Psychiatry Research 229 (2015) 887–894

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Emotional reactivity to social stimuli in patients with eating disorders

Fernanda Tapajóz P. de Sampaio [a,b,d,*], Sebastian Soneira [c], Alfredo Aulicino [d], Paula Harris [a,b], 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

ARTICLE INFO

Article history:
Received 27 November 2014
Received in revised form
31 May 2015
Accepted 17 July 2015
Available online 17 July 2015

Keywords:
Anorexia
Bulimia
Social cognition
Emotion induction
Emotional processing

ABSTRACT

Patients with eating disorders often display a wide range of difficulties in psychosocial functioning. Most of the studies on this subject have focused on theory of mind; however, little is known about the subjective emotional reactivity of patients to social situations. The aim of this study was to evaluate the patients' perceptions of their own emotions when viewing pictures with social content. Emotional reactivity was assessed in 85 women (29 with anorexia nervosa, 28 with bulimia nervosa, and 28 healthy controls) by using 30 images from the International Affective Picture System. Images were divided into categories based on its social content and its emotional valence. The emotional response was evaluated through the Self-Assessment Manikin. Patients with bulimia nervosa presented higher arousal and lower control when viewing images with social content of pleasant, unpleasant, and neutral valence. Patients with anorexia nervosa reported higher arousal and lower control only for social images with neutral valence. There were no differences between groups for the control images. The finding of specific differences in emotional reactivity to pictures with social content contributes to a more accurate understanding of the difficulties of patients in social situations.

1. Introduction

Patients with anorexia nervosa (AN) and bulimia nervosa (BN) show difficulties in socio-emotional processing (Schmidt and Treasure, 2006; Russell et al., 2009; Oldershaw et al., 2011; Treasure and Schmidt, 2013), that are associated with the development and maintenance of the illness and usually imply a poorer prognosis (Zucker et al., 2007). Impaired social functioning has been mentioned among the original descriptions of the symptomatology of eating disorders (ED) (Pearce, 2004). Social phobia, relationship difficulties within the family, poor socialization skills, fear and avoidance of intense emotions and unrealistic social expectations are some of the features that have been widely observed in ED patients (Kaye et al., 2004; Schmidt et al., 1997; Godart et al., 2004; Tiller et al., 1997; Daley et al., 2008; Button et al., 1996).

Recently, there has been increased interest in the socio-emotional difficulties present in patients with ED. Most of the studies on this subject have focused mainly on one aspect of the social cognition, namely, theory of mind. Theory of mind (ToM) refers to the ability to attribute mental states to oneself and other people (Premack and Woodruff, 1978). In the majority of these studies, deficits in ToM have been observed in patients with AN and BN (Russell et al., 2009; Medina-Pradas et al., 2012; Tapajóz P. de Sampaio et al., 2013a). EDs have also been associated with the concept of alexithymia, a disturbance that affects emotional processing, which results in the inability to adequately express emotions and feelings (Bydlowski et al., 2005; Courty et al., 2015). Another aspect of the emotional difficulties presented across the whole spectrum of ED, that play an important role in the development and maintenanceof these disorders, is the emotional dysregulation (Harrison et al., 2010a; Lavender et al., 2014; Brockmeyer et al., 2014).

Despite the growing body of research that has been conducted on the socio-emotional aspects of EDs (Oldershaw et al., 2011), few studies have focused on the characterization of the emotional reactivity of patients to social situations. We use the term emotional reactivity to refer to a brief emotional response to environmental stimuli (Henry et al., 2012). To date, the subjective emotional response of patients with EDs to their social environment remains

* Corresponding author at: Department of Cognitive Neurology, Neuropsychology and Neuropsychiatry, Instituto de Investigaciones Neurológicas Raúl Carrea-FLENI, 8th Floor, Montañeses 2325, C1428AQK Buenos Aires, Argentina. Fax +54 11 5777 3209.
E-mail address: fetapajoz@hotmail.com (F. Tapajóz P. de Sampaio).

http://dx.doi.org/10.1016/j.psychres.2015.07.049
0165-1781/

an open question.

According to Lang et al. (1999), affective processing can be better understood following a dimensional model. They proposed the existence of three basic dimensions of bipolar type around which the emotional response can be organized: (a) *affective valence* ranging from "pleasant" to "unpleasant," (b) *arousal or activation* with poles from "activated" to "calm" and (c) *control*, ranging from "in control" to "controlled by emotions." In order to test their hypothesis they developed an instrument capable of assessing these dimensions, the Self-Assessment Manikin (SAM) (Bradley and Lang, 1994).

A particularly important aspect of the emotional response to be considered, is the level of arousal that individuals experience when faced with social stimuli. In the autism literature, it has been proposed that the atypical behavioral responses to social situations, especially alterations in eye contact seen in patients suffering from Autism Spectrum Disorders (ASD), could be caused by an abnormal level of arousal being experienced in reaction to the social environment (Senju and Johnson, 2009; Mathersul et al., 2013; Louwerse et al., 2014).

In some neuropsychiatric disorders other than autism, differences have been observed in the level of arousal to emotional stimuli. Patients with schizophrenia judged aversive pictures with social content as less arousing than did healthy controls (HC) (Aminoff et al., 2011). In patients with bipolar disorder, a higher intensity of arousal compared with that in HCs, has been observed regardless of the valence of the stimuli (M'Bailara et al., 2012). Nevertheless, in a previous study, it has been found more arousal than HCs when confronted with neutral images (M'Bailara et al., 2009). On the other hand, patients with major depressive disorder presented reduced emotional reactivity to both positively and negatively valenced stimuli (Bylsma et al., 2008).

To our knowledge, few studies in the field of eating disorders have specifically assessed the subjective level of arousal in reaction to social stimuli. Zonnevylle-Bender et al. (2005) examined self-reported emotional arousal and neurophysiologic variables, like heart rate and Hypothalamic–Pituitary–Adrenal (HPA) axis responses to psychosocial stress, in a group of 10 AN patients compared with 22 HCs, through a public speaking test designed to induce an anxious stress. They found that AN patients presented higher levels of anxiety due to stress but this was not reflected in their neurophysiologic response. The HC group reported higher levels of self-reported anxiety, which were consistent with increases in their neurophysiologic responses. These results show a discrepancy between the recognized emotion and the corresponding physiologic arousal in AN patients.

Some studies have examined other aspects of the socio-emotional processing by using different paradigms of visual stimuli (Oldershaw et al., 2011). Joos et al. (2009) assessed the existence of deficits in socio-emotional processing with the use of stimuli from the International Affective Picture System (IAPS). The images were selected to show emotions such as fear, anger, sadness and happiness. Compared with healthy controls, patients with restrictive AN showed an increased fear reaction when confronted with stimuli containing anger, whereas BN patients presented a tendency toward decreased fear. No other differences in emotional perception were observed.

