



## Emotional theory of mind in eating disorders<sup>1</sup>

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**ABSTRACT.** The general aim of this *ex post facto* study was to investigate the emotional component of theory of mind (eToM) in a sample of 97 female patients with eating disorders (ED), considering all the diagnostic subtypes. Empirical research on this matter in ED is limited, specially focused on anorexia nervosa (AN), and results have been contradictory. The Reading the Mind in the Eyes test was administered to the patients and to 39 healthy controls. The emotional valence of the items was also examined. Patients with bulimia nervosa (BN) and ED-not otherwise specified (EDNOS) showed a poorer eToM ability compared to controls, especially in relation to positive emotions and non-emotional cognitive states. AN patients showed no differences in relation to controls. These results suggest that BN and EDNOS may show a specific pattern of difficulties inferring complex emotions, while AN patients would have no relevant difficulties in this regard. These deficits may need to be targeted in psychological treatment.

**KEYWORDS.** Theory of mind. Anorexia. Bulimia. Social cognition. *Ex post facto* study.

**RESUMEN.** El objetivo general del presente estudio *ex post facto* fue investigar el componente emocional de la teoría de la mente (eToM) en una muestra de 97 mujeres

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con trastornos de la conducta alimentaria (TCA), considerando todos los subtipos diagnósticos. La investigación empírica realizada a este respecto en los TCA es limitada, enfocada especialmente en anorexia nerviosa (AN), y los resultados encontrados han sido contradictorios. Se administró el ‘Test de los Ojos’ a las pacientes y a 39 controles sanos. La valencia emocional de los ítems también se examinó. Las pacientes con bulimia nerviosa (BN) y TCA no especificado (TCANE) mostraron una peor habilidad en eToM que las controles, especialmente en relación a las emociones positivas y a los estados cognitivos no emocionales. No se encontraron diferencias entre las pacientes con AN y el grupo control. Los resultados sugieren que las pacientes con BN y TCANE podrían mostrar un patrón específico de dificultades a la hora de inferir emociones complejas en los otros, mientras el grupo de AN no presentaría ninguna dificultad relevante. Estos déficits necesitarían ser tenidos en cuenta en el tratamiento psicológico.

**PALABRAS CLAVE.** Teoría de la mente. Anorexia. Bulimia. Cognición social. Estudio *ex post facto*.

Human social cognition refers to those psychological processes that allow us to make inferences about what is going on inside other people’s mind –their intentions, emotions, and beliefs (Adolphs, 2009). The ability to judge the own and other people’s mental states is referred to as «theory of mind» (ToM) (Leslie, 1987; Premack and Woodruff, 1978). The most extensive ToM studies have been carried out in the field of autism and developmental disorders, brain damage, and schizophrenia. Recently, these studies have been extended to other mental disorders (Brüne and Brüne-Cohrs, 2006; Uekermann and Daum, 2008) and normal aging (Happé, Winner, and Brownell, 1998; Maylor, Moulson, Munces, and Taylor, 2002). Altogether, the literature suggests that impairments of ToM probably have multiple causes and are not specific to a single disorder or psychopathological aspect.

Two major components of ToM have been described (Tager-Flusberg and Sullivan, 2000). On the one hand, the «social-affective» component –emotional ToM (eToM) involves the ability to decode others’ mental states according to immediately available observable information. On the other, the «social-cognitive» component –cognitive ToM (cToM), involves the ability to reason about mental states with the aim of explaining or predicting the actions of others. Both eToM and cToM involve inferring complex mental states and are based on a brain circuitry involving frontal and temporal lobes (Platak, Keenan, Gallup, and Mohamed, 2004).

