

# The link between anxiety and assessment of body attitudes and body size estimation in anorexia nervosa

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## Abstract

Although body size estimation (BSE) tasks are frequently used to investigate distorted body representation in anorexia nervosa (AN), the link between anxiety and task performance has been overlooked. To investigate this, 30 female healthy controls (HCs) and 29 female AN patients completed two body attitude questionnaires and three BSE tasks (the Visual Estimation Task, the Tactile Estimation Task and the Hoop Task). Participants completed two body attitude questionnaires and three BSE tasks; the Visual Estimation Task, the Tactile Estimation Task, and the Hoop Task. The STAI-6 was administered before and after each body-related task to assess state anxiety. Results showed that state anxiety levels increased significantly more in AN patients than in HC after completing each task. Thus, performance of AN patients on BSE and other body-related tasks might not just indicate the (mis)perception of their body but also co-occur with increased state anxiety. This has implications for the interpretation of these tasks and for furthering our understanding of the mechanisms that underlie distorted body image in AN.

## Keywords

Anxiety, body attitudes, body image, body size perception, eating disorders

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## Introduction

Anorexia nervosa (AN) is characterized by a distorted body representation, with patients perceiving and experiencing their body as bigger than it actually is (e.g., Cash & Deagle, 1997). These distortions in body representation can be assessed using self-report questionnaires that focus on attitudes, cognitions, and emotions about the body and its size. In addition, so-called body size estimation (BSE) tasks have been developed to assess how the body is perceived. The first BSE tasks that were used in AN research mainly focused on the visual component of body representation, (i.e. how patients visually perceive their body). However, the validity of these tasks has repeatedly been questioned (Mölbart et al., 2018; Smeets, 1997). A main point of criticism is that performance on these BSE tasks does not only reflect how the body is visually represented in the brain, but that it could also mirror bodily attitudes and cognitions (Smeets, 1997). In response, new BSE tasks were developed to provide a more objective and implicit assessment of body representation. These tasks were mainly nonvisual in nature (for an overview, see Gaudio et al., 2014). For example, these tasks assessed how patients perceived tactile stimuli applied to their body (Keizer et al., 2011; Spitoni et al., 2015) or how they planned and executed body-scaled movements (Guardia et al., 2010; Keizer et al., 2013).

Although these new BSE tasks indeed appear to be more objective, the influence of anxiety on performance on these and other body-related tasks has been overlooked. Anxiety has long been considered to be an important component of AN (Kaye et al., 2004; Pallister & Waller, 2008), with comorbid anxiety disorders being relatively common (e.g., Kaye et al., 2004). In addition, AN patients experience elevated levels of anxiety in food- and eating-related situations, which is suggested to be reflected in premeal and eating-related fears, avoidance behavior in meal situations, and ritualized safety behaviors related to food and eating (e.g. Steinglass et al., 2011). This type of anxiety is even observed in weight-restored AN patients (e.g., Steinglass et al., 2010). What is potentially even more relevant for the interpretation of BSE tasks is the high levels of anxiety that AN patients experience with respect to their body. An intense fear of gaining weight or becoming fat is listed as one of the diagnostic criteria for AN in the DSM-5 (APA, 2013). Rosen et al. (1991) suggest that anxiety is especially experienced when AN patients are

confronted with or exposed to their body. As such, completing a task in which you have to think about your body or (implicitly) estimate the size of your body might immediately increase anxiousness in AN patients. Clinical experience indeed suggests that body-related tasks can induce anxiety and stress in patients. However, it has not been investigated to what extent these anxious feelings might actually bias performance on body-related tasks.

Previous research, unrelated to eating disorders, has demonstrated that the size of a phobic object tends to be overestimated (e.g. Stefanucci et al., 2008). For example, fear of heights has been linked to the level of overestimation of vertical extents (Clerkin et al., 2009). A similar reasoning could be transferred to AN, as patients are typically phobic about their body and its size. Performance on BSE and other body-related tasks might therefore not only reflect distortions in body representations but also certain levels of anxiety. This is indirectly supported by McCabe et al. (2006), who identified potential effects of different biopsychosocial factors on BSE in healthy individuals. They assessed BSE using a morphing paradigm in which participants could manipulate the size of their body on screen. The overestimation of body size in healthy women was predicted, as well as by depression levels. Although they did not include anxiety as a factor, their results do show that BSEs in healthy adults do not only reflect an estimation based on sensory input but are also influenced by cognitive and social factors. In a more recent study, Øverås et al. (2014) measured state anxiety and included AN patients. Asked participants to estimate their body size using a morphing paradigm in which the image of a body was projected onto a wall. Participants estimated their body size either from memory or based on their reflection seen in a mirror. In both conditions, AN patients significantly overestimated their body size more than healthy women. Interestingly, when the authors controlled for state anxiety (i.e., anxiety experienced during the task), the difference in body size overestimation between AN patients and healthy females no longer was significant. No effect was found for other factors, such as depression. This indeed suggests that, in line with our hypothesis, anxiety can influence size perception and could thus potentially be involved in the overestimation of body size in AN patients.

