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# Emotions mediate the relationship between autistic traits and disordered eating: A new autistic-emotional model for eating pathology

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## ARTICLE INFO

## ABSTRACT

The aim of the study was to assess the extent of overlap between autistic traits, body dissatisfaction and disordered eating and to explore the mediating effects of negative attitudes towards emotional expression and emotion dysregulation. The sample comprised 416 university students (82% females, 17-48 years [$M = 19.76$, $SD = 3.85$]), who completed an online questionnaire assessing eating attitudes and behaviours (including dieting, bulimia and oral control), body dissatisfaction, and autistic traits (including the Autism Quotient [AQ] and its related subscales as well as the Empathising Quotient). Attitudes towards emotional expression and emotion regulation were also assessed. Results revealed that eating pathology correlated highly with all AQ subscales, with the exception of the attention to detail subscale. However, there was no significant relationship between empathising and eating pathology. Path-analyses indicated that emotion dysregulation, but not negative attitudes towards emotional expression, was a significant mediator of the relationship between AQ, body dissatisfaction and eating pathology. Direct relationships were also obtained for the AQ-bulimia and the AQ-oral control paths. Prevention and early intervention programs for eating pathology would likely benefit from addressing abnormalities in emotion processes in individuals who score highly on measures of autistic traits.

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## 1. Introduction

A number of inter-related risk factors have been associated with the development of eating disorders (EDs) (Culbert et al., 2015; Hilbert et al., 2014). One theoretical model of EDs, the cognitive-interpersonal model, asserts that traits associated with autism spectrum disorders (ASD), such as problems navigating interpersonal relationships and social-emotional difficulties, may act as both risk and maintaining factors for EDs (Treasure et al., 2012). However, the majority of studies (Westwood et al., 2015) investigating the relationship between EDs and autistic traits have focused on clinical Anorexia Nervosa (AN) populations. Therefore, the question of whether this relationship holds in the general population remains largely unexplored (Carton and Smith, 2014;

Coombs et al., 2011). While there have been a few studies outlining that ASD and EDs share some familial (genetic) behavioural traits (e.g. social impairment and restricted and repetitive behaviours) and intermediate phenotypes (e.g. impaired set-shifting and theory of mind as well as weak central coherence) (e.g. Caglar-Nazali et al., 2014; Westwood et al., 2016; Zucker et al., 2007), investigations into other mechanisms linking the two disorders, have been scarce. Given that deficits in emotion regulation have been found in both EDs (Meyer et al., 2010; Svaldi et al., 2012) and ASD populations (Globerson et al., 2015), it is possible that the relationship between these disorders may be mediated by emotion-related traits. The current study therefore assessed the overlap between eating pathology and a range of autistic traits in a large sample of university students, and also assessed whether emotions mediate this relationship by exploring a new autistic-emotional model of eating pathology. Although the official ED prevalence rate is around 0.5–3%, depending on the specific ED diagnosis, ED symptoms in the general population have been found to be as high as 12%, suggesting that it is meaningful to

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explore risk factors, such as ASD traits, in general population samples (Nagl et al., 2016).

### 1.1. Autistic traits in clinical eating disorders

Research assessing autistic traits in clinical ED populations has mainly focused on common cognitive processing styles across the two disorder groups. Current evidence points to a strong role for three particular deficits, impaired theory of mind (Caglar-Nazali et al., 2014; Davies et al., 2016), weak central coherence (Lang et al., 2014), and deficits in executive functions, including problems in set-shifting (Roberts et al., 2007; Tchanturia et al., 2012; Westwood et al., 2016). Social interaction impairments and reciprocal communication deficits, which are key symptoms of ASD, have also been reported in ED patients (Wentz et al., 2009; Zucker et al., 2007). Moreover, a recent review by Huke et al. (2013), investigating autistic traits in EDs, found that nearly 23% of individuals with an ED displayed autism spectrum traits. These findings provide support for the overlap between ASD and EDs.

#### 1.1.1. The autism spectrum quotient

To assess specific autism-spectrum features in clinical ED patients, recent studies have applied a test of autistic traits, the Autism-Spectrum Quotient (AQ; (Baron-Cohen et al., 2001)). A recent meta-analysis (Westwood et al., 2015) reviewing seven studies, reported significantly higher AQ scores in AN patients compared to controls, with the difference largely attributable to greater social skills deficits, poorer communication skills, and greater inflexibility. Conversely, no significant differences were found between AN patients and controls on the attention to detail AQ subscale. However, it should be noted that this review was limited by the small number of studies included and substantial cross-study heterogeneity. These results are nonetheless supported by several studies that have found differences between ED patients and controls across a number of AQ scales (e.g. Anckarsater et al., 2012), although some studies have only found differences for one AQ subscale (e.g., attention to detail scale, (Iwasaki et al., 2013)). To our knowledge, only one study (Iwasaki et al., 2013) assessed the relationship between specific eating pathology facets and the AQ subscales in a clinical ED sample. Results of this study revealed that whereas communication deficits were associated with increased body dissatisfaction, social-skill difficulties were related to greater bulimic symptom scores on the Eating Disorder Inventory (EDI), indicating that autistic traits might differ depending on the ED symptoms assessed.