Harrison et al. (2010a) assessed attentional biases toward social stimuli (pictures with faces) versus nonsocial stimuli (e.g., chairs) through an emotional Stroop task among patients with AN, patients with BN, and HCs. They found that ED patients had greater attentional bias in color naming for social stimuli. They also had greater bias toward angry faces than toward neutrals. In a subsequent study with the same paradigm, Harrison et al. (2010b) also observed a significantly higher attentional bias for social and anger-threat stimuli in patients recovered from AN compared with HCs, which suggests that this bias may be a trait of AN.

In an experimental study on facial expression and subjective experience of emotion induced through film clips (positive, negative and neutral), Davies et al. (2011) found that AN patients were less facially expressive than HCs in response to positive and negative stimuli, and report feeling less positive emotion but the same level of negative emotion relative to HCs. The authors also found that AN patients looked away significantly more during the negative film clip, as an attempt to avoid a negative feeling. In a posterior study using the same paradigm in adolescents with AN, Rhind et al. (2014) also found that patients presented less facial affect than HCs, although no differences in subjective emotion experience was reported. In AN recovered patients, it was observed that attenuated facial affect was less marked (Davies et al., 2013).

In summary, the subjective emotional experience of eating disorders patients when faced with social stimuli, is yet to be explored, despite the existence of studies that have evaluated various aspects of social processing, such as recognition (Jänsch et al., 2009; Pollatos et al., 2008) and expression of emotions (Davies et al 2011, 2013; Rhind et al., 2014), attentional biases (Harrison et al., 2010a, 2010b), theory of mind (Tchanturia et al., 2004; Russell et al., 2009; Oldershaw et al., 2010; Medina-Pradas et al., 2012; Tapajóz P. de Sampaio et al., 2013a, 2013b), emotional regulation (Harrison et al., 2010a; Lavender et al., 2014; Brockmeyer et al., 2014) and social anhedonia (Tchanturia et al., 2012; Harrison et al., 2014).

The study of the emotional subjective reactivity to social pictures may help to better understand the mechanisms associated with social difficulties and is a significant issue considering that the subjectivity have been somewhat neglected over the last decades (Barrett et al., 2007; Treasure, 2012). From our perspective, to assess the subjectivity of an individual regarding his emotional experiences provides a richer, accurate and customized picture of what's going on in their inner world. Moreover, according Tchanturia et al. (2015), more studies about emotional processing in ED are necessary, especially on the effect of affective valence in emotional processing. On the other hand, as mentioned by M'Bailara et al. (2012), the ability of patients to respond to external stimuli is a critical issue because it directly involves their ability to adapt to the environment.

In previous studies, we have observed that patients with AN show difficulties when performing theory of mind tasks (Tapajóz P. de Sampaio et al., 2013a) and that this difficulties are related to weak central coherence (Tapajóz P. de Sampaio et al., 2013b). Our main motivation for this work was to extend our research to other aspects of social cognition. Rather than to analyze the ability of patients to understand the mental states of others, our goal was to study how these patients feel when observing images with social content. In fact, the aim of the present work was to empirically evaluate the emotional reactivity (valence, arousal, and control) of patients with eating disorders when viewing pictures with social content. A secondary objective was to explore a possible association between emotional response and psychopathologic profile.

In view of the lack of previous studies that specifically assess the level of subjective reactivity of patients with EDs when viewing social images, but based on consistent reports about difficulties in other domains of social cognition (Oldershaw et al., 2011), and on solid evidence of higher levels of alexithymia, inhibition and emotional avoidance in patients with anorexia nervosa (Courty et al., 2015; Lawson et al., 2008; Wildes et al., 2010), our hypothesis was that, when confronted with social images, AN patients might present an emotional reactivity profile consisting in underarousal and overcontrol in comparison with HCs. On the other hand, patients with BN usually show higher rates of impulsivity and emotional dysregulation (Anestis et al., 2009;

Harrison et al., 2010a; Lavender et al., 2014; Brockmeyer et al., 2014). Therefore, It was hypothesized that BN patients would present an emotional reactivity profile that consists in hyperarousal and undercontrol in comparison to HC participants.

2. Methods

2.1. Ethics statement

This study was approved by the bioethics committees of Hospital General Cosme Argerich, Hospital General Abel Zubizarreta, and Instituto "Dr. Cormillot." Written informed consent was obtained from all participants, and written parental consent was requested for participants below 18 years of age.

2.2. Participants

The sample included 85 female participants between 16 and 44 years of age who were grouped as follows: the AN group ($n=29$) consisted of 8 individuals with the restrictive subtype, 1 with the binge-purge subtype, and 20 with ED not otherwise specified (EDNOS) AN type; the BN group ($n=28$) consisted of 21 participants with the purging subtype, 2 with the non-purging subtype, and 5 with the EDNOS BN type; and the HC group ($n=28$) consisted of female healthy controls properly matched by age and education. All patients were diagnosed by a senior psychiatrist specialized in EDs of every participating center according to the DSM-IV diagnostic criteria (American Psychiatric Association, 2000). Patients were recruited from the Section of Eating Disorders at Hospital General Cosme Argerich, Hospital General Abel Zubizarreta and Instituto "Dr. Cormillot" in Argentina.

The exclusion criteria for both clinical groups included any type of developmental disorder, bipolar disorder, psychosis spectrum disorder, and organic brain syndrome or substance dependence. For the healthy controls group an additional exclusion criterion was the presence of any kind of eating disorder as measured by the EDI-II drive for thinness subscale, in which the scores should be below the cutoff point of 14. According to the EDI-II manual, a cutoff point of 14 on this subscale is suggested for screening purposes (Garner, 1998). Furthermore, HC participants were excluded from the study if they had a body mass index (BMI=kg/m^2) outside the normal range (18.5–24.9) established by the World Health Organization.

The HCs included hospital staff, university personnel, colleagues in other institutions, and members of the local community.

2.3. Measures

2.3.1. Clinical measures

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

Beck Depression Inventory (BDI) (Beck et al., 1961, 2006): This 21-question multiple-choice self-report inventory assesses the presence and severity of symptoms of depression.

State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1982): This is 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): This is an 18-item self-report measure of symptoms of obsessive–compulsive disorder (OCD) in six dimensions: checking, washing, ordering, hoarding, obsessing, and neutralizing.

Barratt Impulsiveness Scale (BIS-11) (Barratt, 1985; Oquendo et al., 2001): This is a 30-item self-reported scale that assesses impulsivity. The items are grouped into four subscales: cognitive, motor, unplanned, and total impulsiveness.

