Personality, self-appraisals, and body conscious emotions as predictors of symptoms of body dysmorphia and restrictive disordered eating

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Anorexia nervosa and body dysmorphic disorder are often co-morbid and relate to distortions in the perception of self-appearance. It has been proposed that they should be placed in a new body image disorders category in the DSM. Dimensional perspectives suggest that clinical and sub-clinical manifestations of these psychopathologies reside on the same continuum. We explored the correlates of sub-clinical restrictive disordered eating, and sub-clinical body dysmorphia in 396 participants. Our online study tested how sub-clinical restrictive disordered eating, and body dysmorphia relate to self-perceived attractiveness, self-esteem, body-shame, body-pride, authentic and hubristic pride, and personality as described in revised reinforcement sensitivity theory. Body dysmorphia shared significantly stronger positive correlations than restrictive disordered eating with behavioral inhibition sensitivity, body-shame, and body-guilt, and significantly stronger negative correlations with self-esteem, and self-perceived attractiveness. Restrictive disordered eating and body dysmorphia were negatively correlated with authentic and hubristic pride. Hierarchical regression showed that reinforcement sensitivity explained more variance in body dysmorphia than in restrictive disordered eating (Model 1). Self-esteem and self-perceived attractiveness explained more of the additional variance in body dysmorphia than in restrictive disordered eating (Model 2), as did the addition of body-shame, body-pride, authentic and hubristic pride (Model 3). Sub-clinical restrictive disordered eating and body dysmorphia relate to several constructs that may be important in understanding the development and/or maintenance of two proposed body image disorders: anorexia nervosa and body dysmorphic disorder.

Keywords: body dysmorphia, disordered eating, attractiveness, self-esteem, emotions, personality

Eating disorders (Wu et al., 2020) and body dysmorphic disorder (Minty & Minty, 2021) are worldwide public health concerns. Both anorexia nervosa and body dysmorphic disorder relate to distortions in the perception of self-appearance (Phillipou, Castle, & Rossell, 2019). Whereas anorexia nervosa is characterized by concerns about areas of the body such as the stomach and waist that are linked to weight control, body dysmorphic disorder can additionally relate to concerns about facial features (Toh et al., 2019). A dimensional perspective on eating disorders suggests that clinical and sub-clinical disordered eating behaviors reside on the same trait-like continuum (Wallace et al., 2020). A similar dimensional perspective suggests that clinical body dysmorphic disorder and sub-clinical body dysmorphia reside on the same trait-like continuum (Bala et al., 2021). The present study explores how sub-clinical restrictive disordered eating and sub-clinical body dysmorphia in the general population relate to personality, self-perceived attractiveness, self-esteem, and body and appearance related self-conscious emotions.

Anorexia nervosa and body dysmorphic disorder are psychiatric disorders that are related to disturbances in the perception of, and satisfaction with, one's own body image. Anorexia nervosa is typified by substantially low body weight, a fear of gaining weight, and abnormalities in how one's own body weight or shape is experienced (American Psychiatric Association, 2013). Body dysmorphic disorder is similar to anorexia nervosa as a significant disturbance in body image is present. However, it is typified by a perception of, and obsession with, one or more flaws or defects in one's own physical appearance. These flaws or defects may be slightly observable or unobservable to other people. Body dysmorphic disorder is typified by repetitive behaviors and/or cognitions that are related to the perception of these flaws and/or defects, and causes substantial distress and/or an impairment in social functioning. To reach a diagnosis of body dysmorphic disorder, the symptoms should not be better explained by a diagnosis of an eating disorder (American Psychiatric Association, 2013). Anorexia nervosa and body dysmorphic disorder are often comorbid (Cerea et al., 2018). In the DSM-5 anorexia nervosa is considered an eating disorder whereas body dysmorphic disorder is considered an obsessive compulsive-related disorder (American Psychiatric Association, 2013). However, considering the similarities of anorexia nervosa and body dysmorphic disorder, it has been proposed that the two disorders should be provided with a

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new diagnostic category such as 'body image disorders' (Phillipou et al., 2019).

Both anorexia nervosa and body dysmorphic disorder may relate to the perception of self-attractiveness. For example, body dysmorphic disorder relates to an underestimation of one's own attractiveness (relative to objective observers' ratings; Buhlmann, Etcoff, & Wilhelm, 2008), and anorexia nervosa relates to a belief that a lower body mass index (BMI) is more attractive (Tovee et al., 2000). Both anorexia nervosa (Blechert et al., 2011) and body dysmorphic disorder (Kuck et al., 2021) relate to low levels of self-esteem. Collectively, these studies on the perception of attractiveness and levels of self-esteem suggest that self-appraisals play an important role in the proposed body image disorders.

Feelings of body shame may be activated when a person believes that they have failed to satisfy aesthetic social norms (Tracy & Robins, 2004). Feelings of body guilt may reflect a form of negative self-appraisal concerning engagement, or lack of engagement, with behavior that affects diet and/or physical appearance (Calogero & Pina, 2011). By contrast, feelings of body pride may be activated by positive self-appraisals concerning one's own body or physical appearance. These feelings of body pride can be delineated into authentic body pride and hubristic body pride. Authentic body pride concerns pride experienced when controlling physical appearance, and hubristic body pride concerns pride experienced concerning uncontrollable aspects of the self, such as those aspects of one's appearance that are not self-modifiable (Castonguay et al., 2014). A self-report measure of mixed symptoms of self-reported disordered eating has been shown to be strongly positively correlated with body shame, body guilt, and weakly negatively associated with authentic body pride and hubristic body pride (Mendia et al., 2021).

