



LJMU Research Online

Mele, S, Cazzato, V, Di Taranto, F, Maestro, S, Fabbro, F, Muratori, F and Urgesi, C

Altered exposure-related reshaping of body appreciation in adolescent patients with anorexia nervosa

<http://researchonline.ljmu.ac.uk/id/eprint/4196/>

Article

Citation (please note it is advisable to refer to the publisher's version if you intend to cite from this work)

Mele, S, Cazzato, V, Di Taranto, F, Maestro, S, Fabbro, F, Muratori, F and Urgesi, C (2016) Altered exposure-related reshaping of body appreciation in adolescent patients with anorexia nervosa. *Body Image*, 19. ISSN 1873-6807

LJMU has developed **LJMU Research Online** for users to access the research output of the University more effectively. Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Users may download and/or print one copy of any article(s) in LJMU Research Online to facilitate their private study or for non-commercial research. You may not engage in further distribution of the material or use it for any profit-making activities or any commercial gain.

The version presented here may differ from the published version or from the version of the record. Please see the repository URL above for details on accessing the published version and note that access may require a subscription.

For more information please contact researchonline@ljmu.ac.uk

<http://researchonline.ljmu.ac.uk/>

1 Running Head: **FAMILIARITY** AND BODY APPRECIATION IN ANOREXIA

2

3 **Altered Exposure-Related Reshaping** of Body Appreciation in Adolescent

4 **Patients with Anorexia Nervosa.**

5

6

Abstract

7 Several studies suggest a relation between repeated exposure to extremely thin bodies in
8 media and the perceptual and emotional disturbances of body representation in anorexia
9 nervosa (AN). In this study, we utilized an exposure paradigm to investigate how perceptual
10 experience modulates body appreciation in adolescents with AN as compared to healthy
11 adolescents. Twenty AN patients and 20 healthy controls were exposed to pictures of thin or
12 round models and were then required to express liking judgments about bodies of variable
13 weight. Brief exposure to round models increased the liking judgments of round bodies but
14 not those of thin bodies in healthy adolescents. Furthermore, exposure to round models
15 increased the liking judgments of both thin and round bodies in adolescents with AN. Patients
16 did not show any change of liking judgments after exposure to thin models. These results
17 point to weak norm-based reshaping of body appreciation in AN patients.

18

19 *Keywords:* body image; esthetic appreciation; perceptual adaptation; anorexia
20 nervosa; configural processing

21

22

23 Introduction

24 Eating disorders (EDs) are a unique case in psychiatry because of the etiological role
25 attributed to social and cultural factors. Since the overwhelming majority of individuals who
26 develop an EDs are women (Stice, Marti, & Rohde, 2013), attention has been paid to cultural
27 influences on the formation of woman identity and to the views of the social and family role
28 of women in Western society. In particular, the ideal of thinness conveyed by mass media has
29 been shown to negatively impact body image (Derenne & Beresin, 2006; Hausenblas,
30 Campbell, Menzel, Doughty, Levine & Thompson 2013; Keel & Forney, 2013; Stice, 2002).
31 The constant proposal of ultra-thin models in the media may lead to the internalization of
32 lean body ideals of beauty, contributing to increase the degree of body dissatisfaction in
33 adolescent and young women (Benowitz-Fredericks, Garcia, Massey, Vasagar, &
34 Borzekowski, 2012; Calado, Lameiras, Sepulveda, Rodríguez, & Carrera, 2010; Groesz,
35 Levine, & Murnen, 2002; Hoek, 2006; Rodgers, Salès, & Chabrol, 2010; Stice, Schupak-
36 Neuberg, Shaw, & Stein, 1994; Sypeck, Gray, Etu, Ahrens, Mosimann & Wiseman, 2006;
37 Voracek & Fisher, 2002). Internalizing ideals of ultra-thin beauty is more likely to affect
38 adolescents than adult women, because adolescence is a dynamic phase of life, with many
39 psychological and physical changes, which may make adolescents more sensitive to approval
40 and recognition from others (Presnell, Bearman & Stice, 2004; Siervogel et al., 2003). Those
41 who are dissatisfied with their bodies are also more likely to engage in potentially harmful
42 weight-control behaviors and they are at risk of developing EDs (Moore, 1993). This urges
43 the study of how media exposure affects body perception and its appreciation in adolescents.

44 Studies of face attractiveness have extensively demonstrated that familiarity is a
45 crucial factor in driving our appreciation of others' faces (Langlois et al., 2000; Langlois &
46 Roggman, 1990; Pollard, 1995) and that perceptual experience modulates attractiveness

47 judgments of faces (Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003) and also what we
48 find normal or average in a face (Leopold, O'Toole, Vetter, & Blanz, 2001). More limited is
49 research on the influence of perceptual experience on the ratings of normality and
50 attractiveness of body figures. Winkler and Rhodes (2005) asked participants to make
51 judgments of normality and attractiveness of bodies before and after exposure to a particular
52 body weight. The results showed that exposure to both thin and round models modulated
53 normality judgments, thus shifting perceived normality toward the adapted weight.
54 Conversely, the judgment of body attractiveness was modulated only after exposure to thin
55 models, but not after exposure to round models. Another study (Glauert, Rhodes, Byrne,
56 Fink, & Grammer, 2009) showed that the degree of body dissatisfaction and internalization of
57 Western ideals are negatively correlated with the effects of exposure to round models.
58 Indeed, women with high body dissatisfaction did not change their body attractiveness
59 judgments after exposure to round models, suggesting that body dissatisfaction may be
60 associated with an asymmetric influence of perceptual experience on body appreciation. All
61 in all, these studies showed that exposure to body models can change body appreciation
62 either by changing the way in which bodies are perceived or by reshaping the aesthetic norms
63 to which they are compared.

64 In line with this view, two non-mutually-exclusive mechanisms have been proposed
65 to explain the experience-based reshaping of body appreciation, namely perceptual
66 aftereffects and norm-based coding (Cazzato, Mian, Mele, Tognana, Todisco & Urgesi 2016;
67 Mele, Cazzato, & Urgesi, 2013) *Perceptual aftereffects* occur when exposure to certain
68 features of a stimulus modifies perception in the opposite direction to that of the adapted
69 features (Thompson & Burr, 2009); for example, if an observer is exposed for a while to
70 round body models, subsequently presented bodies appear thinner, while the opposite occurs

71 after exposure to thin models. These perceptual alterations may then influence body
72 appreciation, explaining more positive ratings after exposure to round models and more
73 negative ones after exposure to thin models. Crucially, these perceptually driven modulations
74 of body appreciation are expected to be independent from the similarity between the weight
75 of the model and the weight of the stimulus body (Glauert et al., 2009; Mohr et al., 2016;
76 Thompson & Burr, 2009; Winkler & Rhodes, 2005). In other words, both round and thin
77 bodies are expected to be perceived as thinner and, thus, probably liked more after exposure
78 to round adapting bodies, while the opposite pattern is expected after exposure to thin
79 adapting bodies.

