in the three groups

	AN (n = 22)	BN (n = 19)	HC (n = 24)			
	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Statistics	*p*	*Post hoc*
RME experimental—total (max = 36)	22.1 (3.3)	25.0 (3.3)	25.9 (2.9)	$F(2) = 8.3$	.001	AN < HC**, AN < BN*, BN = HC
RME control (max = 36)	34.9 (0.9)	35.2 (0.9)	35.0 (0.9)	$H(2) = 2.4$	.29	ns
RME male eyes only (max = 19)	10.9 (2.1)	13.1 (2.4)	13.7 (1.8)	$F(2) = 10.1$	.000	AN < HC**, AN < BN**, BN = HC
RME female eyes only (max = 17)	11.2 (2.0)	11.9 (1.7)	12.2 (1.9)	$H(2) = 3.0$	.22	ns
RME positive emotions (max = 13)	9.2 (1.8)	9.5 (1.3)	9.8 (2.1)	$F(2) = 0.7$	.49	ns
RME negative emotions (max = 15)	7.6 (2.3)	9.8 (2.0)	10.1 (1.4)	$H(2) = 13.3$	.001	AN < HC**, AN < BN**, BN = HC
RME neutral/cognitive states (max = 8)	5.2 (0.9)	5.6 (1.3)	5.9 (1.1)	$H(2) = 4.5$	.10	ns
Faux Pas Test (history faux pas) (max = 30)	24.5 (5.1)	25.7 (4.9)	27.4 (3.4)	$H(2) = 4.9$	.08	AN < HC*, BN = HC, AN = BN
Faux Pas Test (history control) (max = 10)	9.6 (0.7)	9.1 (1.3)	10.0 (0)	$H(2) = 8.4$	.01	AN < HC*, BN < HC**, AN = BN
Faux Pas Test (memory) (max = 20)	19.2 (1.1)	19.7 (0.4)	19.7 (0.6)	$H(2) = 3.1$	.20	ns
Faux Pas (total) (max = 40)	34.2 (5.2)	34.9 (5.2)	37.4 (3.4)	$H(2) = 6.5$	.03	AN < HC*, BN = HC, AN = BN

Note: AN, anorexia nervosa; BN, bulimia nervosa; HC, healthy controls; RME, Reading the Mind in the Eyes Test; ns, not significant.
*$p < 0.05$,
**$p < 0.01$.

Table 3 Table of correlations in the anorexia nervosa group

	RME total	RME male	RME female	RME positive	RME negative	RME neutral	FPT faux pas	FPT total
Age	.17	.11	.14	.25	−.03	−.10	−.16	−.21
Education (years)	.21	.17	.17	.35	−.01	.00	−.03	−.09
BMI	.17	.27	.04	.21	.11	.12	.01	−.03
Age of onset	−.11	−.16	.02	−.10	−.04	−.23	−.29	−.27
Duration of illness	.28	.19	.20	.36	−.06	.17	−.08	−.16
MMSE	−.05	.01	−.09	.30	−.36	.14	−.31	−.36
Estimated IQ	**.51***	**.46***	.28	.33	.33	.10	.05	.00
BDI	.14	.15	.00	−.09	.24	−.12	.26	.27
STAI—state	.09	.18	−.18	−.22	.22	−.18	.41	.41
STAI—trait	.16	.08	.00	−.14	.24	−.09	.30	.33
OCI-R	−.05	−.06	−.10	−.15	.00	−.12	.09	.06
BIS-11	−.05	−.01	−.18	−.16	.09	−.29	.17	.19
NEO-FFI neuroticism	.26	.24	−.10	−.22	.35	−.19	**.45***	**.42***
NEO-FFI extraversion	−.05	.03	.05	.06	.02	.17	−.32	−.32
NEO-FFI openness to experience	.15	.12	.13	.36	−.02	.07	−.38	−.38
NEO-FFI kindness	−.26	−.13	−.32	−.16	−.16	−.17	−.27	−.23
NEO-FFI responsibility	.26	.23	.15	.32	.08	.15	.06	.07
EDI-II drive for thinness	.20	.34	−.01	.05	.23	.04	.30	.26
EDI-II bulimia	.19	.22	−.06	.14	.05	.13	.13	.06
EDI-II body dissatisfaction	.03	.15	−.21	−.18	.08	−.12	.16	.12
EDI-II perfectionism	.03	.01	.03	.17	−.16	.15	−.08	−.13
EDI-II interpersonal distrust	−.08	−.25	−.03	.02	−.13	−.25	.23	.22
EDI-II social insecurity	−.16	−.10	−.26	−.29	−.01	−.20	.24	.21
EDI-II total score	.06	.08	−.13	−.22	.14	−.08	.29	.26