ToM, especially eToM, is considered crucial in social relationships (Couture, Penn, and Roberts, 2006), as it is essential for guiding the own behaviour and regulating the own emotional states in the social context (Roncone *et al.*, 2002). It also can be seen as a basis of empathy, trust, and prosocial behaviour (Marsh and Ambady, 2007). Misinterpretations due to an impaired ToM may yield emotional disturbances, inadequate social behaviour, and impaired social functioning in psychopathological conditions. In patients with eating disorders (ED), emotional disturbances and social-emotional isolation are very common (*c.i.* Borda *et al.*, 2011; Kyriacou, Easter, and Tchanturia, 2009;

Pascual, Etxebarria, Cruz, and Echeburúa, 2011; Zaitssof, Fehon, and Grilo, 2009) and recently eToM has emerged as a putative core issue for these patients (Schmidt, Oldershaw, and van Elburg, 2011).

Only a few studies have specifically explored whether eToM is impaired in ED, and the majority have focused merely on anorexia nervosa (AN). All these studies were performed by the same research team and used the Reading the Mind in the Eyes test (RME; Baron-Cohen, Wheelwright, Hill, Raste, and Plumb, 2001) to measure eToM. Russell, Schmidt, Doherty, Young, and Tchanturia (2009) showed that AN patients performed worse than healthy controls (HC), independently of illness severity (body mass index (BMI), illness duration, levels of anxiety or depression). However, they found a slight and positive association between eToM and global functioning. This study found that patients were also impaired at non-ToM control elements, suggesting that AN patients may show a global cognitive deficit rather than poor eToM *per se*. Harrison, Sullivan, Tchanturia, and Treasure (2009) also found that AN patients (especially those with emotion regulation problems) had difficulties with eToM relative to controls. Harrison, Sullivan, Tchanturia, and Treasure (2010) found that restrictive AN patients showed poorer eToM ability than HC while purgative AN and bulimia nervosa (BN) patients did not. While these results remained after controlling for BMI, antidepressant medication, anxiety and depression, eating symptoms did correlate negatively with eToM ability. Oldershaw, Hambrook, Tchanturia, Treasure, and Schmidt (2010) demonstrated that AN patients had difficulties in reading emotions from others' voices or film clips in relation to HC. In contrast, they found no group differences when the task consisted of inferring complex emotions from others' eyes. Furthermore, they considered the emotional valence of the items and concluded that AN patients were significantly poorer than HC at reading positive or negative emotions (*e.g.* relieved, worried), but no differences emerged when reading neutral/cognitive mental states (*e.g.* suspicious). In a recent review, Oldershaw *et al.* (2011) reported a large standard effect size for complex emotion recognition problems in AN relative to HC, although just based on three of the cited studies.

In sum, there is scarce literature about the eToM ability of ED patients and the results of the studies are contradictory and mainly focused on AN. Therefore, the general aim of the present study was to determine the status of eToM in ED patients. The specific aims were: a) to study the eToM ability of female inpatients with ED in relation to a HC group, b) to explore eToM differences according to specific ED diagnosis (AN, BN, ED not otherwise specified -EDNOS), and c) to examine differences in reading emotions with a different valence (positive, negative or cognitive non-emotional states) by ED subtype. While conducting this study, the recommendations of Ramos-Álvarez, Moreno-Fernández, Valdés-Conroy, and Catena (2008) were taken into account. Due to the lack of clear results in the literature, our hypotheses were exploratory.

## Method

### *Participants*

Ninety-seven female patients with ED (44 AN, 30 BN, 23 EDNOS) were recruited from an inpatient ED specialist centre (Eating Disorders Institute, Barcelona, Spain). We used a non-probabilistic sampling method, the consecutive sampling schema, incorporating to the study all the eligible cases who agree to participate. All patients met DSM-IV-TR criteria for ED (American Psychiatric Association, 2002). Exclusion criteria were neurological or severe somatic disease that could interfere with the diagnosis, psychosis, evidence of current substance dependence, or moderate to severe learning difficulties. The HC group consisted of 39 female healthy volunteers, with no history of psychiatric or neurological disorders, and no irregularities in their eating behaviour. Informed, voluntary, and written consent was obtained from all the participants, following the ethical principles for medical research involving human subjects of the Declaration of Helsinki.