Dispositional shame and guilt are both positively correlated with the personality trait of neuroticism (Woien et al., 2003). The observable trait of neuroticism is underpinned by the neuropsychological systems that are implicated in behavioral inhibition and fear (Smillie, 2008), which are described in the revised reinforcement sensitivity theory (rRST; Gray & McNaughton, 2000). In rRST (Gray & McNaughton, 2000) a behavioral approach system (BAS) is active when approach related behavior, consummatory behavior, and/or anticipated reward is experienced. By contrast, a fight-flight-freeze system (FFFS) is active when fear is experienced, and avoidance behavior is initiated following the detection of aversive or threat-related stimuli. A third system; a behavioral inhibition system (BIS) is active when environmental scanning is required, and when goal conflict and uncertainty are experienced. This is experienced as anxiety when the BAS and the FFFS are co-activated. In these situations, the BIS rectifies goal conflict by restraining either the BAS or the FFFS which allows the resulting ongoing behavior to continue. This allows feelings of anxiety to dissipate. From an rRST perspective, BAS sensitivity underpins variability in trait extroversion, whereas both FFFS and BIS sensitivity underpin variability in trait neuroticism (Smillie, 2008). Self-report research shows that restrictive disordered eating in anorexia nervosa relates to

elevated BIS and FFFS sensitivity and reduced BAS-reward interest and reduced BAS-reward reactivity relative to healthy controls (Wilson et al., 2019). Moreover, elevated sub-clinical restrictive disordered eating (which involves obsessing over food intake and body weight control behaviors) is related to elevated BIS and FFFS sensitivity (with BIS sensitivity being the more prominent predictor, du Rocher et al., 2021). Evidence concerning the role of rRST in understanding body dysmorphia is less readily available. However, body dysmorphia was positively correlated with BIS sensitivity in a study that used a BIS measure that was inspired by an older version of RST (Schieber et al., 2013).

The present study

The behavioral traits that are associated with eating disorders appear to reside on the same trait-like continuum as sub-clinical disordered eating behaviors (Wallace et al., 2020), and sub-clinical body dysmorphia and clinical body dysmorphic disorder also appear to reside on the same trait-like continuum (Bala et al., 2021). These perspectives suggest that dimensional views of anorexia nervosa and body dysmorphic disorder could be adopted whereby these clinical disorders are not seen as separate from the sub-clinical behaviors. Anorexia nervosa and body dysmorphic disorder share considerable nosological overlap, and the two disorders have been suggested to be placed together in a new and separate body image disorder category in the DSM (Phillipou et al., 2019). The present study addresses an important gap in the research literature, as there is a lack of information (derived from the same study) concerning how symptoms of both restrictive disordered eating and body dysmorphia in the general population, relate to self-perceived attractiveness, self-esteem, body and appearance related self-conscious emotions, and the dimensions of personality described in rRST (Gray & McNaughton, 2000).

Based on the above literature we hypothesize that self-reported sub-clinical restrictive disordered eating symptoms and self-reported sub-clinical body dysmorphia symptoms are negatively correlated with self-perceived attractiveness and self-esteem. Based specifically on Mendia et al. (2021) we hypothesize that sub-clinical restrictive disordered eating symptoms are positively correlated with body-shame and body-guilt, and negatively associated with authentic body pride and hubristic body pride. We test whether a similar relationship exists with sub-clinical body dysmorphia symptoms. Based on du Rocher et al. (2021) and Wilson et al. (2019) we hypothesize that sub-clinical restrictive disordered eating symptoms are positively correlated with BIS sensitivity and FFFS sensitivity. Based on Schieber et al. (2013) we hypothesize that sub-clinical body dysmorphia symptoms are positively correlated with BIS sensitivity.

We also plan to use hierarchical multiple regression to illustrate the cumulative effects of personality (reinforcement sensitivity), self-appraisal (self-esteem and perceived attractiveness), and body conscious emotions (body-shame, body-guilt, authentic pride, hubristic pride) upon the magnitude of self-reported symptoms of sub-clinical restrictive disordered eating, and self-reported symptoms of sub-clinical body dysmorphia.

METHOD

Participants and sampling procedure

Ethical approval was obtained from the Department of Psychology, Sociology, and Politics at Sheffield Hallam University. Participants gave informed consent, were informed of their right to withdraw, and were made aware of the study via online social media, or a departmental research participation scheme. No financial incentive was offered.

The survey was administered using the Qualtrics online survey platform where self-report surveys can be created and distributed. Any unanswered question(s) on any individual questionnaire activated a request message asking the participant if they wished to answer the missed question(s). This message could be either accepted and the missing question(s) answered, or the message could be declined by the participant before they were able to transition to the next page. Thus, missing responses could be due to a participant not wishing to answer a particular question for personal reasons, due to a random lapse of attention followed by a reluctance to revert to, and answer, the missed question, or due to a premature abort of the survey.