Note: RME, Reading the Mind in the Eyes Test; FPT, Faux Pas Test; BMI, body mass index; MMSE, Mini-Mental State Examination; BDI, Beck Depression Inventory; STAI, State–Trait Anxiety Inventory; OCI-R, Obsessive–Compulsive Inventory—Revised; BIS 11, Barratt Impulsiveness Scale; NEO-FFI, NEO Five-Factor Inventory; EDI-II, Eating Disorder Inventory II.

*$p < 0.05$,

**$p < 0.01$.

In the BN group, performance in RME total score was negatively correlated with the interpersonal distrust subscale of EDI-II ($r_s = -0.57$, $p < 0.05$). Performance in RME male eyes was also negatively correlated with the interpersonal distrust subscale of EDI-II ($r_s = -0.62$, $p < 0.01$) and with the social insecurity subscale of EDI-II ($r_s = -0.49$, $p < 0.05$). Performance in RME positive emotions was correlated with age of onset of illness ($r_s = 0.46$, $p < 0.05$). Performance in negative emotions was negatively correlated with the impulsivity-level ($r_s = -0.48$, $p < 0.05$), interpersonal distrust ($r_s = -0.64$; $p < 0.01$), and social insecurity ($r_s = -0.57$, $p < 0.05$) subscales of EDI-II.

Discussion

The main purpose of this cross-sectional study was to examine the performance of individuals with EDs (anorexia and bulimia) in experimental measures of cognitive (FP task) and affective (RME task) ToM. The second goal was to analyse the relationship between performances in these tasks with clinical status, which was extensively evaluated. It was hypothesized that ED patients would demonstrate lower ToM skills and that this would be independent of their clinical profile.

Our findings partially support these claims. The results show a significant affective ToM impairment in the AN group in the RME task, indicating difficulties in recognizing emotions and in attributing mental states to others, mainly in recognizing negative emotions and emotions in male eyes.

In the Faux Pas Test, we found that, compared with HCs, AN patients were impaired in both ToM and control tasks (a nonspecific deficit). We speculate that this alteration in both conditions may be due to a more basic difficulty in understanding the text, understanding the story context, and making inferences. It is well established in the literature that patients with anorexia have a weak central coherence (Lopez et al., 2008; Lopez, Tchanturia, Stahl, & Treasure, 2009). In this sense, one should expect that text comprehension requires a global approach, and this bias to detail may have influenced the performance in this task. Studies in the autism field support the hypothesis that weak central coherence underlies deficits in inferring, understanding ambiguous language, using the context to support sentence comprehension, and so on (Norbury & Bishop, 2002).

It is important to note that all ToM tasks require a global approach (Russell et al., 2009). Thus, a weak central coherence could have affected the AN performance in the RME task. In a forthcoming work (in progress), we shall further explore this relationship between neurocognition (in particular, central coherence) and social cognition.