Eating Disorder Inventory II (EDI-II) (Garner, 1998; Rutsztein et al., 2006): This is a 91-item inventory that evaluates the symptoms and psychological characteristics of eating behavior disorders. It consists of 11 subscales: drive for thinness, bulimia, body dissatisfaction, perfectionism, interpersonal distrust, social insecurity, interoceptive awareness, ineffectiveness, maturity fears, asceticism, and impulse regulation. In this research, we report only on the total score (the sum of all subscales) and the first subscale (drive for thinness).

To determine the estimated IQ, all participants were asked to complete the Word Accentuation Test - Buenos Aires version.

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

2.3.2. Experimental measures

International Affective Picture System (IAPS) (Lang et al., 1999): this database consists of a set of photographs that are considered valid and reliable for the experimental study of emotional perception. For this study, we selected 30 color pictures, 2 of which were used as examples and 28 as target stimuli. The pictures were selected based on social content (at least one human being) and emotional valence (pleasant, neutral, and unpleasant) and were divided into three stimuli groups. In addition, another stimuli group consisting of nonsocial images of neutral valence was selected as control. Pleasantness was based on the normative ratings provided by the IAPS (Lang et al., 2005). Four categories composed of seven pictures each were shown to the participants in random order:

1. Social pleasant (valence rating ≥ 7).
2. Social neutral (valence rating 4–6).
3. Social unpleasant (valence rating ≤ 3).
4. Control nonsocial neutral (valence rating 4–6).

The participants were asked to evaluate the images presented by using the Self-Assessment Manikin (SAM), which consists of a pictographic Likert-type scale (1–9 points) for evaluating each IAPS image on three emotional dimensions: affective valence, arousal, and control (Fig. 1). For each of the four stimuli categories, the final SAM scores were the average of the seven images in that category.

The SAM scale is widely used for the study of emotions. According to Bradley and Lang (1994), the SAM is a reliable and valid instrument given that presents strong statistical correlation with other longer and complicated semantic scales. SAM data also indicate that these ratings are stable when assessing either within- or between subject reliability (Lang et al., 1999).

2.4. Procedure

The evaluation was carried out in one session. Before the experimental evaluation a clinical interview was held with every participant in order to explain the research project and answer to any question the participant could have. After that, the written informed consent was signed. The participants were weighed and measured to calculate their BMI, data on menstruation frequency and patterns during the past year were collected, and the age of

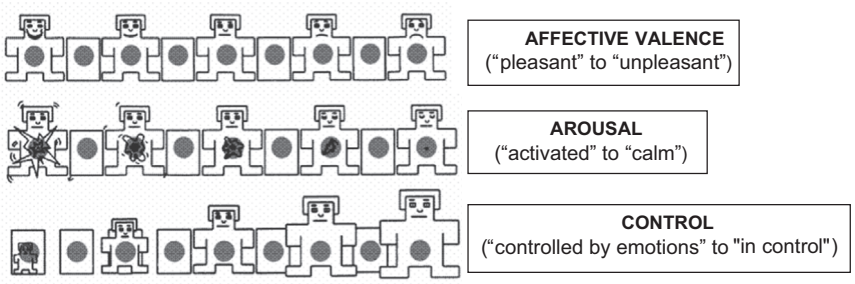

Fig. 1. Self-assessment Manikin.

onset of eating pathology and the duration of illness were confirmed. The participants were blinded to their weight.

In the experimental evaluation, the IAPS pictures were shown in random order to the participants by using a personal computer. After the presentation of each stimulus, the participants were instructed to assess how they felt on seeing the image and to classify their emotions on the three dimensions: affective valence (pleasant-unpleasant), arousal (calm-aroused), and control (submissive-dominant). No time limit was given.

Psychopathology assessment questionnaires were completed before the test session. Four participants did not answer part of the questionnaires (1 in the AN group, 2 in the BN group, and 1 in the HC group). In spite of this, the other main measures were included in the analysis.

2.5. Statistical analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 19 for Windows. All variables were assessed for normality of distribution by using a Kolmogorov–Smirnov test and for homogeneity of variance by using Levene's test.

The parametric assumptions were met only for age, years of education, estimated IQ, duration of illness, and BIS-11 total; thus, analysis of variance (ANOVA) was performed, followed by Bonferroni correction *post hoc* tests. The parametric assumptions for all other variables were not met; thus, Kruskal–Wallis tests were used with Mann–Whitney *U* tests for *post hoc* comparisons.

To explore the relationship between emotional reactivity and psychopathologic variables, Spearman's rank (r_s) correlation was used. All correlation analyses were done separately for each group. All tests were applied at a statistical significance level of 5%.

3. Results

3.1. Demographic and clinical characteristics

Table 1 shows the demographic and clinical characteristics of the participants. No significant differences in age, years of education, and estimated IQ were found between the three groups. As expected, there were statistically significant differences in BMI between the groups. The AN group presented a lower weight than the BN and HC groups (both $P<0.01$), and the BN group presented a higher weight than the controls ($P<0.05$). There were no differences in age of onset and duration of illness between the clinical groups.

The AN and BN patients had greater levels of depression, anxiety, and symptoms of eating disorders than the HCs (all $P<0.01$), but there were no differences between the AN and BN groups. The level of obsessive–compulsive symptoms and impulsivity did not differ between groups.

In the AN group, 17 patients (58.6%) were taking psychoactive medication. There were no differences in emotional reactivity between those taking and those not taking psychotropic drugs (social pleasant: valence $U=81.5$, arousal $U=82.5$, control $U=88.0$; social unpleasant: valence $U=93.5$, arousal $U=87.5$, control $U=95.0$; social neutral: valence $U=94.5$, arousal $U=92.5$, control $U=91.0$; control nonsocial: valence $U=58.5$, arousal $U=63.5$, control $U=78.0$, not significant).

Table 1
Clinical characteristics of participants.