Initially, responses from 607 participants were recorded. However, 34.8% of these responses included one or more missing data points relating to individual items from the self-report questionnaires. Thus, we used Little's MCR test (using IBM SPSS version 26) to test if the data were missing completely at random (MCAR) for each of the seven individual questionnaire measures described below. This series of tests shows that the missing responses can be considered MCAR for the EAT-8 scale (Richter et al., 2016; $\chi^2[21] = 18.6$, $p = 0.612$), the BICI (Littleton, Axsom & Pury, 2005; $\chi^2[18] = 8.9$, $p = 0.962$), the RST-PQ-S (Vecchione & Corr, 2020; $\chi^2[62] = 66.9$, $p = 0.314$), the self-esteem scale (Rosenberg, 1965; $\chi^2[54] = 69.8$, $p = 0.073$), the SPA scale (Belmi & Neale, 2014; $\chi^2[3] = 3.1$, $p = 0.381$), the SRaORA scale (Visser, et al., 2010; $\chi^2[5] = 6.0$, $p = 0.307$), and the BASES (Castonguay et al., 2014; $\chi^2[132] = 122.6$, $p = 0.710$). These analyses therefore suggest that there were no unusual patterns of responses within the data for the seven individual questionnaires.

We wished to make sure that each paired comparison in the correlational analysis contained the same set of participants. Thus, we used complete case analysis and therefore excluded responses from participants who failed to fully complete all the questionnaires. Complete case analysis is not affected by any bias resulting from missing data if the data are MCAR, as the complete cases that are included in the analysis are representative of the cases with missing data (Hughes et al., 2019). Therefore, 396 participants with a mean age of 28.1 (SD=11.5) were entered into the analyses. The final sample comprised 317 females, 76 males and 3 participants who identified as non-binary. Of the 396 participants, 178 identified as students, and 40 of these students received departmental course credit for participation.

Measures

Restrictive disordered eating. Sub-clinical restrictive disordered eating symptoms were measured using the 8-item eating attitudes test (EAT-8; Richter et al., 2016) which is an anorexia nervosa screening instrument. Participants read statements relating to diet-related body-weight control and indicated if they agreed with the statements using a two-choice format. Higher scores indicated elevated restrictive disordered eating related behaviors. In the present study α = 0.82.

Body Dysmorphia. Sub-clinical body dysmorphia symptoms were measured using the 19-item Body Image Concern Inventory (BICI; Littleton, et al., 2005), which is a body dysmorphic disorder screening instrument. Participants read statements about feelings and behaviors relating to dissatisfaction with their own physical appearance and rated how often they experience these feelings or perform these behaviors. Responses were recorded using a 5-point Likert scale. Higher scores indicated greater levels of body dysmorphia related behaviors. In the present study α = 0.95.

Personality. Personality was measured using the 22-item Reinforcement Sensitivity Personality Questionnaire short version (RST-PQ-S; Vecchione & Corr, 2020). Participants read statements about day-to-day behaviors and feelings and rated how well each statement described them in general. Responses were recorded using a 4-point Likert scale. The RST-PQ-S contains 6 subscales: a 5-item BIS scale (containing statements about anxiety and worry), a 5-item FFFS scale (containing statements relating to fearfulness), and four BAS subscales (containing statements about reward-related and impulse-related behaviors). Thus, the RST-PQ-S subdivides the BAS construct into a 3-item BAS reward-interest (BAS-RI) subscale, a 3-item BAS goal-drive persistence (BAS-GDP) subscale, a 3 item BAS reward reactivity (BAS-RR) subscale, and a 3-item BAS impulsivity (BAS-I) subscale. In the present study α = 0.71 for BIS, α = 0.44 for FFFS, α = 0.63 for BAS-RI, α = 0.80 for BAS-GDP, α = 0.69 for BAS-RR, and α = 0.60 for BAS-I.

Self-esteem. Self-esteem was measured using the 10 item Rosenberg self-esteem scale (Rosenberg, 1965). Participants read statements about self-worth and how they feel about themselves and indicated how strongly they disagree/agree with the statements. Responses were recorded using a 4-point Likert scale. Higher scores indicate higher self-esteem. Likert scale. In the present study α = 0.91.

Perceived self-attractiveness. We administered the 3-item self-perceived attractiveness (SPA) measure (Belmi & Neale, 2014). Participants indicated how strongly they agree/disagree with statements concerning how attractive they think they are using a 7-point Likert scale. Higher scores indicated greater self-perceived attractiveness. In the present study α = 0.97. We also administered the 3-item self-rated and other-rated attractiveness (SRaORA) measure (Visser et al., 2010). Participants read statements concerning how attractive / sexually appealing they think they are (and how attractive / sexually appealing they think strangers think they are) and indicated where they rate themselves on a 7-point scale ranging from well below average to well above average. Higher scores indicated greater perceived self-rated and perceived other rated attractiveness. In the present study α = 0.94.