### *Measures*

- Reading the Mind in the Eyes Task (RME): The RME (Baron-Cohen *et al.*, 2001) is a measure of complex emotional recognition or ‘mentalising’, which involves putting oneself in the other’s place. It was first used as an advanced ToM task in adults by Baron-Cohen, Jolliffe, Mortimore, and Robertson (1997) and was adopted to test its emotional component. It consists of 36 items. For each item, the participants see a photograph of a pair of eyes displaying a complex mental state. They must select (from a target and three foils) which word best describes the mental state reflected by the eyes. Participants have unlimited time to decide and a glossary is provided. While not dynamic or whole faces, these stimuli provide some ecological validity by using real eyes. The Spanish version of this test was translated by Perez-Sayes, Luna, and Tirapu (Ubarmin Clinic, Brain Injury Unit, Pamplona, Spain) in collaboration with the Autism Research Centre (Cambridge, UK, [www.autismresearchcentre.com](http://www.autismresearchcentre.com)). Normative data are reported in Baron-Cohen *et al.* (2001). Hallerbäck, Lugnegard, Hjärthag, and Gillberg (2009) demonstrated the test-retest reliability of the RME test. The RME has two different scores: a) overall accuracy (percentage of correct items -RME total accuracy) (Baron-Cohen *et al.*, 2001), and b) valence accuracy (accuracy for positive, negative and neutral/cognitive states) (Oldershaw *et al.*, 2010).
- Clinical assessment: The Structured Clinical Interview for DSM-IV Mental Disorders (SCID-I; First, Spitzer, Gibbon, and Williams, 2002) was administered to assess the presence of psychiatric disorders. The State-Trait Anxiety Inventory (STAI; Spielberg, Gorsuc, and Lushene, 1982) was administered to measure anxiety, the Beck Depression Inventory (BDI-II; Beck, Steer, and Brown, 1996; Sanz, García, Espinosa, Fortún, and Vázquez, 2005) was administered to measure depressive symptoms, and the Rosenberg Self-esteem Scale (RSS; Rosenberg,

1965; Vázquez, Jiménez, and Vázquez-Morejón, 2004) was administered to assess self-esteem.

### *Procedure*

Demographic details were collected by self-report questionnaire, as well as the RME, the STAI, the BDI-II, and the RSS. Participants' weight and height were measured to calculate BMI. Weight and height measurements and the clinical and psychometric assessment were conducted at our centre. The data were collected from August 2008 to June 2010. Patients were tested during the two weeks after admission. The SCID-I was administered by trained clinical psychologists to assess for the presence of psychiatric disorders at the time of admission. Healthy control females were recruited through advertisements in a local newspaper and screened for history of psychiatric disorders by means of the SCID-I and prior to the assessment.

### *Data analysis*

This is an *ex post facto* study (Montero and León, 2007) of eToM in ED patients and HC. In general, group (ED patients *versus* healthy controls) was analyzed as an independent variable and eToM ability as a dependent variable.

The percentage of success was calculated for both all the items (RME total accuracy) and each type of emotion valence (valence accuracy). Normal distributions were identified for the generated variables and other demographic and quantitative clinical measurements by using the Kolmogorov-Smirnov test.

Group differences in demographic and clinical measurements were examined by using chi-squared and one-way analysis of variance with Scheffé post-hoc comparisons when necessary.

Means and standard deviations for each ED subtype versus controls were calculated in order to analyse the differences in RME accuracy between patients and controls or among ED subtypes. Oldershaw *et al.* (2011) suggested for future studies that duration of the disorder, BMI, level of depression, anxiety or self-esteem could have an effect on eToM ability. According to their recommendations, in the present study we analysed age, BMI, BDI, STAI (trait and state) and RSS scores as potential confounding variables by means of separate multiple linear regression models. These analyses were conducted both for RME total accuracy and emotion valence accuracy. Following the proposal by Kleinbaum, Kupper, Mulle, and Nizam (1998), the need to adjust the estimations with control variables was verified. According to Maldonado and Greenland (1993), a difference greater than 10% in the estimation of RME total accuracy or valence accuracy differences between regression models with and without the adjusting term was considered. The effect size in these adjusted comparisons is given by calculating the 95% confidence intervals and by the adjusted Cohen's *d*.