	AN		BN		HC		*Statistics*	*P*	*Post Hoc*
	Mean (*SD*)	*n*	*Mean* (*SD*)	*n*	*Mean* (*SD*)	*n*			
Age (years)	25.2 (7.7)	29	24.7 (5.7)	28	25.8 (7.2)	28	$F(2)=0.15$	0.85	ns
Years of education	14.2 (2.6)	29	13.9 (2.4)	28	15.2 (2.8)	28	$F(2)=1.89$	0.15	ns
Estimated IQ	101.0 (19.3)	29	91.1 (18.7)	28	99.9 (15.0)	28	$F(2)=2.6$	0.07	ns
Body Mass Index (kg/m²)	18.1 (1.8)	29	24.4 (5.9)	28	21.6 (1.8)	28	$H(2)=44.1$	0.000	AN < HC** BN > HC* AN < BN**
Age of onset of illness	16.9 (4.6)	29	16.5 (3.4)	28	na		$U=396.0$	0.87	ns
Duration of illness (years)	8.4 (6.2)	29	8.1 (6.2)	28	na		$t(55)=0.14$	0.88	ns
BDI (21 ÍTENS)	21.5 (11.0)	28	22.5 (9.0)	27	6.1 (5.1)	27	$H(2)=37.4$	0.000	AN > HC** BN > HC** AN=BN
STAI-State	32.3 (13.7)	28	31.5 (12.7)	26	17.7 (9.4)	27	$H(2)=19.5$	0.000	AN > HC** BN > HC** AN=BN
STAI-Trait	37.1 (13.9)	28	37.5 (9.4)	26	19.9 (8.1)	27	$H(2)=30.5$	0.000	AN > HC** BN > HC** AN=BN
OCI-R Total	19.9 (15.5)	28	23.1 (15.8)	27	14.1 (9.4)	27	$H(2)=3.9$	0.14	ns
BIS-11 Total	52.3 (15.1)	28	55.6 (14.4)	26	46.8 (12.3)	27	$F(2)=2.6$	0.79	ns
EDI-II Drive for thinness	12.3 (6.5)	28	14.0 (5.4)	27	1.5 (2.8)	27	$H(2)=43.7$	0.000	AN > HC** BN > HC** AN=BN
EDI-II Total	91.9 (42.3)	28	109.1 (34.3)	27	29.7 (19.2)	27	$H(2)=43.3$	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, BIS-11=Barratt Impulsiveness Scale, EDI-II=Eating Disorder Inventory-Two, na=not aplicable, and ns=not significant.

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

Table 2
Results of IAPS in the three groups.

	AN ($n=29$)	BN ($n=28$)	HC ($n=28$)	*Statistics*	*P*	*Post Hoc*
	Mean (*SD*)	*Mean* (*SD*)	*Mean* (*SD*)			
SOCIAL PLEASANT						
VALENCE	6.9 (1.3)	6.6 (1.4)	7.2 (1.0)	$H(2)=2.7$	0.24	ns
AROUSAL	4.0 (1.4)	4.6 (1.3)	3.3(1.7)	$H(2)=9.9$	0.007	AN=HC BN > HC** AN=BN
CONTROL	5.2 (1.3)	4.9 (1.0)	6.1 (1.7)	$H(2)=6.9$	0.03	AN=HC BN < HC* AN=BN
SOCIAL UNPLEASANT						
VALENCE	1.8 (0.9)	1.6 (0.8)	1.7 (0.9)	$H(2)=0.1$	0.90	ns
AROUSAL	7.3 (1.4)	7.9 (0.9)	6.6 (1.6)	$H(2)=9.3$	0.009	AN=HC BN > HC** AN=BN
CONTROL	2.9 (1.8)	2.5 (1.3)	3.8 (1.8)	$H(2)=7.3$	0.02	AN=HC BN < HC** AN=BN
SOCIAL NEUTRAL						
VALENCE	5.5 (0.9)	5.2 (1.8)	5.6 (1.0)	$H(2)=1.1$	0.55	ns
AROUSAL	4.8 (1.3)	5.8 (1.7)	3.8 (1.6)	$H(2)=21.1$	0.000	AN > HC* BN > HC** AN < BN**
CONTROL	5.1 (1.2)	4.7 (1.5)	6.1 (1.8)	$H(2)=6.8$	0.03	AN < HC* BN < HC* AN=BN
CONTROL (NON SOCIAL-NEUTRAL)						
VALENCE	5.2 (0.7)	5.4 (1.0)	5.6 (0.7)	$H(2)=2.7$	0.25	ns
AROUSAL	4.4 (1.1)	4.3 (1.1)	3.7 (1.3)	$H(2)=5.3$	0.06	ns
CONTROL	5.2 (1.3)	5.5 (1.3)	6.1 (1.6)	$H(2)=3.6$	0.15	ns

AN=Anorexia Nervosa, BN=Bulimia Nervosa, HC=Healthy Controls, and ns=not significant.

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

In the BN group, 18 patients (64.3%) were taking psychoactive medication. The valence in the social neutral and the arousal in the neutral nonsocial images were observed to be higher in those taking medication ($U=45.5$, $P<0.05$ and $U=48.0$, $P<0.05$, respectively). In all other categories, there were no differences between those using and those not using psychotropic drugs (social pleasant: valence $U=59.5$, arousal $U=66.5$, control $U=61.5$; social unpleasant: valence $U=76.5$, arousal $U=57.0$, control $U=75.0$; social neutral: arousal $U=73.5$, control $U=51.5$; control nonsocial: valence $U=79.5$, control $U=72.5$, not significant).

Regarding the symptoms of eating disorders assessed with the EDI-II, all the participants in the HC group scored below the cutoff on the drive for thinness subscale ($M=1.5$, $SD=2.8$).

3.2. Emotional reactivity ratings

Table 2 shows the results on the emotional reactivity to social pictures. For the social pleasant and unpleasant images, the BN group presented higher arousal (all $P<0.01$) and lower control compared with the HCs ($P<0.05$ and $P<0.01$, respectively). There were no differences between the AN group and either the HC or BN group. For the social neutral images, the AN group had significantly higher arousal ($P<0.05$) and lower control ($P<0.05$) than the HC group and lower arousal than the BN group ($P<0.01$); the BN group presented higher arousal ($P<0.01$) and lower control ($P<0.05$) than the HCs. Regarding the control images, there were no differences between the groups.

3.3. Relationship between emotional reactivity and psychopathologic profile

Only significant results are described below.

3.3.1. AN group

Table 3 presents the results of the correlation analyses. Regarding the social pleasant images, control was observed to be negatively correlated with STAI-state ($P<0.05$). For the social unpleasant images, arousal was found to be correlated with OCI-R

Table 3
Table of correlations in Anorexia Nervosa group.

Measure	1	2	3	4	5	6	7	8	9	10	11	12
1. IAPS Social Pleasant Arousal	–											
2. IAPS Social Pleasant Control		–						**−0.41***				
3. IAPS Social Unpleasant Arousal			–							**0.39***		**0.49****
4. IAPS Social Unpleasant Control				–								
5. IAPS Social Neutral Arousal					–							
6. IAPS Social Neutral Control						–	**−0.39***		**−0.44***		**−0.48****	
7. BDI							–	0.82**	0.83**	0.66**	0.53**	0.84**
8. STAI (state)								–	0.67**	0.64**	0.55**	0.77**
9. STAI (trait)									–	0.57**	0.56**	0.75**
10. OCI-R (total)										–		0.68**
11. BIS-11 (total)											–	0.38*
12. EDI-II (total)												–

IAPS=International Affective Picture System, BDI=Beck Depression Inventory, STAI=State-Trait Anxiety Inventory, OCI-R=Obsessive Compulsive Inventory Revised, BIS-11=Barratt Impulsiveness Scale, and EDI-II=Eating Disorder Inventory-Two.