80 Conversely, according to *norm-based coding* mechanisms (Dennett, McKone,
81 Edwards, & Susilo, 2012; Maurer, Grand, & Mondloch, 2002; Reed, Stone, Grubb, &
82 McGoldrick, 2006; Trujillo, Jankowitsch, & Langlois, 2014; Valentine, 1991; Valentine,
83 Darling, & Donnelly, 2004), body exposure may reshape a prototype-referenced template that
84 is used to perceive and appreciate body stimuli. Thus, the appreciation of body stimuli that
85 are similar to the model (e.g., round bodies after exposure to round models) increases, while
86 the appreciation of body stimuli that deviate from the model (e.g., thin bodies after exposure
87 to round models) decreases.

88 In sum, while perceptual aftereffects predict parallel changes of the perception and
89 appreciation of thin and round bodies after body exposure, norm-based mechanisms would
90 induce opposite modulation on the perception and appreciation of thin and round body
91 stimuli. However, previous studies (Glauert et al., 2009; Winkler & Rhodes, 2005) have
92 focused on estimating which body figure appears mostly attractive after body exposure,
93 which prevented them to disentangle between the two mechanisms. Exploring the different
94 effects exerted by body exposure on the appreciation of thin and round body stimuli, it has

95 been shown that both mechanisms are in action during body exposure in healthy adults
96 (Cazzato et al., 2016; Mele et al., 2013). Conversely, only perceptual aftereffects may explain
97 the consequences of body exposure in adult patients with AN, since a parallel increase of the
98 liking of both thin and round body stimuli was observed after exposure to round bodies
99 (Cazzato et al., 2016). This might point to weak norm-based reshaping of body ideals (Urgesi
100 et al., 2014) and abnormally strong perceptual aftereffects after exposure to body models in
101 AN patients.

102 In the present study, we aimed to test if similar alterations characterize body exposure
103 effects in adolescence, which may be a critical age for the establishment of body ideals, and
104 how they are associated with specific personality traits that have been previously shown to
105 mediate body exposure effects. To this aim, we investigated how the liking judgments of
106 body stimuli change after exposure to round and thin models in a group of adolescent patients
107 with AN as compared to healthy adolescents. We utilized the same modified body exposure
108 paradigm used in Mele and coworkers (2013), which allows testing the relative contribution
109 of perceptual aftereffects and norm-based coding. We expected to replicate in healthy
110 adolescents the same pattern of findings previously obtained in adults (Cazzato et al., 2016;
111 Mele et al., 2013), with an asymmetric modulation of appreciation of round, but not of thin
112 bodies; however, we could also expect greater sensitivity to exposure in adolescents as
113 compared to adults, because their ideals of beauty may be in development. Conversely, we
114 expected a different pattern of effects in AN patients, who have body image disturbances and
115 may present a paradoxical increase of the appreciation of both round and thin bodies after
116 exposure to round bodies (Cazzato et al., 2016). Additionally, we explored how the effects of
117 body exposure on liking judgments were related to body dissatisfaction, interoceptive deficits
118 and internalization of Western ideals. Finally, we also controlled that any difference between

119 patients and controls were not only due to difference in the observers' body mass index
120 (BMI). Indeed, a recent study (George, Cornelissen, Hancock, Kiviniemi, & Tovée, 2011) in
121 patients with AN and healthy controls has showed that the observers' body weight affects
122 perception of others' body size and this, in turn, modulates attractiveness ratings. In
123 particular, in both groups BMI was a strong predictor of attractiveness judgment, but
124 observers with anorexia nervosa overestimated body size relative to controls. Thus, we also
125 tested whether the different exposure effects in patients and controls were reliable after
126 controlling for their variance in BMI.

127 **Method**

128 **Participants**

129 A total of 40 female adolescents were enrolled: 20 patients with a diagnosis of AN
130 and 20 healthy volunteers. A further patient was also recruited and tested but not included in
131 the study analyses since she missed a matched healthy control. Patients were recruited at a
132 scientific institute and rehabilitation hospital. They were recruited over a 12-month period on
133 the basis of a sequential recruitment procedure, according to which all the patients referred to
134 as suffering from AN in the recruitment period were screened for inclusion and exclusion
135 criteria. The main inclusion criteria were age between 12 and 18 years and diagnosis of AN
136 restrictive (AN-R) or purge-binge (AN-PB) type, according to DSM-IV-TR. Exclusion
137 criteria for patients included a history of a different type of EDs (bulimia nervosa or eating
138 disorder not otherwise specified); any personality or psychotic disorder; a history of traumatic
139 brain injury or any other neurological illness. Sixteen patients were diagnosed as AN-R, four
140 patients as AN-PB (for bingeing behavior). No patient had a clinical history of a different ED.
141 Patients with mood or anxiety disorders were not excluded to select a more representative
142 sample of AN patients, considering the high comorbidity of ED disorder with mood and

143 anxiety disorders (Godart et al., 2007). Patients aged 12-18 years ($M = 15.45$, $SD = 1.75$) and
144 their BMI at the time of testing was on average 16.57 Kg/m^2 ($SD = 2.06$). All patients were
145 medication-free at the time of testing, while 13 received individual and/or group and/or
146 family therapy.

147 Control participants were recruited from the local community by word of mouth and
148 through advertisements. They were matched for age, gender, race, language, education,
149 socio-economical status, and IQ as evaluated by means of the Raven Standard Progressive
150 Matrices test. A difference of no more than 12 months was allowed between each patient's
151 age and the matching control. Control participants aged 12-19 years ($M = 15.23$, $SD = 1.92$)
152 and their BMI at the time of testing was on average 20.65 Kg/m^2 ($SD = 2.61$). Exclusion
153 criteria for controls included history of any type of EDs, being under medication at the time
154 of testing, presence of any psychiatric or neurological disorder, history of psychiatric
155 disorders among first-degree relatives, history of alcohol or substance abuse or dependence,
156 and any current major medical illness. All participants, except two controls, were right-
157 handed according to a standard handedness inventory (Briggs & Nebes, 1975). All
158 participants reported normal or corrected-to-normal visual acuity in both eyes. They were
159 native Italian speakers of Caucasian race. The demographic and clinical characteristics of the
160 patients and controls are reported in Table 1. In keeping with the diagnosis, the AN patients
161 had a lower BMI with respect to the controls, while the two groups did not differ for
162 educational level and IQ.