Our findings are in line with those by Russell et al. (2009), who also observed deficits in affective ToM and in both conditions (experimental and control) and then a nonspecific deficit in

Table 4 Table of correlations in the bulimia nervosa group

	RME total	RME male	RME female	RME positive	RME negative	RME neutral	FPT faux pas	FPT total
Age	.11	.28	−.20	.07	.22	−.10	−.15	−.11
Education (years)	.18	.27	−.04	.18	.09	.09	−.13	−.21
BMI	.17	.03	.25	.31	−.07	.11	.07	.03
Age of onset	.13	.07	.13	**.46***	.00	−.08	−.15	−.16
Duration of illness	.13	.33	−.23	−.19	.36	−.07	−.09	−.01
MMSE	−.22	−.10	−.32	−.01	−.16	−.32	−.22	−.30
Estimated IQ	.23	.33	−.08	.28	.30	−.18	−.18	−.20
BDI	−.30	−.37	−.11	.02	−.41	−.22	.15	.14
STAI—state	.14	.10	.03	.24	−.01	.05	.17	.13
STAI—trait	.06	.02	.03	.20	−.02	−.05	.12	.18
OCI-R	.00	.06	−.09	−.17	.00	.15	.30	.22
BIS-11	−.16	−.22	.03	.11	**−.48***	.13	.34	.30
NEO-FFI neuroticism	.30	.12	.37	.31	.03	.28	.32	.34
NEO-FFI extraversion	.10	.09	.09	−.20	.33	−.05	−.09	−.21
NEO-FFI openness to experience	.11	.04	.17	−.14	.15	.10	.06	−.10
NEO-FFI kindness	.13	.15	.10	−.24	.34	.14	−.12	−.02
NEO-FFI responsibility	.13	.11	.08	.15	.10	.03	−.01	−.20
EDI-II drive for thinness	.26	.21	.08	.21	.36	−.21	.07	.09
EDI-II bulimia	−.24	−.17	−.20	−.43	−.09	−.07	−.05	.00
EDI-II body dissatisfaction	−.18	−.08	−.26	.02	−.28	−.12	.02	−.05
EDI-II perfectionism	−.05	.16	−.38	−.19	.06	−.13	−.08	.02
EDI-II interpersonal distrust	**−.57***	**−.62****	−.18	−.25	**−.64****	−.18	−.02	−.14
EDI-II social insecurity	−.45	**−.49***	−.16	−.04	**−.57***	−.25	.26	.14
EDI-II total score	−.35	−.32	−.23	−.15	−.36	−.25	.06	.01

Note: RME, Reading the Mind in the Eyes Test; FPT, Faux Pas Test; BMI, body mass index; MMSE, Mini-Mental State Examination; BDI, Beck Depression Inventory; STAI, State–Trait Anxiety Inventory; OCI-R, Obsessive–Compulsive Inventory—Revised; BIS 11, Barratt Impulsiveness Scale; NEO-FFI, NEO Five-Factor Inventory; EDI-II, Eating Disorder Inventory II.

*$p < 0.05$,

**$p < 0.01$.

cognitive ToM. Tchanturia et al. (2004) also found impairments in cognitive ToM in experimental and control tasks.

Contrary to our hypothesis, patients with bulimia were similar to HCs in their performance in both tasks (RME and Faux Pas Test). Thus, it can be concluded that the former have preserved their skills in ToM.

These results are in agreement with most previous studies on ToM in ED (Tchanturia et al., 2004; Russell et al., 2009; Harrison et al., 2009; Harrison et al., 2010; Oldershaw et al., 2010; Kenyon et al., 2012).

On the other hand, we found results divergent from those of Adenzato et al. (2012), who found no specific deficits in ToM in AN patients, and those of Medina-Pradas et al. (2012), who studied all subtypes of ED and found deficits only in BN and EDNOS. Adenzato et al. (2012) suggested that the discrepancy between their results and previous cited studies that found ToM deficits in AN might be due to methodological issues. Thus, they recommended that future research pay special attention to the demographic variables of participants, avoiding comparisons between samples that are not matched. We followed this recommendation. Our sample was carefully matched in demographic variables. The HC group had a BMI within the normal range and had no symptoms associated with ED. Thus, unlike their results, we observed deficits in AN in the RME task.