The aim of the current study was therefore to further extend the findings by Øverås and colleagues (2014) by investigating the association between

anxiety and performance on BSE and body attitude tasks. We will hereafter refer to these tasks collectively as body-related tasks. Øverås and colleagues (2014) specifically looked at state anxiety after visual perception of body size. In this study, we systematically assessed whether anxiety increased after completing four tasks that each measured a different component of body representation. We included an assessment of body attitudes, visual body size perception, tactile size perception, and body-scaled movement. We first hypothesized that AN patients would have more negative attitudes with respect to their body and that they would overestimate their body size compared to healthy controls (HCs; see, e.g., Gaudio et al., 2014; Mölbert et al., 2018). We also expected that AN patients would show higher levels of trait anxiety than HC (Sternheim et al., 2011). In addition, we expected that AN patients would become more anxious when completing each of the four body-related tasks than controls: that is, we hypothesized that compared to HC, AN patients would show an increase in state anxiety from pre- to post-assessment.

## Methods

### Participants

Thirty female HC and 29 female AN patients between the ages of 18 and 32 participated in the study. There was no significant difference between the age of HC ( $M = 23.23$ ,  $SD = 2.53$ , range 20–31) and AN patients ( $M = 22.00$ ,  $SD = 3.37$ , range 18–32),  $t(57) = 1.59$ ,  $p = .117$ . HC needed to have a healthy body mass index (BMI; 19–25) and not have been diagnosed with a psychiatric disorder at the time of recruitment. Pregnant women were excluded from the study. Healthy participants were recruited through Utrecht University. All AN patients were recruited from Altrecht Eating Disorders Rintveld in Zeist where they were receiving eating disorder treatment at the time of the experiment. The patients met the diagnostic criteria for AN (Diagnostic and Statistical Manual of Mental Disorders–5th ed., American Psychiatric Association, 2013). AN patients ( $M = 16.79$ ,  $SD = 3.03$ ) had a significantly lower BMI than HC ( $M = 22.09$ ,  $SD = 2.11$ ),  $t(57) = 7.82$ ,  $p < .001$ . This study was approved by the Ethics Committee of the Faculty of Social and Behavioural Sciences of Utrecht University (FETC15-071) and by the Committee Scientific Research of Altrecht Mental Health Institute (CWO 1610). The study adhered to the Declaration of Helsinki (2013).

### Materials and stimuli

**Body attitude questionnaires.** Positive attitudes toward the body were assessed using the Body Appreciation Scale (BAS; Alleva et al., 2016). This questionnaire contains 10 items (e.g., “I feel that my body has at least a few good qualities”) to which participants respond on a 5-point Likert scale. Responses range between 1 (“Never”) to 5 (“Always”). A higher total score on the BAS reflects a more positive body attitude. Negative body attitudes were assessed with the Body Attitude Test (BAT; Probst et al., 1995). The BAT consists of 20 questions (e.g., “I have a strong desire to be thinner”) that are scored on a 6-point Likert scale ranging from 1 (“Never”) to 6 (“Always”). A high total score on the BAT is indicative of a stronger negative body attitude. Both the BAS and BAT have been shown to be reliable and valid (Alleva et al., 2016; Probst et al., 1995). Although these questionnaires are not used to estimate body size, they were included to assess the cognitive component of body image. We used a combination of the BAS and BAT to get a more complete representation of body attitudes, as having a nonnegative body image does not necessarily indicate that a participant has a positive image of their body.

After calculating the total BAS and BAT scores for each participant, we computed a total body attitude score (T-BAS). To do this, the BAS was first reverse-scored so that higher scores indicated a more negative attitude toward one’s body. The T-BAS was subsequently calculated by taking the sum of the total BAS and BAT. T-BAS scores could range from 30 to 170, with a higher score reflecting a stronger negative body attitude.