163 All participants were naïve as to the purposes of the experiment and were debriefed at
164 the end of the experimental session. Informed consent was obtained from all patients and
165 controls and their parents provided written informed consent. The procedures were approved
166 by the local ethical committee. The study was carried out in accordance with the guidelines of
167 the Declaration of Helsinki.

168

169 Clinical Evaluation

170 Standard clinical scales were administered in order to characterize the patients'
171 disorder as compared to the controls. All participants were administered the Schedule for
172 Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime
173 version (K-SADS-PL) (Kaufman et al., 1997) to confirm the diagnosis in AN patients and
174 exclude any exclusion criteria in both groups. The Symptom Checklist-90-Revised (SCL-
175 90R) was administered to assess a wide range of psychological problems and both
176 internalizing (depression, somatization, anxiety) and externalizing (aggression, hostility,
177 impulsivity) symptoms of psychopathology. In addition to these clinical measures that were
178 used to screen patients and controls, we also measured Body Dissatisfaction (reliability
179 coefficients: .93 in adolescents with AN-R .93 and .96 in adolescents with AN-PB) and
180 Interoceptive Awareness (reliability coefficients: .89 in adolescents with ED) using the Italian
181 version of the Eating Disorder Inventory-3 (EDI-3) (Garner, 2004), and the degree of mass
182 media internalization of models presented by mass media, using the Sociocultural Attitudes
183 Toward Appearance Questionnaire-3 (SATAQ-3; Thompson, Van den Berg, Roehrig,
184 Guarda, & Heinberg, 2004) in its Italian translation (Stefanile, Matera, Nerini, & Pisani,
185 2011; reliability coefficients in healthy adolescent girls: Information = .91, Pressures = .91,
186 Internalization-General = .94, Internalization-Athlete = .84). The Body Shape Questionnaire
187 (Cooper, Taylor, Cooper, & Fairburn, 1987), the Body Attitude Test and the Body
188 Uneasiness Test (Cuzzolaro, Vetrone, Marano, & Garfinkel, 2006) were also administered to
189 both patients and controls but data were non considered in the present study and are reported
190 in supplementary material.

191 Experimental Stimuli and Tasks

192 **Stimuli.** The stimuli were taken from previous studies (Cazzato, Siega, & Urgesi,
193 2012; Mele et al., 2013) and depicted six 3-D human figure models (3 females) from the
194 database of Poser Pro 2010 (e-frontier, Santa Cruz, CA). Each model was rendered in four
195 different daily poses, either static (e.g., standing) or implying motion (e.g., walking, running),
196 each taken from a frontal and a three-quarter view. For each posture and view, the models'
197 body size was manipulated with the Poser software to have moderate to extreme levels of
198 round and thin figures. Hence, a total of 16 images were created for each model: 4 postures x
199 2 views x 4 body sizes. The models were depicted with the face scrambled, wearing black
200 underwear and on a grey background to reduce the influence of non-bodily cues. The 16
201 images of four models (2 females) were utilized during the pre- and post-exposure evaluation
202 phases (64 evaluation stimuli), whereas the extreme round and thin figure images of the
203 remaining 2 models (1 female) were utilized for the exposure phase (16 exposure stimuli).
204 The body stimuli were used in a previous study in which we asked a large number of
205 participants to judge the weight and other perceptual and affective dimensions of each
206 stimulus (Cazzato et al., 2012); the results of this study showed a parametric correspondence
207 between the intended manipulation of body weight and the perceptual judgments of
208 participants who rated the stimuli as varying from extremely thin to extremely round.
209 Furthermore, similar patterns of results were obtained for the ratings related to attractiveness
210 and beauty dimensions as for those related to the subjective judgments of liking. We
211 presented both male and female body stimuli in order to control for the effects of the
212 emotional connotation that female bodies may have for patients with anorexia nervosa, thus
213 telling apart the role of perceptual mechanisms, which should be comparable for male and
214 female bodies, and emotional/motivational factors, which should be specific for female
215 bodies. Nevertheless, previous studies (Cazzato et al., 2016; Mele et al., 2013) have shown
216 comparable exposure effects for male and female bodies in women.

217 **Procedure.** The experiment was composed of three daily sessions, each one
218 consisting of three phases: (1) initial evaluation of the stimuli (pre-exposure phase); (2)
219 exposure phase; and (3) re-evaluation of the stimuli after exposure (post-exposure phase) (see
220 Fig. 1). The three sessions were conducted in three separate days with a waiting period
221 ranging from three to seven days. The session order was balanced between participants. In
222 each session, the participants were administered the same pre- and post-evaluation procedures
223 with different exposure conditions. In the two main exposure conditions, they received only
224 the eight round body stimuli (round exposure) or the eight thin body stimuli (thin exposure).
225 In a third control exposure condition, participants received both round and thin body stimuli,
226 with a 1:1 matching of the number of round and thin figures (control exposure).

227 During the experimental sessions, participants sat 40 cm away from a 18-inch LCD
228 monitor (resolution: 1,280 X 800 pixels; refresh frequency: 60 Hz) on which stimuli appeared
229 on a grey background and subtended a 12° X 10° square region around the fovea. The
230 stimulus-presentation timing and randomization were controlled with E-prime V2.0
231 (Psychology Software Tools Inc., Pittsburgh, PA) on a PC.

232 **Pre- and post-exposure phase.** The 64 evaluation stimuli were randomly presented
233 in three blocks, for a total of 192 trials. Each trial started with the presentation of a central
234 fixation point lasting 500 ms, followed by the body image stimulus presented for 150 ms at
235 the center of the screen. A short stimulus presentation was used to avoid the confounding
236 effects of stimulus exploration strategies that may differently affect the liking ratings across
237 groups and sessions (George et al., 2011). The experimenter continuously inspected
238 participant's gaze during presentation in order to monitor task compliance. The image
239 persistence was limited by presentation of a random-dot mask (12° X 10° in size; duration:
240 500 ms) obtained by scrambling the corresponding body stimulus with a custom-made image

241 segmentation software. After the mask, the question "How much do you like it (*Quanto ti*
242 *piace* in Italian)?" appeared on the screen with a vertical, 10-cm Visual Analogue Scale
243 (VAS) ranging from "I like it very much (*Mi piace molto*)" (score=100) to "I do not like it at
244 all (*Non mi piace per niente*)" (score=0). The top or bottom position of the two extremes was
245 balanced between participants. The participants were asked to express a liking judgment on
246 the body stimuli by moving the mouse cursor onto the point of the VAS corresponding to
247 their opinion. The pre- and post-evaluation phases lasted approximately 10 min each.