Although the number of statistical tests is superior to that allowed to fix the type I error at the usual 5%, no corrections were made because of the exploratory nature of our research and because they could hide some incipient relationships that could be confirmed in subsequent research.

## Results

### Demographic and clinical data

Table 1 shows the statistics for age, education, BMI, duration of illness, and mean scores in the clinical measurements by group. No statistically significant group differences in age or duration of the disorder were evident. EDNOS patients showed the statistically highest BMI, followed by BN and HC groups, which did not differ among them, and AN patients, who showed the statistically lowest BMI. All patient groups showed higher BDI and STAI (State and Trait) scores, as well as lower RSS scores than HC. Concerning education, chi-squared analyses revealed no statistically significant differences among clinical groups, and statistically significant differences between ED groups and HC. The HC group showed higher education level than ED patients. Then, all the analyses were also adjusted for education level.

**TABLE 1.** Demographic and clinical characteristics of the sample ( $N = 136$ ).

	AN ( $n = 44$ )		BN ( $n = 30$ )		EDNOS ( $n = 23$ )		HC ( $n = 39$ )		ANOVA		Post hoc
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i> ( <i>df</i> )	<i>p</i>	
Age	26.80	5.70	26.80	6.10	26.02	8.20	26.04	14.70	.03 (2,132)	.99	-
Education	1 (%) 54.50		58.60		65.20		7.70		29.60	<.001	HC>(AN=BN=EDNOS)
	2 (%) 45.50		41.40		34.80		92.30				
BMI	15.80	1.70	20.90	2.60	25.80	8.30	21.30	2.10	35.50 (2,132)	<.001	AN<(BN=HC)<EDNOS
Duration of illness	9.90	6.60	10.30	5.20	7.30	6.40	---	---	1.77 (2,132)	.18	-
BDI	21.20	12.70	25.30	13.90	28	12.50	3.40	3.30	33.80 (2,132)	<.001	HC<(AN=BN=EDNOS)
STAI-S	28.50	15.80	34.50	12	30.10	16.90	12.20	6.20	19.60 (2,132)	<.001	HC<(AN=BN=EDNOS)
STAI-T	29.30	14.50	34.80	12.70	35.70	16.10	14.30	7.70	20.10 (2,132)	<.001	HC<(AN=BN=EDNOS)
RSS	22.70	6	23.30	5.20	21	6.90	33.30	4	36.80 (2,132)	<.001	HC>(AN=BN=EDNOS)

*Note:* AN: anorexia nervosa; BN: bulimia nervosa; EDNOS: eating disorder non-specified; HC: healthy controls; *M*: mean; *SD*: standard deviation; *df*: degrees of freedom; 1: primary or secondary school; 2: professional school or college or postgraduated; BMI: body mass index; BDI: Beck Depression Inventory-II; STAI-S: State Anxiety Inventory; STAI-T: Trait Anxiety Inventory; RSS: Rosenberg Self-esteem Scale.

Chi-square with 2 degrees of freedom.

### *eToM ability (total and valence accuracy) of patients with ED as a whole*

Table 2 shows the results of comparing RME scores of ED patients as a whole and HC. In general, ED patients showed lower RME scores than HC, but statistically significant differences emerged only in the total accuracy score and in the cognitive/neutral states (valence accuracy). The magnitude of the differences was considerable. The magnitude of the differences between ED and HC groups as regards valence accuracy positive and negative emotions was moderate.