**Visual Estimation Task.** In the Visual Estimation Task (adapted from Keizer et al., 2013), participants were asked to indicate width of their shoulders, abdomen, and hips by placing two adhesive markers on a white wall. Participants were not allowed to look at themselves while placing the markers. After the markers were placed, the participant looked away while the distance between the markers was measured. The order in which the different body parts had to be estimated was counter-balanced between participants. The difference between the subjective width estimation and actual width was used to calculate a misestimation percentage for each body part. An average misestimation score was subsequently computed across all body parts.

**Tactile Estimation Task.** In the Tactile Estimation Task (adapted from Keizer et al., 2011), participants had to

estimate the distance between two tactile stimuli. These stimuli were presented with a caliper on the abdomen (horizontally) and arm (vertically). The distance between the two tactile stimuli varied between 50 mm, 60 mm, and 70 mm. Each distance was presented three times on each body part. Thus, in total, participants completed nine trials on the arm and nine trials on the abdomen. The order of these trials was randomized. Participants kept their eyes closed during this task. After each trial, they were asked to indicate the distance between the two tactile stimuli with their thumb and index on a touchscreen tablet. Each distance estimation was recorded with a MATLAB-based program. The average percentage of misestimation was calculated for the arm and abdomen separately, using the difference between the estimation and actual distance.

**Hoop Task.** In the Hoop Task (adapted from Keizer et al., 2019), participants were presented with 15 different hoops. Each hoop differed in diameter (ranging from 24 cm to 52 cm with 2 cm increments). The hoops were presented one-by-one in a randomized order. Participants turned around after each trial, so they could not see the experimenter removing the hoop from the previous trial and placing the hoop for the next trial on the floor. For each hoop, the participants had to indicate whether they thought they could fit through the hoop. If participants believed they were able to do this, they had to step inside the hoop and lift it up over their head. Participants had to do this for every hoop they thought they could fit through. They were not allowed to try a hoop if they thought they were unable to fit through. The smallest hoop through which participants believed they could fit was recorded. After all trials were completed, the experimenter assessed what the smallest hoop was that the participants could actually fit through. Based on the difference between the estimated and actual smallest hoop size, the percentage of misestimation was calculated.

### STAI-Trait

Trait anxiety was measured with the STAI-Trait. This is a reliable and valid questionnaire to assess the height of anxiety levels that are generally experienced by the participant (Spielberger et al., 1983; Van der Ploeg, 2000). The questionnaire consists of 20 items (e.g., “I am a steady person”) to which participants respond on a 4-point Likert scale ranging from 1 (“Almost Never”) to 4 (“Almost Always”). A high

total score on the STAI-Trait indicates that the participant generally experiences more anxiety.

### STAI-6

The STAI-6 (Marteau & Bekker, 1992; Spielberger et al., 1983) contains 6 items and is a shortened version of the full STAI-State questionnaire (Marteau & Bekker, 1992; Spielberger et al., 1983). As opposed to the STAI-Trait, this questionnaire assess temporary changes in anxiety levels (e.g., “I feel calm”). Responses are given on a 4-point Likert scale that ranges from 1 (“Not at all”) to 4 (“Very much”), with a high total score reflecting higher current levels of anxiety. The STAI-6 has an acceptable reliability and validity (Marteau & Bekker, 1992).

### Procedure

All participants provided written informed consent at the start of the experiment. They subsequently filled out the STAI-Trait questionnaire. The tasks were all presented in the same order for each participant: First the body attitude questionnaires, followed by the Visual Estimation Task, Tactile Estimation Task, and Hoop Task. Before and after each of the tasks participants filled out the STAI-6. To reduce potential transfer of anxiety from one task to another, participants were allowed to do a 2-min filler activity in between the body-related tasks (either adult coloring or crossword puzzle). At the end of the experiment actual width of the hips, abdomen and shoulders was measured. The height and weight of HC was also recorded, to confirm that the HC had a healthy BMI. For AN patients information on height and weight was obtained from their electronic patient file.

### Data analysis

All data analysis was conducted in SPSS.24. We first assessed whether AN patients and HC differed in task performance. This was done using independent *t*-tests for the body attitude questionnaires (T-BAS), the Visual Estimation Task, and the Hoop Task. A 2 (group: AN vs. HC)  $\times$  2 (body part: arm vs. abdomen) mixed analysis of variance (ANOVA) was used for the Tactile Estimation Task. For the primary analysis, a mixed 2 (group: AN vs. HC)  $\times$  2 (time: pre- vs. post-measurement)  $\times$  4 (type body-related task) ANOVA was used to assess differences in levels of STAI-6 state anxiety in each group before and after each body-related task.  $\alpha = .05$ .