248 **Exposure phase.** The exposure stimuli were presented in three 48-trial blocks, with
249 random presentation of male and female models, static and dynamic postures and front- and
250 three-quarter-view body images, for a total of 144 trials. Each stimulus was presented for
251 1,000 ms and was followed by a response frame that remained on the screen until response.
252 The participants were asked to look carefully at the stimulus and to respond immediately to
253 one of the following questions presented, in random order, after the offset of the stimuli:
254 "Male or female model (*Modello maschile o femminile*)?", "Dynamic or static posture
255 (*Postura statica o dinamica*)?" and "Front or three-quarter view (*Visione frontale o di mezzo*
256 *profilo*)?". The two alternative answers were displayed below the question. The participant's
257 task was to press a button that spatially corresponded to the correct answer. The association
258 between the answers and the buttons was balanced between participants. This procedure
259 ensured that participants paid attention to the different morphological and **postural** aspects of
260 the stimuli, limiting the cognitive load of task response after stimulus presentation. The
261 exposure phase lasted about eight minutes.

262 **Data Analysis**

263 We calculated the individual mean VAS values for each condition in the evaluation
264 phase (64 trials per cell). The data were entered into a four-way 2×2×3×2 mixed-model

265 Analysis of Variance (ANOVA) with group as between factor and with time (pre- and post-
266 exposure), exposure (round, thin and control), and weight (round, thin) as within-subject
267 variables. We ran a control ANCOVA analysis to be ensured that any difference between
268 groups was not merely due to their BMI difference *per se*, but to the psychological
269 dimensions that characterize AN vs. healthy adolescents independently from their weight loss
270 or recovery. Thus, BMI was entered as covariate since the two groups differed in body
271 weight ($t_{(38)} = 5.477, p < .001$) and one's own BMI is likely to influence how people judge
272 others' body figures (George et al., 2011; Tovée, Emery, & Cohen-Tovée, 2000; Tovée &
273 Cornelissen, 2001). All pair-wise comparisons were calculated with the Tukey post-hoc test.
274 A significance threshold of $p < .05$ was set for all statistical analyses. Effect sizes were
275 estimated using the partial eta square measure (η_p^2) for ANOVA effects and Cohen's d for
276 pairwise comparisons of the exposure effects. The data are reported as the $M \pm SEM$.

277 To estimate the liking judgment change (LJC) after exposure, we calculated the ratio
278 between the post- and pre-exposure VAS values for each participant and exposure condition,
279 thus allowing an estimate of the judgment change independently from the absolute scale used
280 by the participants in rating the stimuli. Higher LJC values correspond to greater changes in
281 liking judgment. The Pearson's r coefficient between the individual LJC values and scores at
282 the Body Dissatisfaction, Interoceptive Awareness and Internalization of Western Ideals
283 scales, which have been previously associated to the effects of perceptual experience on body
284 appreciation (Glauert et al., 2009; Mele et al., 2013), were calculated separately for each
285 group, using a Bonferroni correction procedure to control for multiple correlations (6
286 correlations).

287 Results

288 Clinical Scales

289 The clinical data of patients and controls are reported in Table 1. Patients had
290 marginally higher scores than controls at the Interoceptive Awareness deficit scale of the
291 EDI-3, while the difference did not reach significance at the Body Dissatisfaction scale. For
292 the SATAQ scales, patients had higher scores with respect to controls at all subscales except
293 at the Internalization Athlete subscale.

294 Body Exposure Effects

295 Figure 2 shows the liking VAS judgment values for round and thin model bodies
296 before and after the three exposure conditions. The 4-way ANOVA revealed non-significant
297 main effects of time and exposure (all $F < 3.4$ and $p > .07$). The main effects of group ($F_{1,38} =$
298 8.79 , $p = .005$, $\eta_p^2 = 0.187$) and weight ($F_{1,38} = 184.81$, $p < .001$, $\eta_p^2 = 0.829$) were
299 significant, indicating that the patients (38.79 ± 1.91) had lower VAS liking judgments of
300 body stimuli compared to the controls (46.81 ± 1.91); and the thin models (57.26 ± 1.90)
301 received higher VAS liking judgments compared to the round models (28.34 ± 1.51). The
302 two-way interactions time \times exposure ($F_{2,76} = 23.79$, $p < .001$, $\eta_p^2 = 0.38$) and weight \times
303 group ($F_{1,38} = 5.13$, $p = .029$, $\eta_p^2 = .11$), as well as the three-way interaction time \times weight \times
304 group ($F_{1,38} = 11.03$, $p < .001$, $\eta_p^2 = 0.22$) were significant and were further qualified by a
305 significant four-way interaction time \times weight \times exposure \times group ($F_{2,76} = 3.32$, $p < .05$, $\eta_p^2 =$
306 0.08), indicating that patients and controls showed different effects of exposure on the liking
307 judgments.

308 The post-hoc analysis indicated that only the liking judgments of round bodies were
309 modulated in controls, whereas the liking judgments of both round and thin bodies were
310 modulated in patients. In particular, for the round exposure condition, controls provided
311 higher VAS liking judgments of round body stimuli after exposure (38 ± 2.22) compared to
312 baseline (31.67 ± 2.26 ; $p < .001$; $d = 0.67$), while the VAS liking judgments of thin bodies

313 were not modulated (pre: 59.21 ± 2.54 ; post: 61.25 ± 3.06 ; $p = .930$; $d = 0.17$). Conversely,
314 patients provided higher VAS liking judgments after exposure as compared to baseline for
315 both round (pre: 20.59 ± 2.26 ; post: 25.11 ± 2.22 ; $p = .005$; $d = 0.46$) and thin (pre: $53.62 \pm$
316 2.54 ; post: 60.32 ± 3.06 ; $p < .001$; $d = 0.55$) body stimuli.

317 Regarding the thin exposure condition, controls provided marginally lower VAS
318 liking judgments of round body stimuli after exposure (33.01 ± 2.57) compared to baseline
319 (36.83 ± 2.74 ; $p = .051$; $d = 0.33$), while the VAS liking judgments of thin bodies were not
320 modulated (pre: 59.78 ± 3.37 ; post: 57 ± 2.96 ; $p = .492$; $d = 0.2$). No changes were obtained
321 in patients for either round (pre: 23.20 ± 2.74 ; post: 20.23 ± 2.57 ; $p = .36$; $d = 0.26$) or thin
322 (pre: 55.05 ± 3.37 ; post: 53.30 ± 2.96 ; $p = .98$; $d = 0.13$) body stimuli.