**TABLE 2.** eToM (RME scores) in patients with ED (*n* = 97) and HC (*n* = 39).

RME	Groups	% Correct answers		Adjusted mean difference (vs. HC)			
		<i>M</i>	<i>SD</i>	Value	<i>P</i>	95% CI	Cohen's <i>d</i>
Overall Accuracy							
Total <sup>a</sup>	HC	75.60	7.60	-7	.005	-11.90 to 2.20	.64
	ED	67.50	12				
Valence Accuracy							
Positive emotions <sup>b</sup>	HC	78.90	13.90	-4.90	.14	-11.50 to 1.70	.33
	ED	72.10	15				
Negative emotions <sup>c</sup>	HC	72.30	11.90	-2.90	.53	-11.90 to 6.10	.19
	ED	65.20	16.30				
Cognitive/neutral states <sup>d</sup>	HC	76.30	12.40	-10.50	.01	-18.80 to -2.10	.59
	ED	64.60	19.70				

Note: eToM: Emotional Theory of Mind; RME: Reading the Mind in the Eyes; HC: Healthy controls; ED: eating disorders; *M*: mean; *SD*: standard deviation; n.s.: non significant.

<sup>a</sup> Mean difference adjusted by Body Mass Index and educational level. *p* value for *t*-test with 132 degrees of freedom.

<sup>b</sup> Mean difference adjusted by Anxiety-state and educational level. *p* value for *t*-test with 132 degrees of freedom.

<sup>c</sup> Mean difference adjusted by Age, Body Mass Index, Self-esteem, Depression, and educational level. *p* value for *t*-test with 128 degrees of freedom.

<sup>d</sup> Mean difference adjusted by Anxiety-trait and educational level. *p* values for *t*-test with 132 degrees of freedom.

*eToM ability (total and valence accuracy) according to ED diagnosis*

Table 3 shows the estimated differences in the RME according to the specific ED diagnosis (AN, BN, EDNOS) in relation to HC. Statistically significant differences were found in RME overall accuracy (total) for BN and EDNOS patients in comparison to HC, with a large magnitude of the differences.

Concerning valence accuracy, BN patients showed a statistically significant lower score than HC when they read positive emotions and cognitive/neutral states. The EDNOS group also exhibited statistically significant poorer scores in cognitive/neutral states than HC. They also tended to show poorer scores in positive emotions (magnitude of the differences moderate). The AN group showed no statistically significant differences in relation to HC.

**TABLE 3.** eToM in the specific ED diagnoses (AN:*n* = 44, BN:*n* = 30, EDNOS:*n* = 23) and HC (*n* = 39)

RME	Groups	% Correct answers		Adjusted mean difference (vs. HC)			
		<i>M</i>	<i>SD</i>	<i>Value</i>	<i>p</i>	95% <i>CI</i>	<i>Cohen's d</i>
Overall Accuracy							
Total <sup>a</sup>	HC	75.60	7.60	-	-	-	
	AN	69.10	9.30	-3	.33	-9 to 3	.19
	BN	66.40	14.90	-8.70	.004	-14.50 to -2.80	.77
	EDNOS	66.10	12.60	-10.60	.002	-17.30 to -4	1.09
Valence Accuracy							
Positive emotions <sup>b</sup>	HC	78.90	13.90	-	-	-	
	AN	74.30	12.40	-5.10	.21	-13.20 to 2.90	.39
	BN	71	17.90	-8	.049	-16 to -.01	.51
	EDNOS	69.20	15.40	-8.40	.07	-17.40 to .62	.58
Negative emotions <sup>c</sup>	HC	72.30	11.90	-	-	-	
	AN	65.90	15.80	-.70	.89	-10.80 to 9.30	.05
	BN	63.60	17.30	-6.20	.22	-16.10 to 3.80	.43
	EDNOS	65.80	16.60	-7.90	.16	-18.90 to 3.20	.57
Cognitive states <sup>d</sup>	HC	76.30	12.40	-	-	-	
	AN	66.50	16.60	-2.20	.71	-14 to 9.50	.16
	BN	64.20	24.70	-11.10	.04	-22.10 to -2.0	.59
	EDNOS	61.40	18	-18.90	.003	-31.40 to -6.40	1.29

Note: eToM: Emotional Theory of Mind; RME: Reading the Mind in the Eyes; AN: anorexia nervosa; BN: bulimia nervosa; EDNOS: eating disorder non-specified; *M*: mean; *SD*: standard deviation.