Body and appearance self-conscious emotions. We administered the 16-item body and appearance self-conscious emotions scale (BASES; Castonguay et al., 2014). The BASES contains 4 subscales in which participants rate using a 5-point Likert scale how often they experience body-

Table 1. Mean scores and 95% confidence intervals (95% CI) for each of the measures

	Mean	95% CI
Restrictive disordered eating		
EAT-8	4.7	4.5-5.0
Body Dysmorphia		
BICI	61.0	59.0-62.3
Personality		
BIS	14.9	14.6-15.2
FFFS	12.1	11.8-12.4
BAS-RI	6.5	6.3-6.7
BAS-GDP	8.5	8.3-8.7
BAS-RR	8.8	8.6-9.0
BAS-I	6.6	6.4-6.8
Self-esteem		
Self-esteem	15.9	15.3-16.5
Perceived self-attractiveness		
SPA	11.3	10.8-11.7
SRaORA	10.8	10.3-11.2
Body and appearance self-conscious emotions		
Body-shame	11.1	10.7-11.6
Body-guilt	11.5	11.1-12.0
Authentic pride	9.6	9.2-9.9
Hubristic pride	7.1	6.8-7.4

shame, body-guilt, authentic pride and/or hubristic pride. A 4-item body-shame subscale asks participants to read statements about how ashamed or inadequate they feel when thinking about their appearance. In the present study $\alpha = 0.95$. A 4-item body-guilt subscale asks participants to read statements about how guilty they feel about looking the way they do, and/or not putting enough effort into improving their appearance. In the present study $\alpha = 0.92$. A 4-item authentic pride subscale asks participants to read statements about how proud they are of the effort they put into maintaining/improving their appearance. In the present study $\alpha = 0.91$. A 4-item hubristic pride subscale asks participants to read statements about how proud they are that they are attractive and superior in appearance relative to others. In the present study $\alpha = 0.91$. Higher scores indicate greater frequency of the emotions.

Data analysis

We were interested in testing our hypotheses concerning how symptoms of restrictive disordered eating and body dysmorphia in the general population, relate to personality, self-perceived attractiveness, self-esteem, and body and appearance related self-conscious emotions. We were also interested in testing the cumulative effects of personality (reinforcement sensitivity), variables that reflect self-appraisals (self-perceived attractiveness, self-esteem), and body conscious emotions (body-shame, body-guilt, authentic pride, hubristic pride) on self-reported restrictive disordered eating and body dysmorphia symptoms. Thus, we chose to base our analysis on hierarchical multiple regression.

The data were analyzed using IBM SPSS version 26, and Jamovi version 2.2.50. Our initial analysis focused on two sets of zero-order correlations. The first set of zero-order

correlations were between sub-clinical body dysmorphia and the predictor variables of reinforcement sensitivity, self-esteem, self-perceived attractiveness, self-rated and other-rated attractiveness, body-shame, body-guilt, authentic pride, and hubristic pride. The second set of zero-order correlations were between sub-clinical restrictive disordered eating, and the same set of predictor variables (reinforcement sensitivity, self-esteem, self-perceived attractiveness, self-rated and other-rated attractiveness, body-shame, body-guilt, authentic pride, and hubristic pride). The next analysis used hierarchical multiple regression to test the effects of the combination of the key variables that were intercorrelated with sub-clinical body dysmorphia and sub-clinical restrictive disordered eating in the initial analysis. In all analyses BIS, FFFS, and BAS-I (impulsivity) were entered as predictors in Model 1, self-esteem and self-perceived attractiveness were added in Model 2, and body-shame, body-guilt, authentic pride, and hubristic pride were added in Model 3. Model 1 thus represents the effect of personality, Model 2 represents the effect of self-appraisals, and Model 3 represents the effect of body conscious emotions.

When using regression analysis, it has been suggested that $N > 104 + m$ (where m represents the number of predictor variables) is adequate when testing the Beta weights for the individual predictor variables (assuming a medium-sized relationship exists; Green, 1991). Our sample fulfilled this requirement in Model 3, which had the most predictors. By contrast, it was not viable to run the regression analyses separately for males and females to test the unique effects of the nine individual predictors as the sample of males was small. However, we were able to run the regression analysis separately for males and females to examine the overall model summaries.

RESULTS

Table 1 shows the mean scores and 95% confidence intervals (95% CI) for each of the measures. The data for each variable was either normally distributed or mildly skewed (all skew values < +/- 1.42; all kurtosis values < +/- 2). These values are below the acceptable levels of skew (-2 to + 2) and kurtosis (-7 to +7) for normal data proposed by Hair et al. (2010).

Bivariate correlations

Given the fact that the skew and kurtosis values fall within the acceptable limits proposed by Hair et al. (2010), and the finding that Pearson's r is not adversely affected by any minor deviations from normally distributed data (Havlicek & Peterson, 1976; Zeller & Levine, 1974), we used Pearson's r for the zero-order correlational analysis. Initially, we confirmed using Pearson's correlations that the EAT-8 (restrictive disordered eating) and BICI (body dysmorphia) measures were significantly positively correlated [$r(394)=0.59$, $p<0.001$].