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

Table 4
Table of correlations in bulimia nervosa group.

Measure	1	2	3	4	5	6	7	8	9	10	11	12
1. IAPS Social Pleasant Arousal	–						**0.38***	**0.42***		**0.52****	**0.50****	**0.46***
2. IAPS Social Pleasant Control		–										
3. IAPS Social Unpleasant Arousal			–									
4. IAPS Social Unpleasant Control				–								
5. IAPS Social Neutral Arousal					–		**0.40***			**0.44***	**0.42***	**0.62****
6. IAPS Social Neutral Control						–						
7. BDI							–	0.56**	0.52**	0.39*	0.53**	0.66**
8. STAI (state)								–	0.73**	0.68**	0.42*	0.46*
9. STAI (trait)									–		0.56**	0.50**
10. OCI-R (total)										–		
11. BIS-11 (total)											–	0.59**
12. EDI-II (total)												–

IAPS=International Affective Picture System, BDI=Beck Depression Inventory, STAI=State-Trait Anxiety Inventory, OCI-R=Obsessive Compulsive Inventory Revised, BIS-11=Barratt Impulsiveness Scale, and EDI-II=Eating Disorder Inventory-Two.

* $P<0.05$.

** $P<0.01$.

total ($P<0.05$) and EDI-II total ($P<0.01$). For the social neutral images, control was negatively correlated with BDI ($P<0.05$), STAI-trait ($P<0.05$), and BIS-11 total ($P<0.01$).

For the psychopathologic scales, as expected, BDI was correlated with STAI (state and trait), OCI-R total, BIS-11 total, and EDI-II total (all $P<0.01$); STAI (state and trait) was correlated with OCI-R total, BIS-11 total, and EDI-II total (all $P<0.01$); and OCI-R total ($P<0.01$) and BIS-11 total ($P<0.05$) were correlated with EDI-II total.

3.3.2. BN group

Table 4 shows the results of the correlation analyses. For the social pleasant images, arousal was observed to be correlated with BDI ($P<0.05$), STAI-state ($P<0.05$), OCI-R total ($P<0.01$), BIS-11 total ($P<0.01$), and EDI-II total ($P<0.05$). For the social neutral images, arousal was associated with BDI ($P<0.05$), OCI-R total ($P<0.05$), BIS-11 total ($P<0.05$), and EDI- II total ($P<0.01$).

As also expected, BDI was found to be correlated with STAI (state and trait, both $P<0.01$), OCI-R total ($P<0.05$), BIS-11 total ($P<0.01$), and EDI-II total ($P<0.01$); and STAI-state was correlated with STAI-trait ($P<0.01$), OCI-R total ($P<0.01$), BIS-11 total ($P<0.05$), and EDI-II total ($P<0.05$). STAI-trait was correlated with BIS-11 total ($P<0.01$) and EDI-II total ($P<0.01$), whereas BIS-11 total was correlated with EDI-II total ($P<0.01$).

4. Discussion

The main purpose of the present study was to evaluate, through an emotional induction paradigm, the emotional reactivity of patients with eating disorders when viewing images with social content of pleasant, unpleasant, and neutral emotional valence. Our hypothesis was that patients with AN would present underarousal and overcontrol and that patients with BN would show hyperarousal and undercontrol compared with healthy control participants. The present results, specifically in the BN group, support this statement.

We found that patients with bulimia nervosa presented higher arousal and lower control when viewing images with social content of pleasant, unpleasant, and neutral emotional valence. In patients with anorexia nervosa, contrary to our expectations, we observed greater arousal and lesser control than HCs, as well as lesser arousal than the BN group, only for social images with neutral valence. Regarding affective valence, which is another dimension of emotion, no differences were observed between the groups, probably because the images had previously been ordered by affective valence according to the norms of the IAPS. For the control images (nonsocial and of neutral valence), there were no differences between the groups in any of the dimensions.

In the BN group, differences in the emotional response to images with social content, independent of its emotional valence, indicate that the unusual self-reported arousal and control ratings are due to social aspect of stimuli. These findings suggest that impairments in socio-emotional processing can be associated with emotional *hyperarousal* and *undercontrol* in the social environment, indicating that seeing pictures with social content stirs the emotions of BN patients with atypical intensity. Our results are consistent with those reported by Harrison et al. (2010a) that found an increased attentional bias towards social versus nonsocial stimuli in BN patients. In our mind, this profile of basic alterations might help to explain the previously mentioned difficulties in social behavior of patients with bulimia, such as social phobia (Kaye et al., 2004). On the other hand, it is known that a pattern of high impulsivity and mood cycling is frequently observed in BN patients (Johnson-Sabine et al., 1984; Perugi et al., 2006; Lunde et al., 2009). Taken together with the aforementioned findings, a classic clinical behavior of these patients such as engaging in binge-purge situations when feeling emotionally disturbed, can be drawn. It is well known that many social situations perceived as stressful by the patients may trigger this type of behavior (Smyth et al., 2007; Crosby et al., 2009).

In the case of AN patients a pattern of hyperarousal and undercontrol was found only when viewing social images with neutral valence. A possible explanation of this result could be that patients perceive the emotional neutrality of this kind of images as ambiguous and confounding, triggering obsessive thinking about "the correct" answer that should be given. This would lead to feelings of hyperarousal and loss of control. This is a very common thinking pattern in AN patients clearly related with the obsessive traits found in this disorder (Kaye et al., 2004; Breithaupt et al., 2014). According to Bradley and Lang (2000), when HC individuals are exposed to stimuli with an affective content (pleasant and unpleasant) their levels of arousal are higher than those produced by neutral stimuli, precisely the opposite of what we have observed in AN patients. These results emphasize the effect of the affective valence in emotional reactivity in patients with AN. This finding is similar to those found in patients with bipolar disorder. These patients' arousal was higher than HCs when assessing neutral pictures (M'Bailara et al., 2009).

On the other hand, a growing number of studies are suggesting a link between cognitive and socio-emotional profile among patients with AN and ASD (Baron-cohen et al., 2013; Tchanturia et al.,

2013). In this sense, it is tempting to speculate that the subjective emotional reactivity to social stimuli presents similarities between these illnesses. However, in the autism literature mixed results are found (Louwerse et al., 2014; Mathersul et al., 2013), possibly due to different methodologies, restraining comparisons between the profiles of AN and ASD. More studies directly comparing the emotional reactivity in these diseases would be of interest.