#### 1.1.2. Empathising

More recently, empathising, the capacity to identify thoughts and feelings in others and to react with appropriate emotions, a commonly reported ASD symptom, has been investigated in relation to EDs. The importance of assessing empathising can be seen in the impaired theory of mind (Caglar-Nazali et al., 2014) and social interaction deficits, which are key symptoms in ED patients (Wentz et al., 2009; Zucker et al., 2007). The studies assessing empathising in EDs have mainly used two distinct measures to assess empathy, the Interpersonal Reactivity Index (Davis, 1983), a multi-dimensional assessment of empathy, and the Empathising Quotient (EQ; (Baron-Cohen and Wheelwright, 2004)), a measure of empathy used to account for the social and communication barriers commonly found in individuals with ASD. The findings of the studies using the Interpersonal Reactivity Index (Beadle et al., 2013; Calderoni et al., 2013) have been mainly inconclusive, with the study by Calderoni et al. (2013) revealing that AN patients reported less cognitive, but not affective empathy than controls, whereas the study by Beadle et al. (2013) found that AN patients demonstrated greater personal distress (a domain of affective empathy) compared to the controls. Of the few more recent studies (Baron-Cohen et al., 2013; Courty et al., 2013; Hambrook et al., 2008), that have utilized the EQ, only the study by Baron-Cohen et al. (2013) found that EQ scores were lower for AN patients compared to controls, however this finding was only obtained for the younger AN age group (aged 12–15 years). It is possible that lack of expected association between poorer empathising using the EQ and AN is due to the fact that low empathising abilities, characterized by social and communication barriers, are broadly present in both AN samples as well as the general population, therefore obscuring any group differences. However, future studies in both clinical and normal population samples are required to test this hypothesis.

### 1.2. Autistic traits and disordered eating in non-clinical samples

EDs and ASD are both largely conceptualised as representing continuums that account for both clinical and non-clinical populations (Baron-Cohen et al., 2001; Miller and Vaillancourt, 2011). Consequently, assessing the relationship between autistic traits and disordered eating symptoms in normal populations is necessary to obtain useful information about the clinical components of the disorders, as well as their more general manifestation across populations. Assessing the overlap in eating pathology and autistic traits in community samples might also address previous problems encountered in clinical ED studies. In particular, it may assist in disentangling the relationship between AN and ASD, which has proven problematic as autistic traits are very likely to arise as a consequence of AN and the associated low weight (Mandy and Tchanturia, 2015), however longitudinal research to confirm this claim is not yet available.

To our knowledge, only two studies have assessed the link between eating pathology and autistic traits in non-clinical samples, one assessing school children (Coombs et al., 2011) and the other one recruiting university students (Carton and Smith, 2014). Both studies reported that greater attention-to-detail, communication deficits, and attention-switching deficits assessed through the AQ, were significantly related to increased total Eating Attitudes Test (EAT-26; (Garner et al., 1982)) scores. However, only Coombs et al. (2011) observed a significant association between the EAT-26 oral control subscale and total AQ score.

There is currently only one study (Bremser and Gallup, 2012) that has assessed the role of empathising in eating pathology using a community sample. The study found that empathising was significantly related to eating pathology. Future studies using community samples are needed to verify these initial results and to clarify the discrepant findings regarding the relationship between EAT-26 scores and AQ scales (Carton and Smith, 2014; Coombs et al., 2011).

### 1.3. Emotions as potential mechanisms linking autistic traits and eating pathology

Despite the demonstrated link between disordered eating symptoms and ASD, the processes that connect the two disorder sets are currently unknown. Emotion dysregulation and negative attitudes towards emotional expression have been found to be entwined with both EDs (Harrison et al., 2010; Svaldi et al., 2012) and ASD (Samson et al., 2013). While research has consistently found a relationship between greater emotion regulation difficulties, including restricted access to emotion regulation strategies and lack of emotional clarity in both EDs (Meyer et al., 2010) and ASD (Globerson et al., 2015), research on negative attitudes towards emotions is more limited. The few studies assessing negative attitudes towards emotions revealed significant positive associations between eating pathology and the reduced tendency to

express emotions (Haslam et al., 2012), as well as the belief that expressing emotions is a sign of weakness (Meyer et al., 2010). Hence, in order to gain a more comprehensive understanding of the relationship between autistic traits and eating pathology, it is important to also take into account the mediating effect of emotion dysregulation and negative attitudes towards emotions.