<sup>a</sup> Mean difference adjusted by Age, Body Mass Index and educational level. *p* value for *t*-test with 129 degrees of freedom.

<sup>b</sup> Mean difference adjusted by Body Mass index and educational level. *p* value for *t*-test with 130 degrees of freedom.

<sup>c</sup> Mean difference adjusted by Age, Body Mass Index, Self-esteem, Depression, Anxiety-trait, -state and educational level. *p* value for *t*-test with 125 degrees of freedom.

<sup>d</sup> Mean difference adjusted by Body Mass Index, Self-esteem and educational level. *p* value for *t*-test with 129 degrees of freedom.

## Discussion

This study aimed to investigate eToM ability in 97 adult women with ED by means of the RME test. ED patients in general, and BN and EDNOS patients in particular, showed poorer eToM ability in comparison to HC regarding overall accuracy and emotionally neutral cognitive states. The BN group also had more difficulties in reading positive emotions than HC. In contrast, ED patients in general and HC did not differ when reading negative emotions. The AN group showed no differences in the RME (overall or valence accuracy) in relation to HC.

BN patients had more difficulties reading positive emotions and emotionally-neutral states relative to controls, but they did not show impairments regarding negative emotions. These results are dissimilar to those found in the only previous study that examined eToM in BN patients, *i.e.* Harrison *et al.* (2010), who found no significant



impairments in BN patients when inferring facial emotions. Our results suggest that BN patients may show impairment in the reading of complex emotions, so more research is needed to corroborate these results. Some studies suggest that disordered eating is used to regulate affect (Cooper, Wells, and Todd, 2004; Waller, Kennerley, and Ohanian, 2004). In particular, Krystal (1977) postulated that somatic strategies such as bingeing or purging may be used to regulate emotion. According to this author, bulimic behaviours involve a strategy of cognitive avoidance of ego threats. Meyer *et al.* (2005) also found that BN patients displayed this strategy, unlike those with AN. Rieger *et al.* (1998) found that BN patients avoided positive –not negative, emotional stimuli. As well, people with BN seem to identify more negative emotions than AN (Joos, Cabrillac, Hartmann, Wirsching, and Zeeck, 2009; Wolf, Sedway, Bulik, and Kordy, 2007) and use more emotionally negative descriptions (Smith, Amner, Johnsson, and Franck, 1997). Therefore, the poor ability of BN patients to make inferences about other people's positive emotions could be understood as an extension of their reduced capacity to experience their own positive sensations and their heightened sensitivity to negative emotions.

Regarding neutral/ cognitive states, all patients, especially BN and EDNOS showed an impaired ability to read them. Pollatos, Herbert, Schandry, and Gramann (2008) suggested that these patients do great efforts to search for and assign an emotion even when not present. Smith *et al.* (1997) demonstrated that ED patients used more emotional words and gave more vague or contradictory responses to describe a neutral face than healthy controls. Therefore, it seems that ED patients have difficulties to assume the neutrality of some situations or cognitive states in others, so they often find an emotional connotation. Considering their negative bias, we believe that the emotional connotation that they find in others' neutral states may be negative. However, this issue still remains unknown. To ascertain the type of emotion or state that ED patients perceive when they fail to infer a specific emotion would be very interesting for understanding their social behaviour. Our group is currently addressing this issue in a parallel study (Medina-Pradas, Navarro, Grau, and Obiols, 2012). This biased pattern of emotional recognition in ED patients, especially BN and EDNOS should be taken into account in clinical practice given the role of emotional recognition in emotional self-regulation, social relationships and self-concept (*f.i.* Harrison *et al.*, 2009).