A correlation analysis was done to evaluate the extent to which the emotional response to social stimuli may be associated with psychopathologic symptoms. In the AN group, a correlation was observed between social pleasant control and STAI-state, between social unpleasant arousal and OCI-R and EDI-II, and between social neutral control and BDI, STAI-trait, and BIS-11. In the BN group, the main correlations found were between social pleasant arousal and BDI, STAI-state, OCI-R, BIS-11, and EDI-II, as well as between social neutral arousal and BDI, OCI-R, BIS-11, and EDI-II.

The aforementioned results indicate that the atypical profile of emotional reactivity in ED patients may have significant links to psychopathologic symptoms. In the AN and BN groups, higher arousal was mostly associated with higher intensity of psychopathologic symptoms; in the AN group, control was negatively correlated with psychopathologic symptoms; i.e. the lower the control, the greater the intensity of symptoms, and vice versa.

Due to the cross-sectional nature of this study, it is not possible to establish a causal relationship in the association found between emotional reactivity and psychopathological symptoms. Further longitudinal studies are necessary in order to deepen in the analysis of this association. However, more speculatively, one might interpret that the emotional hypersensitivity observed (expressed as hyperarousal and undercontrol), reveals that individuals with ED present a dysfunctional way to regulate their emotional states in social situations, which may imply interpersonal problems (Wildes et al., 2010). The increased stress due to social difficulties could be closely related to psychopathological symptoms and may contribute to the maintenance of these disorders

Furthermore, we assessed the possible association between SAM ratings and medication. In general terms, we did not observe differences in emotional response between patients taking and those not taking psychotropic drugs. The only difference detected was in the BN group, in which the valence for social neutral and the arousal for nonsocial neutral images were higher in patients taking medication. However, in these categories, there were no differences in emotional response among the groups studied. This leads us to conclude that the use of psychotropic drugs is not associated with the observed differences in emotional response.

Although we achieved what we proposed to do in this study, some limitations of this work need to be mentioned. According to Louwerse et al. (2014), arousal can be measured at various levels: brain functioning, autonomic arousal (skin conductance level and heart rate), and subjective response. In this paper, we focused only on the level of subjective response. In future works, it would be interesting to extend the research to include an evaluation of the physiologic aspects of arousal in the same sample. It is also necessary to collect more evidence of arousal disturbances in patients with ED. Functional brain imaging studies may provide information about the neurobiological mechanisms underlying alterations in emotional reactivity. On the other hand, more ecological stimuli are needed to imitate real-life situations of social interaction and communication.

Despite its limitations, this study has taken a further step in understanding social disturbances in patients with ED. In general terms, the question explored in this work concerned the ability of patients to respond to social external stimuli. It was assessed the subjective response to social images in a standardized way and included the emotional valence of the stimuli. The integration of these two aspects into one study paradigm is useful because it helps to identify whether differences in emotional response are due to social content or emotional valence (Louwerse et al., 2014).

Our results emphasize the importance of emotional *hyperarousal* and *undercontrol* as a dimension underlying alterations in socio-emotional processing, especially in patients with BN.

The present work contributes to improving the characterization of the profile of social difficulties in patients with ED. Considering the growing evidence of deficits in social cognition in these patients and its consequences for the maintenance and prognosis of the illness, socio-emotional factors have become an important aspect of the treatment. A deeper understanding of the subjective processes underlying social situations may improve clinical treatment. Specific treatments such as focal psychotherapies could address this issue by helping patients to improve their insight in their social performance and provide specific behavioral tools to be applied in this context.

Acknowledgements

F.T., P.H. and R.F.A. are supported by CONICET. Fernanda Tapajóz thanks L. and M. Botta Cantcheff for reading the manuscript and providing stimulating observations. The authors thank Prof. Dr. Helmuth Kruger for his support, the Cormillot and Fleni Institutes, the Argerich and Zubizarreta Hospitals, and all the participants in this study.

References

American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. APA, Washington, DC.
Aminoff, S.R., Jensen, J., Lagerberg, T.V., Andreassen, O.A., Melle, I., 2011. Decreased self-reported arousal in schizophrenia during aversive picture viewing compared to bipolar disorder and healthy controls. Psychiatry Res. 185, 309–314.
Anestis, M.D., Peterson, C.B., Bardone-Cone, A.M., Klein, M.H., Mitchell, J.E., Crosby, R.D., Wonderlich, S. a, Crow, S.J., le Grange, D., Joiner, T.E., 2009. Affective lability and impulsivity in a clinical sample of women with bulimia nervosa: the role of affect in severely dysregulated behavior. Int. J. Eat. Disord. 42, 259–266.
Baron-cohen, S., Jaffa, T., Davies, S., Auyeung, B., Allison, C., Wheelwright, S., 2013. Do girls with Anorexia Nervosa have elevated autistic traits. Mol. Autism 4, 1–8.
Barratt, E.S., 1985. Impulsiveness subtraits: arousal and information processing. In: Spence, J.T., Itard, C.E. (Eds.), Motivation, Emotion and Personality. Elsevier North Holland, New York, pp. 43–68.
Barrett, L., Mesquita, B., Ochsner, K., Gross, J., 2007. The experience of emotion. Annu. Rev. Psychol. 58, 373–403.
Beck, A.T., Ward, C.H., Mendelson, M., Mock, J., Erbaugh, J., 1961. An inventory for measuring depression. Arch. Gen. Psychiatry 4, 53–63.
Beck, A.T., Steer, R.A., Brown, G.K., 2006. BDI, Inventario de depresión de Beck, 2nd ed. Buenos Aires, Paidós.
Bradley, M.M., Lang, P.J., 1994. Measuring emotion: The selff-assessment manikin and the semantic differential. J. Behav. Ther. Exp. Psychiatry 25, 49–59.
Bradley, M.M., Lang, P.J., 2000. Measuring emotion: behavior, feeling, and physiology. In: Lane, R.D., Nadel, L. (Eds.), Cognitive Neuroscience of Emotion. Oxford University Press, New York, pp. 242–276.
Breithaupt, L.E., Payne, H.A., Rose, M., 2014. Body checking as a behavioral link: a preliminary study assessing inhibition and its association to idiosyncratic body checking in Anorexia Nervosa. Eat. Behav. 15, 591–594.
Brockmeyer, T., Skunde, M., Wu, M., Bresslein, E., Rudofsky, G., Herzog, W., Friederich, H.-C., 2014. Difficulties in emotion regulation across the spectrum of eating disorders. Compr. Psychiatry 55, 565–571.
Burin, D.I., Jorge, R.E., Arizaga, R.A., Paulsen, J.S., 2010. Estimation of Premorbid Intelligence: The Word Accentuation Test – Buenos Aires Version. J. Clin. Exp. Neuropsychol. 22, 677–685.
Button, E.J., Sonuga-Barke, E.J., Davies, J., Thompson, M., 1996. A prospective study of self-esteem in the prediction of eating problems in adolescent schoolgirls: questionnaire findings. Br. J. Clin. Psychol. 35, 193–203.
Bydlowski, S., Corcos, M., Jeammet, P., Paterniti, S., Berthoz, S., Laurier, C., Chambry, J., Consoli, S.M., 2005. Emotion-processing deficits in eating disorders. Int. J. Eat. Disord. 37, 321–329.
Bylsma, L.M., Morris, B.H., Rottenberg, J., 2008. A meta-analysis of emotional reactivity in major depressive disorder. Clin. Psychol. Rev. 28, 676–691.
Courty, A., Godart, N., Lalanne, C., Berthoz, S., 2015. Alexithymia, a compounding factor for eating and social avoidance symptoms in Anorexia Nervosa. Compr. Psychiatry 56, 217–228.
Crosby, R.D., Wonderlich, S.A., Engel, S.G., Simonich, H., Smyth, J., Mitchell, J.E.,