Table 2 shows the zero-order Pearson's correlations between each of the measures and the EAT-8 (restrictive disordered eating) and BICI (body dysmorphia) measures. The correlates of sub-clinical restrictive disordered eating and sub-clinical body dysmorphia were similar. However, Table

Table 2. The zero-order Pearson's correlations between the rRST, self-esteem, perceived attractiveness, and body conscious emotions measures and the EAT-8 (restrictive disordered eating) and BICI (body dysmorphia) measures

	EAT-8	BICI
BIS	0.31***	0.57***
FFFS	0.10	0.08
BAS-RI	-0.01	-0.11*
BAS-GDP	0.04	-0.12*
BAS-RR	-0.03	-0.03
BAS-I	0.09	0.19***
Self-esteem	-0.38***	-0.63***
SRaORA	-0.22***	-0.38***
SPA	-0.28***	-0.50***
Body-shame	0.50***	0.79***
Body-guilt	0.49***	0.71***
Authentic pride	-0.18***	-0.23***
Hubristic pride	-0.16***	-0.28***

Note: $p \leq 0.05$*; $p \leq 0.01$**; $p \leq 0.001$***

2 shows that there were some observable differences in the magnitude of some of the correlation values relating to restrictive disordered eating, relative to those relating to body dysmorphia. Thus, we selectively tested if the correlations between sub-clinical body dysmorphia and BIS, body-shame, body-guilt, self-esteem, self-rated and other-rated attractiveness, and self-perceived attractiveness differed significantly from the correlations between sub-clinical restrictive disordered eating and BIS, body-shame, body-guilt, self-esteem, self-rated and other-rated attractiveness, and self-perceived attractiveness. To do this we used an online hypothesis test for comparing correlations (Lenhard & Lenhard, 2014). This test allows a comparison of correlations retrieved from the same sample and is calculated according to Eid, Gollwitzer and Schmidt (2011). The resulting Z tests showed that sub-clinical body dysmorphia shared significantly stronger positive correlations with BIS, body-shame, and body-guilt, and significantly stronger negative correlations with self-esteem, and self-perceived attractiveness, than sub-clinical restrictive disordered eating shared with these variables (all Zs > 3.70, all ps < 0.001).

As the tail of the distribution of the hubristic pride data was particularly long and thin, we re-confirmed the correlations between hubristic pride and the EAT-8 (restrictive disordered eating) and BICI (body dysmorphia) scores using non-parametric correlations. Spearman's rho showed that hubristic pride was significantly correlated with BICI scores [$rs(394)= -0.27$, $p<0.001$] and with EAT-8 scores [$rs(394)= -0.14$, $p=0.007$]. This pattern of non-parametric correlations follows what was obtained using the parametric Pearson's correlations depicted in Table 2.

Multiple correlations

We conducted separate hierarchical multiple regression analyses with EAT-8 (restrictive disordered eating) and BICI (body dysmorphia) scores as dependent variables (DVs). To keep the amount of predictor variables to a minimum, only correlates with an r value of above 0.15 in the correlational analysis presented in Table 2 were entered as predictors. Both self-perceived attractiveness and self-rated and other-rated attractiveness fulfilled these criteria. As they are almost identical constructs, and to avoid potential issues with multicollinearity, we included self-perceived attractiveness as a predictor as the correlations for self-perceived attractiveness in Table 2 were stronger than the correlations for self-rated and other-rated attractiveness.

Although multiple regression does not require the DV and predictor variables to be normally distributed, the residuals should ideally be normally distributed (Williams, Grajales, & Kurkiewicz, 2013). Examination of histograms and Q-Q plots at each stage of each regression analysis showed that the residuals were approximately normally distributed. Moreover, there were no obvious violations of the homoscedasticity assumption in the overall models (but there was some minor evidence of heteroscedasticity in the hubristic pride comparisons). We confirmed that there were no issues with multicollinearity, and no evidence of any nonlinear relationships between the predictor variables and the DV. Thus, the assumptions of multiple regression were not violated.

Our main analysis consisted of two different hierarchical multiple regression models. For ease of direct comparison between the body dysmorphia and restrictive disordered eating analyses, we present the standardized regression coefficients (and the 95% CIs around these coefficients) derived from the EAT-8 and BICI hierarchical regression analyses in the same table (Table 3). These standardized regression coefficients can be interpreted as a scale-free estimation of the effect-size of the relationship that each predictor shares with the DV (Kim, 2011).

In the analysis with sub-clinical restrictive disordered eating as the DV, Model 1 included BIS, FFFS, and BAS-I (impulsivity), which explained 9% of the variance in EAT-8 scores, with BIS being a significant individual predictor. Neither FFFS nor BAS-I (impulsivity) were significant individual predictors in the model. The addition of self-esteem and self-perceived attractiveness in Model 2 increased the amount of variance in EAT-8 scores explained by the regression to 16%, with self-esteem being a significant individual predictor. There were no other significant predictors in the model. The model change for model 2 was significant [R^2 change = 0.07; F change = 16.2; $p<0.001$]. The further addition of body-shame, body-guilt, authentic pride, and hubristic pride in Model 3 increased the amount of variance in EAT-8 scores explained by the regression to 27%, with body shame, and body guilt being significant individual predictors. There were no other significant predictors in the model. The model change for model 3 was significant [R^2 change = 0.12; F change = 16.1; $p<0.001$].