## Results

### Body-related tasks

AN patients had a significantly higher T-BAS than HC,  $t(57) = -9.69, p < .001$ , indicating that they had a stronger negative attitude toward their body (see Table 1). The misestimation percentage was also significantly larger for AN patients on the Visual Estimation Task,  $t(32.25) = -4.38, p < .001$ , and the Hoop Task,  $t(41.38) = -3.71, p < .001$ . With regard to the Tactile Estimation Task, there was no significant main effect for body part  $F(1, 57) = .07, p = .792$ . However, the interaction between group and body part was significant  $F(1,57) = 6.01, p = .017$ . Post hoc Bonferroni-corrected independent samples  $t$ -tests showed that AN patients had a larger percentage of misestimation for tactile stimuli on the abdomen than HC,  $t(57) = -2.70, p = .009$ . The misestimation percentage for tactile stimuli presented on the arm did not differ between the AN and HC groups,  $t(57) = -.58, p = .565$ . Taken together, these results demonstrate that AN patients have more negative attitudes about their body and overestimate their body size more compared to HC on the level of visual body size perception, tactile size perception, and body-scaled action.

**Table 1.** Means and standard deviations (in brackets) for body-related tasks.

	AN	HC
T-BAS (body attitudes)	119.03 (23.40)	67.10 (17.42)
Visual Estimation Task	25.43 (26.68)	2.91 (7.49)
Hoop Task	24.54 (18.51)	9.37 (10.99)
Tactile Estimation Task		
Arm	7.71 (23.83)	4.10 (24.14)
Abdomen	16.66 (32.08)	-3.11 (23.74)

Note. The Visual Estimation Task, Hoop Task, and Tactile Estimation Task scores represent the misestimation percentages. The T-BAS refers to the total body attitude scores (BAS + BAT).

**Table 2.** Mean STAI-6 scores and standard deviations (in brackets) before and after body-related tasks.

	AN		HC	
	Pre	Post	Pre	Post
T-BAS	13.72 (3.98)	15.28 (4.59)	7.80 (2.51)	8.07 (2.69)
Visual Estimation Task	13.38 (4.30)	16.44 (4.59)	7.53 (2.45)	9.03 (2.59)
Tactile Estimation Task	14.17 (4.47)	16.21 (5.45)	7.27 (1.98)	8.40 (2.50)
Hoop Task	14.10 (4.06)	16.52 (4.85)	7.30 (2.12)	8.60 (2.87)

### Anxiety

AN patients scored higher ( $M = 59.48, SD = 11.79$ ) than HC ( $M = 32.07, SD = 8.39; t(57) = -10.32, p < .001$ ) on trait anxiety assessed with the STAI. See Table 2 for mean pre- and postscores of the STAI-6 for each body-related task and participant group.

The mixed 2 (group: AN vs. HC)  $\times$  2 (time: pre- vs. post-measurement)  $\times$  4 (type body-related task) ANOVA showed significant main effects for group (AN vs. HC),  $F(1,57) = 66.38, p < .001$ , and for time (pre- vs. post-measurement),  $F(1,57) = 48.35, p < .001$ , but not for type of body-related task  $F(3,171) = 1.94, p = .125$ . The interaction between type of task and group was not significant  $F(3,171) = 2.63, p = .052$ , but we did find a significant interaction between task and time,  $F(3,170) = 4.28, p = .006$ , and more importantly between time and group,  $F(1,57) = 6.51, p = .013$ . This indicates that, independent of which body-related task was completed, state anxiety levels increase from pre- to post more in AN patients than in HC.