2009. Daily mood patterns and bulimic behaviors in the natural environment. Behav. Res. Ther. 47, 181–188.
Daley, K.A., Jimerson, D.C., Heatherton, T.F., Metzger, E.D., Wolfe, B.E., 2008. State self-esteem ratings in women with bulimia nervosa and bulimia nervosa in remission. Int. J. Eat. Disord. 41, 159–163.
Davies, H., Schmidt, U., Stahl, D., Tchanturia, K., 2011. Evoked facial emotional expression and emotional experience in people with Anorexia Nervosa. Int. J. Eat. Disord. 44, 531–539.
Davies, H., Schmidt, U., Tchanturia, K., 2013. Emotional facial expression in women recovered from Anorexia Nervosa. BMC Psychiatry 13, 1–9.
Foa, E.B., Huppert, D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., Salkovskis, P.M., 2002. The obsessive–compulsive inventory: development and validation of a short version. Psychological Assessment 14, 485–496.
Garner, D., 1998. Manual del EDI 2: Inventario de Trastornos de la Conducta Alimentaria. TEA Ediciones, Madrid.
Godart, N.T., Perdereau, F., Curt, F., Lang, F., Venisse, J.L., Halfon, O., Bizouard, P., Loas, G., Corcos, M., Jeammet, P., Flament, M.F., 2004. Predictive factors of social disability in anorexic and bulimic patients. Eat. Weight Disord. 9, 249–257.
Harrison, A., Sullivan, S., Tchanturia, K., Treasure, J., 2010a. Emotional functioning in eating disorders: attentional bias, emotion recognition and emotion regulation. Psychol. Med. 40, 1887–1897.
Harrison, A., Tchanturia, K., Treasure, J., 2010b. Attentional bias, emotion recognition, and emotion regulation in anorexia: state or trait. Biol. Psychiatry 68, 755–761.
Harrison, A., Mountford, V., Tchanturia, K., 2014. Social anhedonia and work and social functioning in the acute and recovered phases of eating disorders. Psychiatry Res. 218, 187–194.
Henry, C., Phillips, M., Leibenluft, E., M'Bailara, K., Houenou, J., Leboyer, M., 2012. Emotional dysfunction as a marker of bipolar disorders. Front. Biosci. 1–4, 2722–2730.
Jänsch, C., Harmer, C., Cooper, M.J., 2009. Emotional processing in women with Anorexia Nervosa and in healthy volunteers. Eat. Behav. 10, 184–191.
Johnson-Sabine, E.C., Wood, K.H., Wakeling, A., 1984. Mood changes in bulimia nervosa. Br. J. Psychiatry 145, 512–516.
Joos, A.A.B., Cabrillac, E., Hartmann, A., Wirsching, M., Zeeck, A., 2009. Emotional perception in eating disorders. Int. J. Eat. Disord. 42, 318–325.
Kaye, W.H., Bulik, C.M., Thornton, L., Barbarich, N., Masters, K., 2004. Comorbidity of anxiety disorders with anorexia and bulimia nervosa. Am. J. Psychiatry 161, 2215–2221.
Lang, P., Bradley, M.M., Cuthbert, B.N., 1999. International Affective Picture System (IAPS). NIMH Center for the Study of Emotion and Affection, New York.
Lang, P.J., Bradley, M.M., Cuthbert, B.N., 2005. International Affective Picture System (IAPS): Instruction Manual and Affective Ratings. University of Florida, Gainesville, FL (Technical Report A-6).
Lavender, J.M., Wonderlich, S.A., Peterson, C.B., Crosby, R.D., Engel, S.G., Mitchell, J. E., Crow, S.J., Smith, T.L., Klein, M.H., Goldschmidt, A.B., Berg, K.C., 2014. Dimensions of emotion dysregulation in bulimia nervosa. Eur. Eat. Disord. Rev. 22, 212–216.
Lawson, R., Emanuelli, F., Sines, J., Waller, G., 2008. Emotional awareness and core beliefs among women with eating disorders. Eur. Eat. Disord. Rev. 16, 155–159.
Louwerse, A., Tulen, J.H.M., van der Geest, J.N., van der Ende, J., Verhulst, F.C., Greaves-Lord, K., 2014. Autonomic responses to social and nonsocial pictures in adolescents with autism spectrum disorder. Autism Res.: Off. J. Int. Soc. Autism Res. 7, 17–27.
Lunde, A.V., Fasmer, O.B., Akiskal, K.K., Akiskal, H.S., Oedegaard, K.J., 2009. The relationship of bulimia and Anorexia Nervosa with bipolar disorder and its temperamental foundations. J. Affect. Disord. 115, 309–314.
Martínez-González, A.E., Piqueras, A.J., Marzo, J.C., 2011. Validación del inventario de obsesiones y compulsiones revisado (OCI-R) para su uso en población adolescente española. An. Psicol. 27, 763–773.
M'Bailara, K., Demotes-Mainard, J., Swendsen, J., Mathieu, F., Leboyer, M., Henry, C., 2009. Emotional hyper-reactivity in normothymic bipolar patients. Bipolar Disord. 11, 63–69.
M'Bailara, K., Atzeni, T., Colom, F., Swendsen, J., Gard, S., Desage, A., Henry, C., 2012. Emotional hyperreactivity as a core dimension of manic and mixed states. Psychiatry Res. 197, 227–230.
Mathersul, D., McDonald, S., Rushby, J. a, 2013. Automatic facial responses to affective stimuli in high-functioning adults with autism spectrum disorder. Physiol. Behav. 109, 14–22.
Medina-Pradas, C., Navarro, J.B., Álvarez-Moya, E.M., Grau, A., Obiols, J.E., 2012. Emotional theory of mind in eating disorders. Int. J. Clin. Health Psychol. 12, 189–202.
Oldershaw, A., Hambrook, D., Tchanturia, K., Treasure, J., Schmidt, U., 2010. Emotional theory of mind and emotional awareness in recovered Anorexia Nervosa patients. Psychosom. Med. 72, 73–79.