In the analysis with sub-clinical body dysmorphia as the DV, Model 1 included BIS, FFFS, and BAS-I (impulsivity), which explained 32% of the variance in BICI scores, with BIS being a significant individual predictor. Neither FFFS nor BAS-I (impulsivity) were significant individual predictors in the model. The addition of self-esteem and self-perceived attractiveness in Model 2 increased the variance in BICI scores explained by the regression to 49%, with BIS, BAS-I, self-esteem, and self-perceived attractiveness being

Table 3. The separate hierarchical multiple regression models with either EAT-8 (restrictive disordered eating) scores or BICI (body dysmorphia) scores as the Dependent Variable

| | Dependent Variables | | | |
| | EAT-8 (restrictive disordered eating) | | BICI (body dysmorphia) | |
	beta	95% CI	beta	95% CI
Model 1	Adjusted R^2 = 0.09***		Adjusted R^2 = 0.32***	
	$F_{(3,392)}$ 14.2		$F_{(3,392)}$ 62.3	
BIS	0.30	0.20 - 0.40 ***	0.56	0.47 - 0.65 ***
FFFS	0.06	-0.04 - 0.15	0.01	-0.07 - 0.10
BAS-I	0.00	-0.10 - 0.10	0.02	-0.06 - 0.11
Model 2	Adjusted R^2 = 0.16***		Adjusted R^2 = 0.49***	
	$F_{(5,390)}$ 15.6		$F_{(5,390)}$ 76.1	
BIS	0.11	-0.01 - 0.23	0.27	0.18 - 0.37 ***
FFFS	0.07	-0.03 - 0.16	0.03	-0.05 - 0.10
BAS-I	0.03	-0.07 - 0.13	0.08	0.00 - 0.15 *
Self-esteem	-0.25	-0.38 - -0.12 ***	-0.33	-0.43 - -0.23 ***
SPA	-0.10	-0.21 - 0.01	-0.23	-0.31 - -0.14 ***
Model 3	Adjusted R^2 = 0.27***		Adjusted R^2 = 0.69 ***	
	$F_{(9,386)}$ 17.2		$F_{(9,386)}$ 99.6	
BIS	0.05	-0.06 - 0.16	0.20	0.12 - 0.27 ***
FFFS	0.07	-0.02 - 0.15	0.03	-0.03 - 0.0
BAS-I	-0.01	-0.10 - 0.08	0.01	-0.05 - 0.07
Self-esteem	-0.04	-0.18 - 0.09	-0.07	-0.16 - 0.02
SPA	0.11	-0.02 - 0.25	0.04	-0.05 - 0.13
Body-shame	0.31	0.14 - 0.48 ***	0.54	0.43 - 0.65 ***
Body-guilt	0.26	0.11 - 0.41 ***	0.21	0.11 - 0.30 ***
Authentic pride	0.04	-0.07 - 0.16	0.14	0.07 - 0.21 ***
Hubristic pride	-0.04	-0.16 - 0.08	-0.06	-0.14 - 0.01

Note: $p \leq 0.05$*; $p \leq 0.01$**; $p \leq 0.001$***. BIS, FFFS, and BAS-I (impulsivity) are entered as predictors in model 1, self-esteem and self-percieved attractivness (SPA) are added in model 2, and body-shame, body-guilt, authentic pride, and hubristic pride are added in model 3. The beta values are the standardised coefficients, and the 95% CIs are the confidence intervals around these coefficients

significant individual predictors. FFFS was not a significant individual predictor. The model change for model 2 was significant [R^2 change = 0.17; F change = 66.0; $p<0.001$]. The addition of body-shame, body-guilt, authentic pride, and hubristic pride in Model 3 increased the variance in BICI scores explained by the model to 69%, with BIS, body-shame, body-guilt, and authentic pride being significant individual predictors. There were no other significant individual predictors. The model change for model 3 was significant [R^2 change = 0.21; F change = 65.7; $p<0.001$].

Sex differences

As the sample of males was small it was not viable to run the above analyses separately for males and females to test the unique effects of the nine individual predictors. However, we ran the hierarchical regression models separately for the sample of males, and the sample of females, solely to report the incremental change in adjusted R^2 for each stage of the analyses. For females in the EAT-8 (restrictive disordered eating) analysis model 1 was significant [adjusted R^2=0.07, $p<0.001$], as were model 2 [adjusted R^2=0.16, $p<0.001$], and model 3 [adjusted R^2=0.27, $p<0.001$]. For males in the EAT-8 (restrictive disordered eating) analysis model 1 was not significant [adjusted R^2=0.04, $p=0.101$], whereas model 2 was on the threshold of significance [adjusted R^2=0.08, $p=0.056$], and model 3 was significant [adjusted R^2=0.12, $p=0.041$]. For females in the BICI (body dysmorphia) analysis model 1 was significant (adjusted R^2=0.28, $p<0.001$), as were model 2 (adjusted R^2=0.50, $p<0.001$), and model 3 (adjusted R^2=0.70, $p<0.001$). For males in the BICI (body dysmorphia) analysis model 1 was significant [adjusted R^2=0.21, $p<0.001$], as were model 2 [adjusted R^2=0.42, $p<0.001$], and model 3 [adjusted R^2=0.64, $p<0.001$].

DISCUSSION

Sub-clinical body dysmorphia shared significantly stronger positive correlations with BIS, body-shame, and body-guilt than sub-clinical restrictive disordered eating shared with BIS, body-shame, and body-guilt. Moreover, sub-clinical body dysmorphia shared significantly stronger negative correlations with self-esteem and self-perceived attractiveness than sub-clinical restrictive disordered eating shared with self-esteem and self-perceived attractiveness. The negative correlations between both sub-clinical restrictive disordered eating and sub-clinical body dysmorphia and self-perceived attractiveness and self-esteem are consistent with research showing that both anorexia nervosa (Blechert et al., 2011), and body dysmorphic disorder (Kuck et al., 2021), relate to low levels of self-esteem. The positive correlation between sub-clinical restrictive disordered eating and BIS sensitivity is consistent with previous studies (du Rocher et al., 2021; Wilson et al., 2019), as is the positive correlation between sub-clinical body dysmorphia and BIS sensitivity (Schieber et al., 2013). Sub-clinical restrictive disordered eating and sub-clinical body dysmorphia shared positive correlations with body-related shame and body-related guilt which is consistent with previous research on disordered eating that used the BASES (Mendia, et al., 2021), and with research on restrictive disordered eating that used different measures of body-related shame and body-related guilt (Calogero & Pina, 2011). Moreover, sub-clinical body dysmorphia was negatively correlated with both authentic pride and hubristic pride, which is also consistent with the study by Mendia, et al. (2021).