323 No changes were observed after the control exposure for either round or thin bodies in
324 both controls and patients (all $ps > .38$).

325 The ANCOVA analysis controlling for participants' BMI revealed no main effects or
326 two- and three-way interactions (all $F < 1.76$ and $p > .19$); however, the four-way interaction
327 time \times weight \times exposure \times group ($F_{2,74} = 6.06$, $p = .003$, $\eta_p^2 = 0.14$) was significant even
328 after controlling for the effects of BMI differences between the two groups. Thus, in keeping
329 with the ANOVA results, the ANCOVA confirmed that the different exposure-related
330 modulation on the liking judgments of the two groups was not merely due to their BMI
331 difference *per se*. Only the main effects of group and model's weight were heavily influenced
332 by the participant's BMI.

333 **Correlation analysis**

334 There were no significant correlations between the LJC and Body Dissatisfaction,
335 Internalization of Western ideals, and Interoceptive Awareness in both control ($-.21 < r <$
336 $.23; p > .149$) and patient ($-.21 < r < .29; p > .209$) groups.

337 Discussion

338 The present study wanted to investigate the effects of perceptual experience on body
339 appreciation in adolescents with AN, with the ultimate aim of testing how and if it is possible
340 to change their appreciation of bodies. The results showed that exposures to round or thin
341 figures exerted a different modulation of the liking judgments of bodies in AN and healthy
342 adolescents.

343 In keeping with previous studies on healthy adults (Cazzato et al., 2016; Mele et al.,
344 2013), the healthy adolescents of this study showed an asymmetric exposure-related
345 modulation of body appreciation: only round bodies were affected by exposure, with an
346 medium-sized increase in their appreciation after exposure to round models and a small-sized
347 decrease after exposure to thin models. Conversely, the liking judgments of thin bodies were
348 not changed after any type of exposure. This asymmetric modulation may be explained by the
349 interaction between perceptual aftereffects and norm-based reshaping processes (Mele et al.,
350 2013). Indeed, the two mechanisms might have mutually reinforcing effects for round bodies,
351 which are thought to appear thinner (for perceptual aftereffects) and more similar to the
352 template (for norm-based coding) and are, thus, likely to be **appreciated** more after round
353 exposure. Conversely, round bodies are thought to appear rounder (for perceptual
354 aftereffects) and more distant from the template (for norm-based coding) after thin exposure,
355 thus receiving lower liking ratings. Perceptual aftereffects and norm-based coding may have
356 opposite and mutually deleting effects for thin bodies, which are thought to appear thinner
357 (for perceptual aftereffects), but more distant from the template (for norm-based coding) after

358 round exposure. In a similar vein, thin bodies are thought to appear rounder (for perceptual
359 aftereffects), but more similar to the template (for norm-based coding) after thin exposure.
360 The ultimate outcome of the interaction between perceptual aftereffects and norm-based
361 coding for the appreciation of thin bodies is that both round and thin exposures do not modify
362 their appreciation, thus explaining the asymmetric modulation of the judgments of round but
363 not of thin bodies in both healthy adolescents (this study) and healthy adults (Mele et al.,
364 2013).

365 In patients, the liking ratings changed only after round exposure, whereas both thin
366 and control exposure conditions did not affect body appreciation. The absence of any effect
367 of thin exposure might be ascribed to the fact that AN patients were already adapted to
368 thinness and the experimental thin models used in our study corresponded to or were even
369 rounder than the ideal of thinness incorporated by patients, thus failing to induce any
370 exposure-related modulation of body appreciation. This result is in line with a recent study
371 (Mohr, Rickmeyer, Hummel, Ernst & Grabhorn, 2006) that has shown that only round body
372 adaptation, but not thin body adaptation, influenced the judgment of own body weight in EDs
373 patients, supporting the notion of a long-lasting visual adaptation to thinness in EDs patients.
374 Crucially, the level of internalization, information and pressure of media messages was
375 higher in our patients than in controls, revealing how the ultra-thin ideal of beauty offered by
376 the media may be rooted in the patients. Indeed, a recent study has shown that AN patients
377 tend to associate more easily emaciated than thin bodies to beauty-related words, suggesting
378 that they have a beauty ideal of an emaciated body, rather than of a thin body (Smith, Joiner,
379 & Dodd, 2014). In contrast, round bodies were distant from such emaciated body ideal, yet
380 their presentation did not change the prototype-referenced template.

381 The increase of the liking ratings of both thin and round bodies after exposure to
382 round models is in line with the modification expected according to perceptual aftereffects
383 mechanisms devoid of any counteracting effect of norm-based reshaping. In other words, the
384 increase of liking ratings of both round and thin bodies may be explained by the fact that
385 body stimuli appeared thinner after round exposure for perceptual aftereffects. Thus, these
386 results suggest that, in keeping with adult patients (Cazzato et al., 2016), adolescents with AN
387 have an alteration of the mechanisms involved in the effects of perceptual experience on body
388 appreciation, with weak norm-based reshaping of esthetic body ideals. This alteration of AN
389 patients seems to be independent from illness duration and age at onset, being present on both
390 adults and adolescents, and may stem from their deficits of configural processing and
391 preference for detail-based processing of the human body (Urgesi et al., 2012, 2014). This
392 deficit may prevent patients from updating the norms that are used to recognize and judge
393 new bodies and faces (Rhodes, Jeffery, Boeing, & Calder, 2013), leaving them anchored to
394 ideals of extreme thinness.

395 The rigidity of norm-based templates observed in the effects of perceptual experience
396 on body appreciation in AN patients is in keeping with a recent model (Gaudio & Riva, 2013;
397 Riva & Gaudio, 2012) claiming that AN patients have difficulties in updating their body
398 representation on the basis of perceptual input, thus being anchored to the memory of a
399 'virtual body'. The patients would show deficits in shifting between egocentric and allocentric
400 bodily information, preventing them from updating the self-image stored in long-term
401 memory on the basis of direct perceptual experience. In other words, the egocentric
402 representation of body image based on the perceptions and sensations that depart from the
403 body does not integrate with the allocentric body representation that is conveyed by others
404 (Cazzato et al., 2016). Although this model has been developed to explain self-body

405 misperception in AN patients, the template that AN patients use to judge what is familiar or
406 beautiful in others may be anchored to long-term memory representations that are hard to
407 change following perceptual experience.