## Discussion

We investigated if higher levels of state anxiety co-occur with performance on BSE and body attitude tasks in AN patients. We first checked whether AN patients showed altered performance on body-related tasks in several domains. In line with our hypothesis, AN patients experienced more negative body attitudes and overestimated their body size more than HC. This provides a replication of earlier studies (for a review, see Gaudio et al., 2014) showing that AN patients hold negative attitudes about their body and its size (e.g. Cash & Deagle, 1997). As shown previously, we found that AN visually perceive their body as bigger than it actually is (e.g., Keizer et al., 2013), that they overestimate the size of stimuli touching their skin (e.g., Keizer et al., 2011, Spitoni et al., 2015), and that planning of movements relies on an enlarged representation of body size (e.g., Guardia et al., 2010, Keizer et al.,

2013). We also observed higher levels of both trait and state anxiety in AN compared to HC, which is consistent with the previously established link between anxiety and AN (e.g., Pallister & Waller, 2008; Sternheim et al., 2020). Most importantly, state anxiety increased more in AN patients after having completed a body-related task than in HC. Anxiety does therefore not only play a general role in AN, but it also appears to co-occur with performance on body-related tasks. This result confirms our hypothesis and further extends previous work by Øverås and colleagues (2014). We believe our findings are of interest as in AN the role of anxiety has rarely been studied in relation to BSE and body size evaluation. Work that has focused on this link mostly studied anxiety in relation to *actual* body size. For example, anxious and depressive symptoms are known to increase when AN patients gain weight (e.g., Metral et al., 2014). The current study extends on this by demonstrating that there might also be a link between anxiety and the *mental representation* of body size.

Our findings imply that the performance of AN patients on body-related tasks might not just be a reflection of the (mis)perception of their body but also include the potential effects of increased feelings of anxiety. Following previous work in which it was shown that the size of a phobic object tends to be overestimated (e.g., Stefanucci et al. 2008), it is possible that these elevated anxiety levels bias body size estimates in the direction of overestimation. Although this remains to be investigated as the setup of our study does not allow for drawing this conclusion, one could already argue that our findings have implications for the way in which results of BSE and other body-related tasks are interpreted. For example, AN patients overestimate the distance between two tactile stimuli. This is generally interpreted as AN patients' mental representation of body size being inaccurate (see, e.g., Keizer et al., 2012, Spitoni et al., 2015). We demonstrate in the current study that in AN patients' state anxiety is higher after completing a tactile estimation task than before starting this task. This leads to the question of whether data from tactile estimation tasks *only* reflect distortions in the mental representation of the body in the brain or whether patients were unable to perform optimally on this task due to feelings of anxiety. As such our findings open the debate once again (see, e.g., Smeets, 1997) on whether BSE tasks can be used to objectively assess perceptual disturbances in BSE in AN or whether they are

potentially prone to being biased by cognitive factors and emotions, such as anxiety.

A point that deserved to be raised as well is whether a BSE task that objectively assesses perception of body size would even be ecologically valid. AN patients most likely experience high anxiety levels when confronted with their body in daily life. Therefore, it might not be possible or even necessary to disentangle the overestimation of body size and anxiety in body-related tasks. Nevertheless, it remains important that researchers consider anxiety as a potential biasing factor when interpreting the results from body-related tasks.

The results of our study strengthen the idea that anxiety could play an important role in body representation distortions. Even though the current study focused specifically on the link between anxiety and performance on body-related tasks, we believe that our findings offer a starting point from which the influence of anxiety on BSE in AN can further be explored. In the current study, we extended the findings by Øverås and colleagues (2014) by demonstrating that higher levels of state anxiety co-occur with worse performance on body-related tasks in AN patients. In previous work by Øverås and colleagues (2014), elevated anxiety levels were observed after completing a visual BSE task. We have shown here that in AN patients state anxiety increases irrespective of the domain that is tested. It was observed for assessment of body attitudes, for visual BSE, size estimation of tactile stimuli, and for body-scaled action. The absence of an interaction effect for type of task seems to suggest that the increase in anxiety levels is not task dependent and occurs irrespective of the paradigm that is used. The current study was correlational in nature and therefore we cannot exclude the possibility that perhaps overestimating the own body increases anxiety, instead of the other way around. The exact relation between state anxiety and body-related tasks should be further investigated in future studies, for example by conducting an experimental study in which anxiety is manipulated and its influence on body-related tasks is assessed.

An important limitation of our study is that we assessed anxiety after participants completed the tasks. In future work, it would be interesting to obtain physiological data, such as heart rate variability, which enables continuous monitoring of anxiety and stress levels during a body-related task. This will provide more insights into if and which components of

the body-related tasks induce anxiety, and how this is related to overestimation of body size.

Taken together, the current study replicates previous work showing that AN patients hold negative attitudes toward their body and that they overestimate their body size in experimental paradigms that focus on various domains. Furthermore, our study provides a stepping-stone for future work as we advocate for more recognition for the potential interplay between anxiety and BSE in AN. We believe this will aid the further understanding and contextualization of distortions in body representation in AN.

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