The regression analyses showed that the combination of rRST variables explained more variance in sub-clinical body dysmorphia than sub-clinical restrictive disordered eating (in Model 1). Similarly, the addition of self-esteem and self-perceived attractiveness in Model 2 explained more of the additional variance in sub-clinical body dysmorphia than in sub-clinical restrictive disordered eating, as did the subsequent addition of the body conscious emotion variables in Model 3. One might argue that sub-clinical body dysmorphia is more strongly linked to the combination of self-esteem and self-perceived attractiveness than is sub-clinical restrictive disordered eating due to some conceptual overlap between the measures. For example, the questions that assessed body dysmorphia symptoms could be considered to share more conceptual overlap with self-perceived attractiveness and self-esteem, than the questions that assessed restrictive disordered eating symptoms share with self-perceived attractiveness and self-esteem. However, this type of argument does not explain why the combination of rRST variables (in Model 1) also explained more variance in sub-clinical body dysmorphia than sub-clinical restrictive disordered eating. This effect was predominantly driven by BIS sensitivity. In rRST (Gray & McNaughton, 2000) BIS activity is increased when anxiety is experienced during cautious risk assessment, and when scanning the environment for potential threats. In cases of sub-clinical body dysmorphia (or body dysmorphic disorder), the observation of perceived facial flaws in a mirror might be more strongly related to BIS activity than the observation of body weight and/or shape in cases of sub-clinical restrictive disordered

eating (or anorexia nervosa). However, we note that the questions in the BICI do not exclusively refer to dysmorphia concerning the face region of the body.

According to rRST (Gray & McNaughton, 2000) BIS activity will often restrain motor responses when task relevant stimuli elevate levels of goal conflict. From this perspective, any stimuli perceived as causing this goal conflict will have their neural representation altered and tagged as something that is possibly at fault and needs further checking. Therefore, rRST suggests that when these tagged stimuli are re-experienced, they will be processed with a greater level of behavioral inhibition. In sub-clinical restrictive disordered eating (or anorexia nervosa) the perception of unwanted body weight would likely activate this tagging process, which may inhibit food consumption. In sub-clinical body dysmorphia (or body dysmorphic disorder) perceived flaws may also activate this tagging process, which, in turn, may activate the obsessive-compulsive checking behaviors. Thus, rRST can offer a similar neuropsychological explanation of the interruption of motor responses in both restrictive disordered eating and body dysmorphia. This tagging process may also activate body conscious emotions, as body shame and body guilt clearly contributed to Model 3 of the regression analysis for both sub-clinical body dysmorphia and sub-clinical restrictive disordered eating. For example, feelings of body shame may be related to a belief that one has failed to satisfy aesthetic social norms (Tracy & Robins, 2004), which could reflect a form of goal conflict. Similarly, feelings of body guilt may relate to a lack of perceived control concerning weight and/or physical appearance (Calogero & Pina, 2011), which could also reflect a form of goal conflict.

The present study has an important practical implication. Our data suggests that future clinical intervention studies might investigate the utility of reducing body shame and body guilt, as well as BIS sensitivity in cases of anorexia nervosa and body dysmorphic disorder. It is also noteworthy that self-reported BIS sensitivity shares a negative correlation with self-reported attentional control ability (du Rocher et al., 2021), and that anxiety and attentional control abilities share a substantial genetic correlation (Gagne et al., 2017). Thus, it is possible that the effect of the neuropsychological tagging process described above would be exacerbated if those high in BIS sensitivity also have a deficit in attentional control and cannot shift attention away from thoughts of weight gain or perceived flaws in physical appearance. Thus, future intervention studies might investigate how dispositional attentional control ability affects any intervention for anorexia nervosa or body dysmorphic disorder that is based on reducing BIS sensitivity, body shame and/or body guilt.

Body dysmorphic disorder is highly comorbid with social anxiety disorder, and treatment protocols for the two disorders can be similar (Fang & Hofmann, 2010). Anorexia nervosa is also characterized by elevated levels of social anxiety (Kerr-Gaffney, Harrison, & Tchanturia, 2018), and trait social interaction anxiety and trait social phobia share a positive zero-order correlation with BIS sensitivity (du Rocher & Warfield, 2022). Therefore, future studies might benefit from testing whether the correlations between BIS sensitivity and body dysmorphia, or BIS sensitivity and an-

orexia nervosa, differ in participants with high levels of these subtypes of trait social anxiety relative to participants with low levels of these subtypes of trait social anxiety.