408 **Limitations**

409 A limitation of our study is the comparatively low number of patients tested and
410 further studies in larger sample populations are needed to evaluate the clinical significance of
411 the findings. Furthermore, participants were not diagnosed using a well-established ED-
412 specific standardized instrument (e.g., Eating Disorder Examination interview), thus limiting
413 the assessment of the full range of the specific psychopathology of EDs. Furthermore,
414 although both AN and healthy adolescents were tested in three separate sessions conducted at
415 approximately the same time, we did not control for the time elapsed from the last meal and
416 could not standardise levels of fullness/satiation across participants and sessions. It is also
417 worth noting that our AN patient group had recovered weight (16.59 kg/m²), thus urging
418 caution in generalizing the results to the overall population of AN patients. However, a
419 relatively high BMI in our patient sample may attenuate the impact of possible spurious
420 effects of emaciation on cognitive functions. In a similar vein, it can be excluded that the
421 remaining BMI differences between AN patients and controls may have contributed to their
422 performance in body appreciation, because we controlled for such differences using BMI as
423 covariate **in a control analysis**. Thus, the different effects of round body exposure on the AN
424 patients' vs. healthy controls' appreciation of body stimuli must stem from their specific
425 strategies in processing body stimuli. However, since we did not compare the effects of body
426 exposure effects with those of exposure to nonbodily stimuli, the specificity of patients'
427 alterations for the human body remains unclear.

428 Another limitation to the generalization of the results is due to the fact that AN
429 patients and controls had comparable body dissatisfaction at the EDI-3, even if the greater
430 body image concerns of the patients' groups were apparent at the BSQ and BUT (see
431 Supplementary Material). However both AN and control groups were in the adolescent age, a
432 period characterized by many changes in body shape due to ripening process that can affect
433 body image and degree of body dissatisfaction (Presnell et al., 2004; Siervogel et al., 2003).

434 A critical question is related to the personality dimensions associated to the rigidity of
435 norm-based templates of body processing in AN patients. The correlation analysis revealed
436 no relation between the amount of exposure-related change of liking judgments and
437 individual scores at the Body Dissatisfaction, Internalization of Western Ideals and
438 Interoceptive Awareness scales in either controls or AN patients. This is in keeping with
439 previous studies using the same paradigm in adult individuals (Cazzato et al., 2016; Mele et
440 al., 2013) and may suggest that more sensitive measures are required to detect the subtle
441 interindividual differences within each group that may be associated with abnormal
442 susceptibility to the ideals of body beauty conveyed by media.

443 **Conclusions**

444 We investigated the psychological mechanisms that may explain the influence of
445 media exposure on the establishment of the beauty ideals of extreme body thinness in
446 adolescents with AN. As compared to control adolescents, AN adolescents showed an
447 abnormal pattern of experience-dependent reshaping of body appreciation, which seems to be
448 based on low-level perceptual mechanisms, affecting how bodies appear after repeated
449 exposure to extreme body models, rather than on the dynamic reshaping of body norms. In
450 conclusion, the present study provided evidence of weak norm-based reshaping of body
451 appreciation in AN patients. The rigidity of norm-based coding processes may be associated

452 with deficits of configural body processing and contribute to patients' susceptibility to the
453 influence of extreme body thinness ideals conveyed by media. Future studies will have to
454 identify the multiple factors that may mediate the rigidity of norm-based templates of
455 extreme body thinness in AN patients and to plan appropriate interventions to facilitate
456 configural processing of body figures and the update of norm-based templates.

457

458 **Declaration of Conflicting Interests**

459 The authors declared that they had no conflicts of interest with respect to their
460 authorship or the publication of this article.

461

462 **Ethical approval**

463 All procedures performed in studies involving human participants were in accordance
464 with the ethical standards of the local ethical committee and with the 1964 Helsinki
465 declaration and its later amendments or comparable ethical standards.

466

467 **References**

- 468 Benowitz-Fredericks, C. A., Garcia, K., Massey, M., Vasagar, B., & Borzekowski, D. L. G.
469 (2012). Body image, eating disorders, and the relationship to adolescent media use.
470 *Pediatric Clinics of North America*, 59, 693–704. doi:10.1016/j.pcl.2012.03.017
- 471 Briggs, G. G., & Nebes, R. D. (1975). Patterns of hand preference in a student population.
472 *Cortex*, 11, 230–238.
- 473 Calado, M., Lameiras, M., Sepulveda, A. R., Rodríguez, Y., & Carrera, M. V. (2010). The
474 mass media exposure and disordered eating behaviours in Spanish secondary
475 students. *European Eating Disorders Review: The Journal of the Eating Disorders*
476 *Association*, 18, 417–427. doi:10.1002/erv.1024
- 477 Cazzato, V., Siega, S., & Urgesi, C. (2012). “What women like”: influence of motion and
478 form on esthetic body perception. *Frontiers in Psychology*, 3, 235.
479 doi:10.3389/fpsyg.2012.00235
- 480 Cazzato, V., Mian, E., Mele, S., Tognana, G., Todisco, P., Urgesi, C. (2016). The effects of
481 body exposure on self-body image and esthetic appreciation in anorexia nervosa.
482 *Experimental Brain Research*, 234, 695-709. doi:10.1007/s00221-015-4498-z
- 483 Cooper, P., Taylor, M., Cooper, Z., & Fairburn, C. G. (1987). The development and
484 validation of the Body Shape Questionnaire, 6, 485–494.
- 485 Cuzzolaro, M., Vetrone, G., Marano, G., & Garfinkel, P. E. (2006). The Body Uneasiness
486 Test (BUT): development and validation of a new body image assessment scale.
487 *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 11, 1-13.

- 488 Dennett, H. W., McKone, E., Edwards, M., & Susilo, T. (2012). Face aftereffects predict
489 individual differences in face recognition ability. *Psychological Science*, *23*, 1279-
490 1287. doi:10.1177/0956797612446350
- 491 Derenne, J. L., & Beresin, E. V. (2006). Body image, media, and eating disorders.
492 *Academic Psychiatry*, *30*, 257-261. doi:10.1176/appi.ap.30.3.257
- 493 Garner, D. M. (2004). *The eating disorder inventory-3 professional manual*. Lutz, FL:
494 Psychological Assessment Resources (Italian Version; Giannini, M., Pannocchia,
495 L., Dalle Grave, R., Muratori, F., & Viglione, V., 2008. *Eating Disorder Inventory-*
496 *3. Manuale*. Firenze, Italy: Giunti OS - Organizzazioni Speciali).
- 497 Gaudio, S., & Riva, G. (2013). Body image in anorexia nervosa: The link between
498 functional connectivity alterations and spatial reference frames. *Biological*
499 *Psychiatry*, *73*, e25-e26. doi:10.1016/j.biopsych.2012.08.028
- 500 George, H. R., Cornelissen, P. L., Hancock, P. J. B., Kiviniemi, V. V., & Tovée, M. J.
501 (2011). Differences in eye-movement patterns between anorexic and control
502 observers when judging body size and attractiveness. *British Journal of*
503 *Psychology*, *102*, 340–354. doi:10.1348/000712610X524291
- 504 Glauert, R., Rhodes, G., Byrne, S., Fink, B., & Grammer, K. (2009). Body dissatisfaction
505 and the effects of perceptual exposure on body norms and ideals. *The International*
506 *Journal of Eating Disorders*, *42*, 443–452. doi:10.1002/eat.20640
- 507 Godart, N. T., Perdereau, F., Rein, Z., Berthoz, S., Wallier, J., Jeammet, P., & Flament, M.
508 F. (2007). Comorbidity studies of eating disorders and mood disorders. *Critical*