Moreover, Adenzato et al. (2012) investigated a group of AN patients with a short duration of illness, in order to avoid the possible effects of starvation and severe weight loss. In our study, we can say that the patients had a moderate duration of illness (the AN and BN groups were matched but had 7.4 ± 5.6 and 8.4 ± 6.8, respectively), but still, the results in ToM tasks were not correlated with this measure nor with BMI.

Our results suggest that AN patients have impairment in the reading of complex emotions and that BN patients have preserved this domain of social cognition. However, given the contrasting findings pointed out earlier, more research is needed to determine the profile of ToM deficits in ED patients, especially in BN.

On the other hand, a surprising result was that there were no differences between groups in relation to obsessive–compulsive symptoms and impulsivity, as these features are strongly associated with ED (Hoffman et al., 2013). However, a trend in results showing a greater intensity of these characteristics in ED patients may be noted.

Concerning our second hypothesis, in the AN group, the correlation analysis showed no relationship between performance in ToM tasks and clinical status. The only correlation found was between the RME and estimated IQ, which indicates the importance of this variable in the performance on this test. A recent publication by the standardization of the RME in Argentina (Román et al., 2012) showed the association of the RME with IQ. However, our results did not vary after controlling for this variable.

Given the lack of correlation between BMI, years of duration of illness, mood and anxiety symptoms, personality traits, and

performance in ToM tasks and no performance differences between those taking and not taking psychotropics, it can be concluded that the low performance in affective ToM tasks among AN patients is independent of clinical symptoms. These results are in concordance with other previous studies that found that ToM results were maintained after controlling the following clinical variables: BMI, illness duration, IQ, and levels of anxiety and depression (Russell et al., 2009); age of onset, illness duration, BMI, frequency of bulimic or compensatory behaviours, and anxious and depressive symptoms (Oldershaw et al., 2010); and age, BMI, self-esteem, and levels of depression and anxiety (Medina-Pradas et al., 2012).

It can be also concluded that the profile of difficulties in ToM is different between AN and BN patients. Further research on the effect of starvation on the brain is necessary to better understand the deficits observed, specifically in AN patients. Furthermore, more complex and ecological tests are needed in order to demonstrate subtle differences between groups.

One of the main limitations of this study is the small number of subjects in each group, which limits the possibility of generalizing the conclusions. Moreover, our sample of patients had a moderate duration of illness. Although this variable was not associated with performance in ToM tasks, it should be considered as a limiting factor due to the effects of chronic starvation and weight loss. For a future study, we are working to expand the sample to follow the recommendation of Harrison et al. (2009) to evaluate patients with a short duration of illness. Another limitation of the study is its cross-sectional nature. Longitudinal research would allow observation of the stability of deficits, that is, if they are traits that are maintained after a recovery or if they are associated with the ill state. This would clarify if the deficits in ToM can be candidates for endophenotypes for AN (Zucker et al., 2007). In any event, the present research succeeded in achieving its aims.

This work contributes to a limited literature on the sociocognitive profile in patients with ED. Besides replicating the results of most previous studies, we have deepened the characterization of participants, including measures of personality traits, impulsivity, the effects of psychotropic medications, and so on.

The findings of this research may have clinical implications in the rehabilitation of social skills in AN patients. The cognitive remediation in this disease has shown fruitful results (Abbate-Daga, Buzzichelli, Marzola, Amianto, & Fassino, 2012; Tchanturia et al., 2008). Thus, designing specific programmes to improve social skills, such as training in social perception and understanding of the mental states of others, may be beneficial in this population.

Acknowledgements

Fernanda Tapajóz is grateful to P. Harris and L. Drucaroff for useful comments and to colleagues in the Fleni Cognitive Neurology Department. Special thanks are due to M. Botta Cantcheff and C. Braga Junior for reading the manuscript and stimulating observations. The authors thank Cormillot and Fleni Institutes, Argerich and Zubizarreta Hospitals, and all the participants who took part in the study. F. T. was supported by a CONICET PhD fellowship.

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