### 1.4. The current study

The present study sought to build on the current state of knowledge by addressing the aforementioned limitations and research gaps. This study therefore investigated the associations between autistic traits and eating pathology in a non-clinical student population with an additional focus on whether negative attitudes towards emotions and emotion dysregulation might mediate this relationship. Assessment of a range of autistic traits, including empathising capacities, allowed for a more comprehensive picture of the specific autistic traits that may be associated with eating pathology. Additionally, identifying the potential mechanisms involved, including emotion regulation and attitudes towards emotions, can provide valuable insight into the co-occurrence of both autistic traits and disordered eating symptoms.

More specifically, the current study had two aims: 1.) to investigate the associations between autistic traits and disordered eating symptoms in a non-clinical sample and 2.) to assess whether negative attitudes towards emotions and emotion dysregulation mediated the relationship between autistic traits, body dissatisfaction and eating pathology. The proposed autistic-emotional model (see Fig. 1), was assessed using path-analyses to test this second aim. We decided to include body dissatisfaction as an extra mediating variable in our model, as research has shown it is the strongest predictor of eating pathology (Stice et al., 2010) and to our knowledge, with the exception of the study by Iwasaki et al. (2013), no other study has assessed the relationship between body dissatisfaction and autistic traits.

## 2. Method

### 2.1. Participants

Participants were 416 university students (82% female) from an Australian University. Ages ranged from 17 to 48 years ($M=19.76$ years, $SD=3.85$). Two hundred and forty (57.7%) participants were Australian-born. A significant proportion of participants identified as Asian (42.1%, $n=175$) and Caucasian (37.5%, $n=156$), followed by Middle Eastern (4.1%, $n=17$), with other groups constituting 15.4% of the sample ($n=64$). As it was a student population, most participants had completed at least secondary education (66.6%, $n=277$), with 23.6% ($n=98$) additional participants completing some previous tertiary studies. The majority of participants reported being single (74%; $n=308$), followed by being in a monogamous or committed relationship (23.8%, $n=99$). Mean Body Mass Index (BMI) for the current sample was 21.99 ($SD=3.58$).

### 2.2. Materials

#### 2.2.1. Sociodemographics
Demographic information, including age, ethnic background, education, and marital status, were assessed.

#### 2.2.2. The Eating Attitudes Test (EAT-26; (Garner et al., 1982))
The EAT-26 is a 26-item test designed to measure eating attitudes and behaviours associated with disordered eating. The EAT-26 consists of three subscales: avoiding calorific foods and preoccupation with shape (dieting), thoughts about food and bulimic
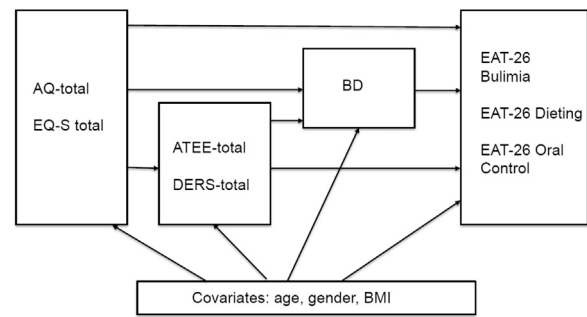


**Fig. 1.** Proposed relationship in the autistic-emotional model for eating pathology. AQ: Autism Quotient, EQ-S: Empathising; DERS: Difficulties in Emotion Regulation Scale; ATTE: Attitudes toward Emotional Expression Scale; BD: Body Dissatisfaction, EAT-26: Eating Attitudes Test.

symptoms (bulimia and food preoccupation), and self-control with food and perceived pressure from others to gain weight (oral control). The EAT-26 has an excellent Cronbach's alpha measure of reliability of 0.90 (Garner et al., 1982). In the current study the Cronbach alpha for the total EAT-26 was 0.89.

#### 2.2.3. Body Shape Questionnaire (BSQ; (Evans and Dolan, 1993))
The brief form of the BSQ (the BSQ-8) was used to assess body shape preoccupation. The BSQ-8 consists of eight items extracted from the full version by Evans and Dolan (1993). Questions assess satisfaction with different body parts over the previous four weeks. The BSQ has been shown to have good concurrent and discriminative validity (Cooper et al., 1986). The Cronbach alpha value for the BSQ in the current study was 0.92.