- 509 review of the literature. *Journal of Affective Disorders*, 97, 37–49.
510 [doi:10.1016/j.jad.2006.06.023](https://doi.org/10.1016/j.jad.2006.06.023)
- 511 Groesz, L. M., Levine, M. P., & Murnen, S. K. (2002). The effect of experimental
512 presentation of thin media images on body satisfaction : a meta-analytic review. *The*
513 *International Journal of Eating Disorders*, 31, 1–16. [doi:10.1002/eat.10005](https://doi.org/10.1002/eat.10005)
- 514 Hausenblas HA, Campbell A, Menzel JE, Doughty J, Levine M, Thompson JK (2013)
515 Media effects of experimental presentation of the ideal physique on eating disorder
516 symptoms: a meta-analysis of laboratory studies. *Clinical Psychology Review*, 33,
517 168-181. [doi: 10.1016/j.cpr.2012.10.011](https://doi.org/10.1016/j.cpr.2012.10.011)
- 518 Hoek, H. W. (2006). Incidence, prevalence and mortality of anorexia nervosa and other
519 eating disorders. *Current Opinion in Psychiatry*, 19, 389–394.
520 [doi:10.1097/01.yco.0000228759.95237.78](https://doi.org/10.1097/01.yco.0000228759.95237.78)
- 521 Kaufman, J., Birmaher, B., Brent, D., Rao, U., Flynn, C., Moreci, P., Williamson, D. &
522 Ryan N. (1997). Schedule for Affective Disorders and Schizophrenia for School-
523 Age Children-Present and Lifetime Version (K-SADS-PL): initial reliability and
524 validity data. *Journal of the American Academy of Child and Adolescent*
525 *Psychiatry*, 36, 980-988.
- 526 Langlois, J. H., Kalakanis, L., Rubenstein, A. J., Larson, A., Hallam, M., & Smoot, M.
527 (2000). Maxims or myths of beauty? A meta-analytic and theoretical review.
528 *Psychological Bulletin*, 126, 390–423.
- 529 Langlois, J. H., & Roggman, L. A. (1990). Attractive faces are only average. *Psychological*
530 *Science*, 1, 115–121. [doi: 10.1111/j.1467-9280.1990.tb00079.x](https://doi.org/10.1111/j.1467-9280.1990.tb00079.x)

531 Leopold, D. a, O'Toole, a J., Vetter, T., & Blanz, V. (2001). Prototype-referenced shape
532 encoding revealed by high-level aftereffects. *Nature Neuroscience*, 4, 89–94.

533 [doi:10.1038/82947](https://doi.org/10.1038/82947)

534 Maurer, D., Grand, R. Le, & Mondloch, C. J. (2002). The many faces of configural
535 processing. *Trends in Cognitive Sciences*, 6, 255–260. [doi: 10.1016/S1364-](https://doi.org/10.1016/S1364-6613(02)01903-4)

536 [6613\(02\)01903-4](https://doi.org/10.1016/S1364-6613(02)01903-4)

537 Mele, S., Cazzato, V., & Urgesi, C. (2013). The importance of perceptual experience in the
538 esthetic appreciation of the body. *PloS One*, 8, e81378.

539 [doi:10.1371/journal.pone.0081378](https://doi.org/10.1371/journal.pone.0081378)

540 [Mohr H. M., Rickmeyer C., Hummel D., Ernst M. & Grabhorn R. \(2006\). Altered Visual
541 Adaptation to Body Shape in Eating Disorders: Implications for Body Image
542 Distortion. *Perception*, Feb 25. pii: 0301006616633385](#)

543 Moore, D. C. (1993). Body image and eating behavior in adolescents. *Journal of the
544 American College of Nutrition*, 12, 505–510.

545 [doi:10.1080/07315724.1993.10718343](https://doi.org/10.1080/07315724.1993.10718343)

546 Pollard, J. S. (1995). Attractiveness of composite faces: a comparative study. *International
547 Journal of Comparative Psychology*, 8, 77–83.

548 [Presnell K., Bearman S. K. & Stice E. \(2004\). Risk factors for body dissatisfaction in
549 adolescent boys and girls: a prospective study. *The International Journal of Eating
550 Disorders*, Dec;36\(4\):389-401. doi: 10.1002/eat.20045](#)

- 551 Reed, C. L., Stone, V. E., Grubb, J. D., & McGoldrick, J. E. (2006). Turning configural
552 processing upside down: part and whole body postures. *Journal of Experimental*
553 *Psychology. Human Perception and Performance*, 32, 73–87. doi:10.1037/0096-
554 1523.32.1.73
- 555 Rhodes, G., Jeffery, L., Boeing, A., & Calder, A. J. (2013). Visual coding of human
556 bodies: perceptual aftereffects reveal norm-based, opponent coding of body
557 identity. *Journal of Experimental Psychology. Human Perception and*
558 *Performance*, 39, 313–317. doi:10.1037/a0031568
- 559 Rhodes, G., Jeffery, L., Watson, T. L., Clifford, C. W. G., & Nakayama, K. (2003). Fitting
560 the mind to the world: face adaptation and attractiveness aftereffects. *Psychological*
561 *Science*, 14, 558–566. doi:10.1046/j.0956-7976.2003.psci_1465.x
- 562 Riva, G., & Gaudio, S. (2012). Allocentric lock in anorexia nervosa: new evidences from
563 neuroimaging studies. *Medical Hypotheses*, 79, 113–117.
564 doi:10.1016/j.mehy.2012.03.036
- 565 Rodgers, R. F., Salès, P., & Chabrol, H. (2010). Psychological functioning, media pressure
566 and body dissatisfaction among college women. *Revue Européenne de Psychologie*
567 *Appliquée/European Review of Applied Psychology*, 60, 89–95.
568 doi:10.1016/j.erap.2009.10.001
- 569 Siervogel, R. M., Demerath, E. W., Schubert, C., Remsberg, K. E., Chumlea, W. C., Sun,
570 S., ... Towne, B. (2003). Puberty and body composition. *Hormone Research*, 60
571 (SUPPL. 1), 36-45. doi: 10.1159/000071224