AN patients showed no differences in relation to controls when reading complex emotions in others. The present results agree with Oldershaw *et al.* (2010) and Kucharska-Pietura, Gowda, and Midwinter (2009), who also failed to find RME deficits in AN. However, our findings are inconsistent with two of the previous studies, which did find a poor RME performance in AN (*i.e.*, Harrison *et al.*, 2009, 2010; Russell *et al.*, 2009). Considering the emotional valence of the items, we did not identify differences between AN and controls either. Oldershaw *et al.* (2010) also found no differences regarding neutral stimuli. However, they found poorer performance in AN patients concerning positive and negative emotions. The same inconsistencies are found in studies addressing facial recognition of basic emotions in AN. Thus, some authors identify an impairment in the recognition of specific basic emotions (positive and negative, Kucharska-Pietura, Nikolaou, Masiak, and Treasure, 2004; neutral and negative, Pollatos *et al.*, 2008) while others find no differences according to the emotional valence of basic emotions (Jänsch,

Harmer, and Cooper, 2009). Therefore, no clear conclusions can still be drawn on this matter. More research is needed to determine the eToM performance of AN patients.

The present findings were adjusted for age, levels of depression, self-esteem, anxiety, and BMI. In agreement with our results, Bydlowski *et al.* (2005) emphasized that emotional recognition deficits in ED, particularly in AN, seemed to be independent of depression. Russell *et al.* (2009) and Oldershaw *et al.* (2010) also showed that eToM performance was independent of AN severity indexes or related psychopathological aspects. Therefore, these results suggest that eToM deficits in ED are specifically linked to the eating disorder itself. Nevertheless, other studies found that emotional recognition deficits in ED were mediated by depression and anxiety (Gilboa-Schechtman, Avnon, Zubery, and Jeczmiem, 2006; Kucharska-Pietura *et al.*, 2004; Mendlewicz, Linkowski, Bazelmans, and Philippot, 2005). Interestingly, our results did not vary after adjusting for educational level either. In this regard, Baron-Cohen (1991) showed that deficits in mental state comprehension were selective, *i.e.*, other cognitive capacities ('non-social' intelligence) may well be preserved with an impaired ToM.

This study has some shortcomings. First, we did not take into account intelligence to match the clinical and control groups, although an indication of the educational level was provided instead. Second, the RME test is based on standardized static pictures of eyes. Social interaction in everyday life is much more complex and dynamic, and people normally rely on several sensory modalities when evaluating the emotional state of others. Future research should examine the eToM ability of ED patients in more complex and ecologically valid scenes. Trying to maximize ecological validity, our group investigated how ED patients perceive their key relatives' negative and positive affect towards them (Medina-Pradas, Navarro, López, Grau, and Obiols, 2011). Interestingly, a similar (negatively biased) perceptual pattern was found, which gives support to the present findings.

The present study has also some strengths such as the inclusion of the three main ED subtypes (*i.e.*, AN, BN and EDNOS), as well as reasonable sample sizes. Furthermore, we investigated the emotional valence of the items, which is crucial to understand the emotional behaviour of ED patients. All these contributions represent an addition to the literature.

Despite the importance of the problems associated with an impaired eToM, especially social-emotional isolation, the literature in this area is limited for ED. Future research recommendations include to address specific psychopathological dimensions in order to develop more precise treatments according specific symptoms. Set-shifting ability should also be explored, as its impairment in ED (Roberts, Tchanturia, Stahl, Southgate, and Treasure, 2007) may involve emotional rigidity during eToM performance in these patients (Tchanturia, Campbell, Morris, and Treasure, 2005). Similarly, whether experimental findings reflect state or trait eToM deficits in ED should also be examined. These potential studies would help to delineate the social cognitive endophenotypes in ED (Zucker *et al.* 2007).

Regarding clinical implications of the present results, we must consider the important social, familiar and personal consequences of a ToM deficit (*e.g.* Roncone *et al.*, 2002). Building skills in emotion functioning may enable the patient to feel more confident

about social interaction and reduce isolation, and to become aware of their pattern of emotion perception. In this regard, interventions such as dialectical-behavioural therapy (Linehan, 1993) or mentalisation-based therapy (Bateman and Fonagy, 2004; Fonagy and Bateman, 2006) may be of benefit for ED patients with impairments in eToM.

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