#### 2.2.4. The Autism-Spectrum Quotient (AQ; (Baron-Cohen et al., 2001))
The AQ is a 50-item test designed to measure the extent to which individuals with normal intelligence exhibit ASD characteristics. It consists of five subscales representing domains of ASD: reciprocal social interaction skills (social skills), ability to switch attention (attention switching), ability to pay attention to detail (attention to detail), communication skills (communication), and imagination skills (imagination). The AQ has an acceptable Cronbach's alpha reliability of 0.63 (Baron-Cohen et al., 2001). In the current study, the Cronbach alpha for the total AQ score was 0.73.

#### 2.2.5. The Empathy Quotient Short (EQ-S; (Wakabayashi et al., 2006))
The EQ-S, is a 22-item version of the EQ test (EQ; (Baron-Cohen and Wheelwright, 2004)), which measures empathy in different social situations. Higher scores indicate greater empathising ability. Cronbach's alpha reliability is excellent 0.90 (Wakabayashi et al., 2007). In the current study the Cronbach alpha was 0.89.

#### 2.2.6. The Attitudes towards Emotional Expression Scale (ATEE; (Joseph et al., 1994))
The ATEE is a 20-item measure of attitudes towards the expression of emotions. In the current study only the total ATEE score was used, with higher scores indicating greater negative attitudes towards emotional expression. The ATEE has an excellent Cronbach's alpha reliability of 0.90 (Joseph et al., 1994). The Cronbach alpha in this study was 0.91.

#### 2.2.7. The Difficulties in Emotion Regulation Scale (DERS; (Gratz and Roemer, 2004))
The DERS is a 36-item measure designed to assess multiple facets of emotion dysregulation. For the current study only the

total DERS score was used. The DERS has an excellent Cronbach's alpha reliability of 0.93 (Gratz and Roemer, 2004), and 0.93 in the present study.

## 2.3. Procedure

Participants were asked to complete an online questionnaire via a Qualtrics survey website and received one hour credit in return for their participation. Participation in the study was voluntary and electronic informed consent was obtained from all participants prior to commencement. Ethical approval for the current study was obtained from the University's Human Research Ethics Committee, where the study was conducted.

## 2.4. Statistical analyses

Partial correlations adjusted by age, gender, and BMI were conducted using SPSS version 22 (IBM Corp, 2013) to assess the relationship between eating pathology symptoms, autistic traits (AQ and its subscales, and empathising), negative attitudes towards emotions and emotion dysregulation. AQ subscales were also assessed in these analyses.

Subsequently, a path-analysis was undertaken using Mplus Version 7.3 (Muthén and Muthén, 1998–2012) to evaluate model fit for a proposed model of inter-relation among the variables outlined in Fig. 1. For simplicity's sake, AQ total scores and not AQ subscale scores were used in these analyses. In this model, EAT-26 subscale scores (bulimia, diet, and oral control) were included as the dependent variables, while body dissatisfaction, negative attitudes towards emotions, and emotion dysregulation, were included as potential mediators of the relationships between EAT-26 subscales, AQ-total, empathising and body dissatisfaction. Age, gender, and BMI were covariates in the model.

Given the large number of proposed associations, it is possible that some pathways were non-significant. Thus, in the interests of parsimony, this full model was augmented, in a subsequent exploratory phase, with model trimming through removal of non-significant pathways ($p > 0.05$) iteratively, by deleting the most non-significant pathway each time until there were no further non-significant pathways in the model. Indirect effects were calculated from this final model, as well as $R^2$ estimates for all modelled variables that were predicted by other variables. Bootstrapping with 1000 samples and bias-corrected confidence intervals were used to assess mediation effects.

## 3. Results

### 3.1. Data cleaning

Missingness was lower than 5% and was consistent with missing completely at random; Little's MCAR $x^2_{(df=771)}=367.05$, $p=0.99$. Expectation maximization was used to fill in these missing values (Tabachnick and Fidell, 2013). All variables met guidelines for normality (Curran et al., 1996), and therefore were entered into analyses untransformed.