Oldershaw, A., Hambrook, D., Stahl, D., Tchanturia, K., Treasure, J., Schmidt, U., 2011. The socio-emotional processing stream in Anorexia Nervosa. Neurosci. Biobehav. Rev. 35, 970–988.
Oquendo, M.A., Baca-Garcia, E., Graver, R., Morales, M., Montalvan, V., Mann, J., 2001. Spanish adaptation of the Barratt Impulsiveness Scale (BIS-11). Eur. J. Psychiatry 15, 147–155.
Pearce, J.M.S., 2004. Richard Morton: Origins of Anorexia Nervosa. Eur. Neurol. 52, 191–192.
Perugi, G., Toni, C., Passino, M.C., Akiskal, K.K., Kaprinis, S., Akiskal, H.S., 2006. Bulimia nervosa in atypical depression: the mediating role of cyclothymic temperament. J. Affect. Disord. 92, 91–97.
Pollatos, O., Herbert, B.M., Schandry, R., Gramann, K., 2008. Impaired central processing of emotional faces in Anorexia Nervosa. Psychosom. Med. 70, 701–708.
Premack, D., Woodruff, G., 1978. Does the chimpanzee have a theory of mind. Behav. Brain Sci. 1, 515–526.
Rhind, C., Mandy, W., Treasure, J., Tchanturia, K., 2014. An exploratory study of evoked facial affect in adolescent females with Anorexia Nervosa. Psychiatry Res. 220, 711–715.
Russell, T.A., Schmidt, U., Doherty, L., Young, V., Tchanturia, K., 2009. Aspects of social cognition in Anorexia Nervosa: affective and cognitive theory of mind. Psychiatry Res. 168, 181–185.
Rutsztein, G., Armatta, A., Casquet, A., Leonardelli, E., López, P., Marola, M.E., Moiseeff, C., Murawski, B., Redondo, G., 2006. Body image and eating disorders in ballet students. Poster presented at the International Conference on Eating Disorders. Barcelona, Spain.
Schmidt, U., Tiller, J.M., Blanchard, M., Andrews, B., Treasure, J., 1997. Is there a specific trauma precipitating Anorexia Nervosa. Psychol. Med. 27, 523–530.
Schmidt, U., Treasure, J., 2006. Anorexia Nervosa: valued and visible. A cognitive-interpersonal maintenance model and its implications for research and practice. Br. J. Clin. Psychol. 45, 343–366.
Senju, A., Johnson, M.H., 2009. Atypical eye contact in autism: models, mechanisms and development. Neurosci. Biobehav. Rev. 33, 1204–1214.
Sierra, N., Torralva, T., Roca, M., Manes, F., Burin, I., 2010. Estimación de la inteligencia premórbida en deterioro cognitivo leve y moderado y en déficit ejecutivo. Rev. Neuropsicol. Latinoam. 2, 25–32.
Smyth, J.M., Wonderlich, S.A., Heron, K.E., Sliwinski, M.J., Crosby, R.D., Mitchell, J.E., Engel, S.G., 2007. Daily and momentary mood and stress are associated with binge eating and vomiting in bulimia nervosa patients in the natural environment. J. Consult. Clin. Psychol. 75, 629–638.
Spielberger, C.D., Gorsuc, R.L., Lushene, R.E., 1982. STAI: Cuestionario de Ansiedad Estado-Rasgo. Versión Española Adaptada. TEA Ediciones, Madrid.
de Sampaio, Tapajóz Pereira, Soneira, F., Aulicino, S., Allegri, R.F., A., 2013a. Theory of mind in eating disorders and their relationship to clinical profile. Eur. Eat. Disord. Rev.: J. Eat. Disord. Assoc. 21, 479–487.
de Sampaio, Tapajóz P., Soneira, F., Aulicino, S., Martese, A., Iturry, G., Allegri, R.F., M., 2013b. Theory of mind and central coherence in eating disorders: Two sides of the same coin. Psychiatry Res. 210, 1116–1122.
Tchanturia, K., Happé, F., Godley, J., Treasure, J., Bara-Carril, N., Schmidt, U., 2004. Theory of mind in Anorexia Nervosa. Eur. Eat. Disord. Rev. 12, 361–366.
Tchanturia, K., Davies, H., Harrison, A., Fox, J.R.E., Treasure, J., Schmidt, U., 2012. Altered social hedonic processing in eating disorders. Int. J. Eat. Disord. 45, 962–969.
Tchanturia, K., Smith, E., Weineck, F., Fidanboylu, E., Kern, N., Treasure, J., Cohen, S. B., 2013. Exploring autistic traits in anorexia: a clinical study. Mol. Autism 4, 1–8.
Tchanturia, K., Dapelo, M., Harrison, A., Hambrook, D., 2015. Why study positive emotions in the context of eating disorders. Curr. Psychiatry Rep. 17, 2–12.
Tiller, J.M., Sloane, G., Schmidt, U., Troop, N., Power, M., Treasure, J., 1997. Social support in patients with Anorexia Nervosa and bulimia nervosa. Int. J. Eat. Disord. 21, 31–38.
Treasure, J., 2012. Emotion in eating disorders. Eur. Eat. Disord. Rev. 20, 429–430.
Treasure, J., Schmidt, U., 2013. The cognitive-interpersonal maintenance model of Anorexia Nervosa revisited: a summary of the evidence for cognitive, socio-emotional and interpersonal predisposing and perpetuating factors. J. Eat. Disord. 1, 13.
Wildes, J.E., Ringham, R.M., Marcus, M.D., 2010. Emotion avoidance in patients with Anorexia Nervosa: initial test of a functional model. Int. J. Eat. Disord. 43, 398–404.
Zonnevylle-Bender, M.J.S., van Goozen, S.H.M., Cohen-Kettenis, P.T., Jansen, L.M.C., van Elburg, A., van Engeland, H., 2005. Adolescent Anorexia Nervosa patients have a discrepancy between neurophysiological responses and self-reported emotional arousal to psychosocial stress. Psychiatry Res. 135, 45–52.
Zucker, N.L., Losh, M., Bulik, C.M., Labar, K.S., Piven, J., Pelphrey, K.A., 2007. Anorexia Nervosa and autism spectrum disorders: guided investigation of social cognitive endophenotypes. Psychol. Bull. 133, 976–1006.