- 572 Smith, A. R., Joiner, T. E., & Dodd, D. R. (2014). Examining implicit attitudes toward
573 emaciation and thinness in anorexia nervosa. *The International Journal of Eating*
574 *Disorders*, 47, 138–147. doi:10.1002/eat.22210
- 575 Stefanile, C., Matera, C., Nerini, A., & Pisani, E. (2011). Validation of an Italian version of
576 the sociocultural attitudes towards appearance questionnaire-3 (SATAQ-3) on
577 adolescent girls. *Body Image*, 8, 432–436. doi: 10.1016/j.bodyim.2011.06.001
- 578 Stice, E., Schupak-Neuberg, E., Shaw, H. E., & Stein, R. I. (1994). Relation of media
579 exposure to eating disorder symptomatology: an examination of mediating
580 mechanisms. *Journal of Abnormal Psychology*, 103, 836–840. doi: 10.1037/0021-
581 843X.103.4.836
- 582 Stice, E. (2002). Sociocultural influences on body image and eating disturbance. In C. G.
583 Fairburn & K. D. Browne (Eds.), *Eating disorders and obesity: A comprehensive*
584 *handbook* (pp. 103-107). New York, NY: The Guilford Press.
- 585 Stice, E., Marti, C. N., & Rohde, P. (2013). Prevalence, incidence, impairment, and course
586 of the proposed DSM-5 eating disorder diagnoses in an 8-year prospective
587 community study of young women. *Journal of Abnormal Psychology*, 122, 445–
588 457. doi:10.1037/a0030679
- 589 Sypeck, M. F., Gray, J. J., Etu, S. F., Ahrens, A. H., Mosimann, J. E., & Wiseman, C. V.
590 (2006). Cultural representations of thinness in women, redux: playboy magazine's
591 depiction of beauty from 1979 to 1999. *Body Image*, 3, 229–235.
592 doi:10.1016/j.bodyim.2006.07.001

- 593 Thompson, J. K., van den Berg, P., Roehrig, M., Guarda, A. S., & Heinberg, L. J. (2004).
594 The sociocultural attitudes towards appearance scale-3 (SATAQ-3): development
595 and validation. *The International Journal of Eating Disorders*, *35*, 293–304.
596 [doi:10.1002/eat.10257](https://doi.org/10.1002/eat.10257)
- 597 Thompson, P., & Burr, D. (2009). Visual aftereffects. *Current Biology*, *19*, R11-R14.
598 [doi:10.1016/j.cub.2008.10.014](https://doi.org/10.1016/j.cub.2008.10.014)
- 599 Tovée, M. J., Emery, J. L., & Cohen-Tovée, E. M. (2000). The estimation of body mass
600 index and physical attractiveness is dependent on the observer's own body mass
601 index. *Proceedings of the Royal Society B: Biological Sciences*, *267*, 1987–1997.
602 [doi:10.1098/rspb.2000.1240](https://doi.org/10.1098/rspb.2000.1240)
- 603 Tovée, M. J., & Cornelissen, P. L. (2001). Female and male perceptions of female physical
604 attractiveness in front-view and profile. *British Journal of Psychology*, *92*, 391–
605 402. [doi: 10.1348/000712601162257](https://doi.org/10.1348/000712601162257)
- 606 Trujillo, L. T., Jankowitsch, J. M., & Langlois, J. H. (2014). Beauty is in the ease of the
607 beholding: a neurophysiological test of the averageness theory of facial
608 attractiveness. *Cognitive, Affective & Behavioral Neuroscience*, 1061–1076.
609 [doi:10.3758/s13415-013-0230-2](https://doi.org/10.3758/s13415-013-0230-2)
- 610 Urgesi, C., Fornasari, L., Perini, L., Canalaz, F., Cremaschi, S., Faleschini, L., ...
611 Brambilla, P. (2012). Visual body perception in anorexia nervosa. *The International*
612 *Journal of Eating Disorders*, *45*, 501–511. [doi: 10.1002/eat.20982](https://doi.org/10.1002/eat.20982)
- 613 Urgesi, C., Fornasari, L., Canalaz, F., Perini, L., Cremaschi, S., Faleschini, L., ... &
614 Brambilla, P. (2014). Impaired configural body processing in anorexia nervosa:

615 evidence from the body inversion effect. *British Journal of Psychology*, 105, 486-
616 508. doi: 10.1111/bjop.12057

617 Valentine, T. (1991). A unified account of the effects of distinctiveness, inversion, and race
618 in face recognition. *Quarterly Journal of Experimental Psychology*, 43, 161–204.
619 doi: 10.1080/14640749108400966

620 Valentine, T., Darling, S., & Donnelly, M. (2004). Why are average faces attractive? The
621 effect of view and averageness on the attractiveness of female faces. *Psychonomic*
622 *Bulletin & Review*, 11, 482–487.

623 Voracek, M., & Fisher, M. L. (2002). Shapely centrefolds? Temporal change in body
624 measures: trend analysis. *British Medical Journal*, 325, 1447-1448.

625 Winkler, C., & Rhodes, G. (2005). Perceptual adaptation affects attractiveness of female
626 bodies. *British Journal of Psychology*, 96, 141–154.
627 doi:10.1348/000712605X36343

628

629

630 *Figure 1.* Study procedure. The experiment was composed of three daily sessions,
631 each one consisting of three phases: A) initial evaluation of the stimuli (pre-exposure phase);
632 B) exposure phase; and C) re-evaluation of the stimuli after exposure (post-exposure phase).
633 In each session, the participants were administered the same pre- and post-evaluation
634 procedures (A and C) with different exposure conditions (B). In the two main exposure
635 conditions, they received only the 8 round body stimuli (round exposure) or the 8 thin body
636 stimuli (thin exposure). In a third control exposure condition, participants received both
637 round and thin body stimuli, with a 1:1 matching of the number of round and thin figures
638 (control exposure)

639 *Figure 2.* Study results. The graphs show the $M (\pm SEM)$ scores on the visual
640 analogue scale (VAS) before and after the three exposure conditions in both control and AN
641 patient groups. Asterisks indicate significant pair-wise comparisons ($p < .05$).

642