### 3.2. Associations between the variables assessed

Associations between the variables of interest are displayed in Table 1. As can be seen, relationships were of varying magnitudes. Eating pathology variables were significantly associated with most other variables, with the exception of the empathising scale, although the EAT-26 oral control subscale was unrelated to any other variable. The body dissatisfaction variable was positively related to all EAT-26 scales, total AQ, negative attitudes towards emotions and emotion dysregulation. Total AQ score was positively associated with negative attitudes towards emotions and emotion dysregulation, whereas empathising was negatively related to both emotion measures. In regards to the AQ subscales, we found that attention switching was positively related to all variables, whereas attention to detail was unrelated to any of the variables. Of note, the social skill AQ scales (social skills, communication) and the AQ-imagination scale were positively related to the EAT-26 bulimia, but not any other EAT-26 subscales. Finally, body dissatisfaction correlated positively with the AQ social skills and attention switching subscales.

### 3.3. Path analyses

Although the full model provided excellent correspondence with the data ($x^2_{(df=6)}=12.50$, $p=0.052$, CFI=0.990, RMSEA=0.060, SRMR=0.024), several paths were non-significant. Through an iterative process (removing one non-significant pathway at each step), a revised and more parsimonious model with 13 fewer pathways was found to also fit the data well ($x^2_{(df=19)}=26.57$, $p=0.115$, CFI=0.989, RMSEA=0.037, SRMR=0.035), as shown in Fig. 2. Each of the components of this final model are discussed in turn.

**Table 1**
Partial Correlations between eating pathology, autistic traits, negative attitudes towards emotions and emotion dysregulation.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EAT-26 Total (1)** | – | | | | | | | | | | | | |
| **EAT-26 Dieting (2)** | 0.94*** | – | | | | | | | | | | | |
| **EAT-26 Bulimia (3)** | 0.79*** | 0.65*** | – | | | | | | | | | | |
| **EAT-26 Oral Control (4)** | 0.55*** | 0.35*** | 0.25** | – | | | | | | | | | |
| **Body Satisfaction (5)** | 0.66*** | 0.67*** | 0.55*** | 0.12 | – | | | | | | | | |
| **DERS total (6)** | 0.36** | 0.35*** | 0.33*** | 0.11 | 0.41*** | – | | | | | | | |
| **ATEE total (7)** | 0.25** | 0.26** | 0.17* | 0.05 | 0.78*** | 0.54*** | – | | | | | | |
| **AQ Total (8)** | 0.26*** | 0.21** | 0.32*** | 0.12 | 0.23** | 0.42*** | 0.33*** | – | | | | | |
| **AQ Social Skills (9)** | 0.14 | 0.11 | 0.23** | −0.02 | 0.18* | 0.36*** | 0.28*** | 0.76*** | – | | | | |
| **AQ Attention Switching (10)** | 0.33*** | 0.30** | 0.34*** | 0.14 | 0.29*** | 0.39*** | 0.24** | 0.70*** | 0.48*** | – | | | |
| **AQ Attention to Detail (11)** | 0.10 | 0.11 | 0.04 | 0.08 | −0.01 | 0.02 | 0.05 | 0.37*** | −0.10 | 0.09 | – | | |
| **AQ Communication (12)** | 0.12 | 0.05 | 0.19* | 0.15 | 0.13 | 0.27*** | 0.27*** | 0.69*** | 0.59*** | 0.35*** | −0.01 | – | |
| **AQ Imagination (13)** | 0.06 | 0.02 | 0.15* | 0.02 | 0.08 | 0.22** | 0.13 | 0.44*** | 0.22** | 0.13 | 0.01 | 0.13 | – |
| **EQ-S Total (14)** | 0.22* | 0.05 | −0.07 | 0.06 | 0.07 | −0.24** | −0.22** | −0.47*** | −0.52*** | −0.29** | 0.14 | −0.52*** | −0.22 |

AQ: Autism Quotient, EQ-S: Empathising; DERS: Difficulties in Emotion Regulation Scale; ATTE: Attitudes toward Emotional Expression Scale; EAT-26: Eating Attitudes Test.
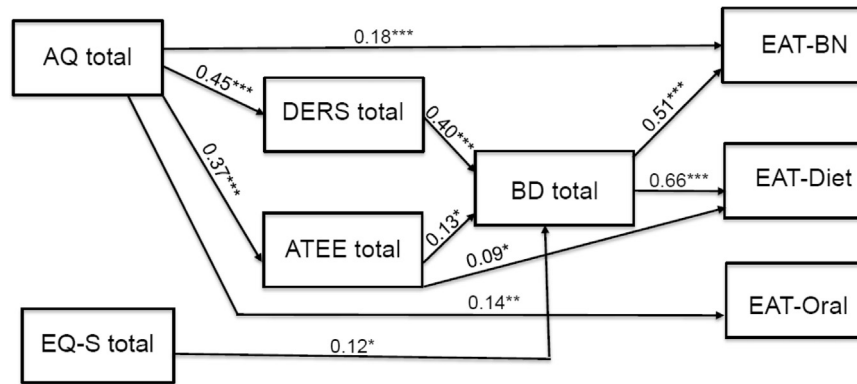
*** $p < 0.001$.
** $< 0.01$.
* $p < 0.05$.