The significance of the present study is that we have provided novel information concerning how symptoms of restrictive disordered eating and body dysmorphia in the general population relate to self-perceived attractiveness, levels of self-esteem, body and appearance related self-conscious emotions, and the dimensions of personality described in rRST (Gray & McNaughton, 2000). Moreover, the comparisons between the predictor variables and symptoms of restrictive disordered eating, and the comparisons between the predictor variables and symptoms of body dysmorphia, have been conducted on data derived from the same sample of participants. We have illustrated how the study of personality as described in rRST (Gray & McNaughton, 2000) can inform our understanding of restrictive disordered eating and body dysmorphia. Currently, evidence concerning the role of rRST in understanding sub-clinical body dysmorphia is rare and has relied on using a BIS measure that was inspired by an older version of RST (Schieber et al., 2013).

The behavioral traits that are associated with eating disorders are proposed to reside on the same trait-like continuum as sub-clinical disordered eating behaviors (Wallace et al., 2020), and clinical body dysmorphic disorder is proposed to reside on the same trait-like continuum as sub-clinical body dysmorphia (Bala et al., 2021). These dimensional views of anorexia nervosa and body dysmorphic disorder infer that the clinical disorders are not separate from the sub-clinical behaviors. Therefore, it is important to understand how bio-behavioral traits (such as those described in rRST), and other dispositional self-referent emotion variables measured in the present study, relate to self-reported behaviors indicative of restrictive disordered eating and body dysmorphia. Moreover, anorexia nervosa and body dysmorphic disorder share considerable nosological overlap, and the two disorders have been suggested to be placed together in a new and separate body image disorder category in the DSM (Phillipou et al., 2019). Thus, the present study has produced data exposing the correlates of symptoms of restrictive disordered eating and body dysmorphia, that may inform the debate concerning the possible re-categorization of anorexia nervosa and body dysmorphic disorder.

Limitations

The present study is informative, but it does have some limitations. Firstly, there were more females than males (or non-binary participants) in our sample; therefore, a replication focusing on male participants would be useful. However, although the male sample was too small to test individual predictor effects, we did test the overall model summaries separately for males and females. Secondly, we used a measure of body dysmorphia that assesses symptoms of body dysmorphic disorder. However, the DSM-5 describes a similar disorder termed muscle dysmorphia which mainly affects males (American Psychiatric Association, 2013). A replication might test whether muscle dysmorphia relates to our predictor variables in the same way as body dysmorphia and restrictive disordered eating. Thirdly, we measured restrictive disordered eating as a sub-clinical form of anorexia

nervosa type behaviors. However, as our study was conducted online, we did not ask participants for their body mass index (BMI), which is important when diagnosing anorexia nervosa.

Fourthly, the Pearson correlations in Table 2 can be considered a scale free index of an effect size of an association between our variables, and the standardized regression coefficients in Table 3 can be interpreted as a scale free estimation of the effect-size of the relationship that each predictor variable shares with the DVs (Kim, 2011). In the present study, the DVs in the regression models were the total scores of the EAT-8 or BICI measures. However, the EAT-8 measure of restrictive disordered eating included fewer items than the BICI measure of body dysmorphia. Thus, we cannot rule out the possibility that if there were more items (in effect, a broader range of questions) that contributed to the total score of the restrictive disordered eating measure, that this could alter the magnitude of the relationship between restrictive disordered eating and the other measures.

Fifthly, the data were all collected cross-sectionally, which negates efficiently testing any mediation pathways between our trait variables. In short, mediation analysis on our data could facilitate a temporal illusion whereby one of the variables appeared to have been experienced by participants before one of the other variables was experienced by participants (Roe, 2012). The absence of any longitudinal evidence to facilitate forming any causal hypotheses would make such an analysis in the present study particularly vulnerable to this problem, as all the variables measured trait like behavior derived from self-report data, that was reported by participants at the same time. However, future longitudinal evidence may provide the basis for a mediation hypothesis and a subsequent re-analysis.

Conclusion

Anorexia nervosa and body dysmorphic disorder might be re-categorized as body image disorders (Phillipou et al., 2019) and sub-clinical restrictive disordered eating and sub-clinical body dysmorphia are thought to reside on the same trait-like continuums as anorexia nervosa and body dysmorphic disorder respectively (Wallace et al., 2020; Bala et al., 2021). We tested how sub-clinical restrictive disordered eating and sub-clinical body dysmorphia, relate to personality, self-perceived attractiveness, self-esteem, and body and appearance related self-conscious emotions. Body dysmorphia shared significantly stronger positive correlations than restrictive disordered eating with BIS sensitivity, body-shame, and body-guilt, and significantly stronger negative correlations with self-esteem, and self-perceived attractiveness. Restrictive disordered eating and body dysmorphia were negatively correlated with authentic pride and hubristic pride. Cumulatively, our predictor variables explained more variance in sub-clinical body dysmorphia than in sub-clinical restrictive disordered eating. Whereas one might expect sub-clinical body dysmorphia to be better predicted than sub-clinical restrictive disordered eating by variables such as attractiveness and self-esteem, this effect was also present for the combination of the rRST variables, with BIS sensitivity being the prominent predictor. We have compared sub-clinical body dysmorphia and sub-clinical restric-

tive disordered eating to some important measures of personality, self-appraisal and body conscious emotion that may be important in understanding the development and maintenance of anorexia nervosa and body dysmorphic disorder.

ACCOUNTS

Ethics statement

Participants gave informed consent and had the right to withdraw. The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki.

Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Data

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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