**Fig. 2.** Significant associations among variables modelled in the autistic-emotional model for eating pathology. *p < 0.05; **p < 0.01; ***p < 0.001. AQ: Autism Quotient, EQ-S: Empathising; DERS: Difficulties in Emotion Regulation Scale; ATTE: Attitudes toward Emotional Expression Scale; BD: Body Dissatisfaction. Note: Covariates (age, gender and BMI), non-significant pathways and inter-correlations amongst variables are omitted from the figure for clarity of presentation.

### 3.3.1. Autistic traits, body dissatisfaction and eating pathology

In this revised model, the bulimia subscale was significantly predicted by AQ ($\beta=0.18$, $p < 0.001$, two-tailed) and body dissatisfaction ($\beta=0.51$, $p < 0.001$), the EAT-26 dieting subscale was significantly related to body dissatisfaction ($\beta=0.66$, $p < 0.001$) and ATEE total ($\beta=0.09$, $p=0.040$), and the oral control subscale was significantly predicted by AQ total ($\beta=0.14$, $p=0.008$). Body dissatisfaction was significantly predicted by the emotion dysregulation ($\beta=0.40$, $p < 0.001$) and ATEE total ($\beta=0.13$, $p=0.049$). The relationship between body dissatisfaction and empathising was marginally significant ($\beta=0.12$, $p=0.05$). These significant predictors (plus the covariates of age, BMI, and gender) accounted for 34%, 48%, 4%, and 25% of the variance in bulimic symptoms, dieting, oral control, and body dissatisfaction, respectively.

### 3.3.2. Emotion variables

Both negative attitudes towards emotions and emotion dysregulation were significantly predicted by AQ ($\beta=0.37$, $p < 0.001$ and $\beta=0.45$ $p < 0.001$, respectively). In total, 21% of the variance in emotion dysregulation and 14% of the variance in negative attitudes towards emotions was accounted for by these predictors and covariates.

### 3.3.3. Mediation effects

Examination of mediation effects – based on the significant paths shown in Fig. 2 – revealed that the total indirect effects from AQ total to EAT-26 dieting ($\beta=0.184$, 95% confidence intervals: 0.126, 0.242) and EAT-26 bulimia ($\beta=0.116$, 95% CIs: 0.078, 0.153) were significant. Further exploration of these pathways showed that the AQ-EAT-26 dieting relationship had significant indirect effects via emotion dysregulation and body dissatisfaction (AQ total→emotion dysregulation→body dissatisfaction→EAT-26 dieting; $\beta=0.118$, 95% CIs: 0.069, 0.167), but not via negative attitudes towards emotions and body dissatisfaction (AQ total→ negative attitudes towards emotions→body dissatisfaction→EAT-26 dieting; $\beta=0.032$, 95% CIs: −0.003, 0.066). Moreover, the AQ total-EAT-26 bulimia relationship had significant indirect effects via emotion dysregulation and body dissatisfaction (AQ total→ emotion dysregulation→body dissatisfaction→EAT-26 bulimia; $\beta=0.091$, 95% CIs: 0.051, 0.131), but not via negative attitudes towards emotions and body dissatisfaction (AQ total→negative attitudes towards emotions→body dissatisfaction→EAT-26 bulimia; $\beta=0.025$, 95% CIs: −0.002, 0.051). Finally, body dissatisfaction failed to significantly mediate the relationship between empathising and EAT-26 dieting ($\beta=0.076$, 95% CIs: −0.001, 0.152).

## 4. Discussion

This is the first study to investigate the mediating effect of negative attitudes towards emotions and emotion dysregulation on the relationship between autistic traits, body dissatisfaction and eating pathology. Our findings demonstrated positive correlations between most of the AQ scales, body dissatisfaction and EAT-26 scales, with the exception of attention to detail. The only scale not significantly related to any of the variables assessed was the EAT-26 oral control scale. Conversely, empathising was not significantly related to body dissatisfaction or any of the EAT-26 scales. The second main finding revealed that emotion dysregulation, but not negative attitudes towards emotions, mediated the relationship between AQ total score, body dissatisfaction and eating pathology in our autistic-emotional model. Direct effects were also observed, with AQ total scores being directly related to the EAT-26 bulimia and oral control subscales, however the effect size in both instances was small. Each of these findings is further discussed below.

### 4.1. The relationship between autistic traits, body dissatisfaction and eating pathology

#### 4.1.1. Autism Spectrum-Quotient (AQ)

The finding that disordered eating symptoms and the total AQ score were positively related, is supported by previous clinical (Westwood et al., 2015) and non-clinical (Carton and Smith, 2014; Coombs et al., 2011) studies. We found strong positive correlations between greater attention-switching difficulties and all EAT-26 subscales, a finding which has been supported by previous research investigating both clinical ED samples (Hambrook et al., 2008) and non-clinical populations (Carton and Smith, 2014). Relatedly, attention switching has been found to be associated with obsessive compulsive personality (OCPD) traits, which are considered an endophenotype for EDs, particularly AN (Calderoni et al., 2015). It is therefore unclear whether attention-switching difficulties in the present sample are related to predisposing OCPD traits associated with AN, or whether they are a manifestation of autistic traits. We also found significant relationships between the AQ social-skills and the AQ communication scales and the EAT-26 bulimia scale. This result corroborates findings from community samples (Carton and Smith, 2014) and also supports previous clinical work showing that amongst individuals with an ED, bulimic symptoms were related to deficits in social skills (Iwasaki et al., 2013) and theory of mind (Caglar-Nazali et al., 2014). Interestingly, for the first time in a non-clinical population, we found a significant relationship between the AQ-imagination and the EAT-26 bulimia subscale. It is possible that this finding is related to the

higher novelty seeking scores commonly associated with bulimic symptoms and behaviours (Atiye et al., 2015; Garrido and Subirá, 2012), however, this finding should await replication in future studies. Notably, attention to detail did not correlate with any of the EAT-26 subscales, a finding that has been corroborated by a recent meta-analysis in AN and controls (Westwood et al., 2015), although has been contradicted by previous non-clinical studies (Carton and Smith, 2014; Coombs et al., 2011) not included in the review. Further research assessing community and clinical samples is however required to verify these findings.

### 4.1.2. Empathising

The finding that problems with empathising were not significantly related to body dissatisfaction and eating pathology in the correlational analyses, is supported by the clinical ED studies showing no significant differences in empathising between AN patients and controls (Hambrook et al., 2008). This contradicts however, the finding by Baron-Cohen et al. (2013), who demonstrated significantly lower empathising scores in ED patients compared to controls, although as previously mentioned this result was only found in the younger ED individuals. Our findings also contradict the only other study assessing empathising in a community sample (Bremser and Gallup, 2012), which found that empathising was related to eating pathology. Interestingly, in our path-model, but not in the correlational analyses, the empathising-body dissatisfaction path was significant, indicating that relationships change once other factors are taken into consideration. It is also possible that empathising might vary in itself and that individuals with eating pathology, especially AN, could potentially hyperempathise with others, however further clinical and non-clinical studies are required to verify this assumption.

### 4.2. The assessment of the proposed autistic-emotional model for eating pathology

### 4.2.1. Direct effects of autistic traits on eating pathology

Overall our proposed model corresponded excellently with the data, even after the model was trimmed, providing support for the three-phase model of social and emotional functioning, which asserts that social-emotional difficulties act as both risk and maintaining factors for eating pathology, with deficits in affect regulation as a key component of the illness phase (Treasure et al., 2012). In regards to the direct paths, we found that the total AQ score was directly related to the EAT-26 bulimia and oral control subscales. The finding that AQ was a significant predictor for the EAT-26 bulimia scores might indicate the necessity to further assess AQ traits in individuals suffering from bulimic symptoms. Interestingly, in the clinical ED literature, to our knowledge, only one study has looked at BN in addition to AN (Iwasaki et al., 2013) and findings of this study revealed no significant differences in AQ scores between BN patients and controls. However, it should be noted that the study by Iwasaki et al. (2013) did find significant positive correlations between the EDI-bulimia scale and the AQ social skills scale. The finding that AQ was directly related to the EAT-26 oral control scale is in line with the findings by Coombs et al. (2011), who also found a significant association between the EAT-26 oral control subscale and the total AQ score. However, in our study, this finding was somewhat surprising given that the EAT-26 oral control scale was not significantly associated with any of the AQ scales in the initial correlational analyses. It is again possible that this relationship only becomes apparent when other variables in addition to sociodemographics are simultaneously included in the model. However, these findings should be interpreted with caution as effect sizes for these direct paths were small.

### 4.2.2. The indirect effects of autistic traits on body dissatisfaction and eating pathology

Our study is the first to demonstrate that emotional regulation difficulties, but not attitudes towards emotions, mediated the relationship between autistic traits, body dissatisfaction and eating pathology. These findings suggest that improvements in emotional regulation might reduce body dissatisfaction and eating pathology in people with autistic traits. Although no previous studies have investigated the mediating role of emotions in the relationship between autistic traits, body dissatisfaction and eating pathology, three recent studies have assessed anxious/depressive symptoms in EDs (Calderoni et al., 2015; Tchanturia et al., 2013) and depression and conduct problems in ASD (Garcia-Villamisar and Rojahn, 2015). The first study by Tchanturia et al. (2013) found that levels of autistic traits correlated with depression, anxiety and social interaction difficulties in an AN sample, however ED symptoms were not related to autistic traits. It is therefore possible that autistic traits might be indirectly related to eating pathology through depression, anxiety and lack of social skills. The findings from this study were corroborated by Calderoni et al. (2015), who assessed whether internalizing (anxious/depressive) symptoms were related to autistic traits in an AN-Restrictive (AN-R) group, by comparing the AN-R group to two control groups, a 'true' healthy control group (no internalizing symptoms) and a 'false' healthy control group (controls displaying internalizing symptoms similar to the AN-R group). The findings of this study revealed no significant differences in autistic traits between the AN-R group and the "false" control group, indicating that autistic traits may be linked to anxiety and depression rather than to AN-R per se. Finally, Garcia-Villamisar and Rojahn (2015), found that in an ASD sample, comorbid psychopathology frequently associated with ASD (e.g. depression, conduct problems etc.) and stress mediated the relationship between autistic traits and restrictive and repetitive behaviour in a sample of ASD individuals, and that their overall model explained 60% of the variation in repetitive behaviours. Given that our study is the first to test the autistic-emotional model, future studies are needed to verify our findings. In addition, other potential mediating variables, including comorbid psychopathology, stress and/or social competence, may be promising candidates for future studies interested in expanding our model. Finally, it should also be noted that emotion dysregulation was not directly related to eating pathology, but mediated by body dissatisfaction, highlighting the importance of body image disturbances in the development and maintenance of eating pathology (Stice et al., 2010).

### 4.3. Limitations of the current study

Although the present study increases our understanding of the relationships between autistic traits, emotions and eating pathology, the findings of this study must be interpreted in light of some important limitations. Firstly, despite the use of well-validated self-report measures, there remains the possibility of a social desirability bias hindering the validity of the results. It will therefore be important to validate these findings using measures that incorporate performance-based tasks and clinical interviews, such as the Autism Diagnostic Observational Schedule (ADOS) (Mandy and Tchanturia, 2015). Secondly, the cross-sectional design of this study precludes causal inferences, and future longitudinal studies would be better suited to disentangle the temporal order of ASD symptoms, emotion regulation difficulties, and disordered eating pathology. However, there are currently no longitudinal studies investigating autistic traits and eating pathology, so our study represents an excellent initial step in elucidating the mediating variables that might explain this relationship. Finally, while the large sample assessed is a considerable strength, to increase

generalizability, replication with a clinical ED sample comprising different ED psychopathologies is desirable.

### 4.4. Clinical implications

Despite the aforementioned limitations, this study has numerous strengths, including the utilisation of a large university sample and the novelty of the autistic-emotional model of autistic traits and eating pathology. The present findings suggest that prevention and intervention programs for eating pathology would likely benefit from addressing abnormalities in emotional processes in individuals who score highly on measures of autistic traits. Cognitive therapies that directly target deficits associated with autistic traits such as socio-emotional deficits and problems with attention switching, may be particularly effective in this population. Previous work has found that cognitive remediation therapy (CRT, Tchanturia et al., 2014) and emotion skills training (CREST, Tchanturia et al., 2015) was helpful for ED patients, which could be extended to individuals at risk for both autistic traits and eating pathology. Finally, as difficulties regulating emotions are associated with the development of a range of psychopathologies including EDs and ASD (Globerson et al., 2015), interventions targeting emotion regulation may provide a transdiagnostic approach to resilience and mental health promotion programs, and the prevention of psychopathology more broadly.

### 4.5. Conclusions

To conclude, the current study revealed that autistic traits, body dissatisfaction and eating pathology in a non-clinical student population were positively related and that emotional dysregulation mediated the relationship between these two problem sets. If corroborated, these findings could have important implications for prevention and early intervention programmes, which should focus on emotion regulation in individuals with autistic traits at risk for developing eating pathology. Future studies, ideally longitudinal, should examine both clinical ED and community populations utilising our autistic-emotional model, to clarify the direction of effects between the variables included in the model. This would also allow for better characterisation of the specific emotion dimensions that may elucidate the relationships between different autistic traits, body dissatisfaction and eating pathology.

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