Received: 5 March 2021 | Revised: 29 October 2021 | Accepted: 29 October 2021

DOI: 10.1002/eat.23638

ORIGINAL ARTICLE

International Journal of EATING DISORDERS WILEY

Implicit approach-avoidance tendencies toward food and body stimuli absent in individuals with anorexia nervosa, bulimia nervosa, and healthy controls

Ines Kollei PhD[1] | Judith Leins MSc[1,2] | Mike Rinck PhD[3] | Manual Waldorf PhD[4] | Melanie Kuhn MSc[5] | Elisabeth Rauh MD[5] | Sabine Steins-Loeber PhD[1]

[1]Department of Clinical Psychology and Psychotherapy, Otto-Friedrich-Universitaet Bamberg, Bamberg, Germany

[2]Department of Psychiatry, Ubbo-Emmius Hospital Norden, Norden, Germany

[3]Behavioural Science Institute, Radboud University, Nijmegen, The Netherlands

[4]Department of Clinical Psychology and Psychotherapy, Osnabrueck University, Osnabrueck, Germany

[5]Schön Klinik Bad Staffelstein, Bad Staffelstein, Germany

Correspondence
Ines Kollei, Department of Clinical Psychology and Psychotherapy, Otto-Friedrich-Universitaet Bamberg, Markusplatz 3, 96047 Bamberg, Germany.
Email: ines.kollei@uni-bamberg.de

Action Editor: Anja Hilbert

Abstract

Objective: Body and food-related information are thought to activate cognitive biases and contribute to the maintenance of eating disorders (ED). Approach-avoidance biases may play an important role in the maintenance of dietary restriction and excessive food intake. Therefore, the present study aimed to examine approach-avoidance biases toward food and body stimuli in individuals with anorexia nervosa (AN), bulimia nervosa (BN), and healthy controls (HC).

Methods: The study included 42 individuals with AN, 24 individuals with BN, and 38 HCs. We used two implicit Approach-Avoidance Tasks (AAT) to assess approach-avoidance biases: participants completed a Food-AAT (high-calorie vs. low-calorie food) and a Body-AAT (thin vs. normal weight bodies). Additionally, explicit ratings of food and body stimuli were assessed.

Results: There were no significant Group × Stimulus × Direction interactions in the implicit Food-AAT or implicit Body-AAT. In explicit ratings, individuals with AN and BN reported less urge to eat and more regret if they ate high-calorie and low-calorie food; individuals with AN and BN rated normal weight bodies as less normal weight, less attractive and less desirable than HCs. There were no group differences in explicit ratings of the thin body.

Discussion: We did not find evidence for biased approach-avoidance tendencies toward food or body stimuli in individuals with AN or BN. Future studies are necessary to understand conflicting findings regarding approach-avoidance biases toward food and body stimuli in individuals with ED.

KEYWORDS
anorexia nervosa, approach-avoidance, body, bulimia nervosa, food

1 | INTRODUCTION

Anorexia nervosa (AN) is characterized by severe dietary restriction or maladaptive weight loss behavior, leading to a significantly low body weight (American Psychiatric Association, 2013). In contrast, food craving, intense desire for food and frequent binge-eating episodes followed by compensatory behavior, characterize bulimia nervosa (BN) (American Psychiatric Association, 2013). Despite extensive research efforts, more knowledge about key mechanisms that are involved in the maintenance of AN and BN is needed: which mechanisms enable individuals with AN to maintain their significantly low body weight and which mechanisms drive individuals with BN to binge episodes (Glashouwer et al., 2020; Jansen, 2016)?

Dual process models may help to elucidate these questions. They differentiate between controlled, symbolic or reflective, and automatic, associative or impulsive information processing (Strack & Deutsch, 2004) and suggest that behavior is the outcome of an interplay between the reflective and impulsive system. Recently, dual process models have been applied to eating behavior, and researchers argue that cognitive biases in the impulsive system such as approach-avoidance tendencies contribute to the maintenance of disordered eating (Loijen, Vrijsen, Egger, Becker, & Rinck, 2020; Paslakis, Scholz-Hehn, Sommer, & Kühn, 2020).

Approach-avoidance tendencies refer to action tendencies toward salient stimuli, such as food and body stimuli in EDs (Williamson, White, York-Crowe, & Stewart, 2004). In individuals with AN, an approach tendency toward food may be weakened or even absent, which contributes to severe restriction of food intake (Neimeijer, de Jong, & Roefs, 2015). In individuals with BN, strong approach biases toward food may undermine self-control and contribute to excessive food intake (Brockmeyer, Hahn, Reetz, Schmidt, & Friederich, 2015). Apart from food stimuli, body stimuli are key stimulus characteristics that may activate cognitive biases (Williamson et al., 2004). Woud, Anschutz, Van Strien, and Becker (2011) suggested that an approach bias toward a thin beauty ideal may contribute to dieting behavior. Thus, approach-avoidance biases toward food and body stimuli could be important mechanisms in the maintenance of disordered eating.

Cognitive behavioral therapy (CBT) for EDs focuses on explicit mechanisms such as strict dieting and other weight-control behaviors or overvaluation of weight and shape (Fairburn, Cooper, & Shafran, 2003), whereas implicit processes are neglected. In contrast, cognitive bias modification (CBM) targets implicit biases such as approach-avoidance tendencies, and computerized training interventions have successfully been implemented as an add-on to standard CBT in the treatment of several mental disorders (Loijen et al., 2020). Therefore, the identification of automatic approach-avoidance tendencies in individuals with EDs is necessary for elucidating key maintenance factors and developing treatments that target these factors. Examining approach-avoidance tendencies across and between diagnostic categories can refine models that aim to explain the maintenance of disordered eating behavior in individuals with AN and BN and may inform the development of transdiagnostic or specific interventions such as approach-avoidance trainings.

Research in student samples indicates that approach-avoidance trainings can change food-related approach-avoidance biases (Kakoschke, Kemps, & Tiggemann, 2017). In clinical samples, evidence is very sparse. Brockmeyer et al. (2019) examined the effects of an active approach bias modification (ABM) training compared to sham ABM in a BN and binge-eating disorder sample. The results were mixed: they found that participants in both conditions experienced significant reductions in binge eating, ED symptoms, trait food craving, and food cue reactivity. Active ABM tended to result in greater reductions in ED symptoms than sham ABM. However, food intake, approach bias, and attention bias toward food did not change.

So far, only a few studies have examined approach-avoidance tendencies toward food and body stimuli in clinical samples of women with AN or BN. Veenstra and de Jong (2011) and Neimeijer, Roefs, Glashouwer, Jonker, and de Jong (2019) assessed approach-avoidance tendencies in adolescents. They found evidence for less automatic motivational orientation toward food and reduced approach tendencies for high-calorie food in adolescent AN spectrum patients, compared to healthy controls (HCs). Paslakis et al. (2016) assessed approach-avoidance tendencies in adults. They found that HCs were generally faster in pulling high-calorie and low-calorie food stimuli, whereas patients with AN were generally slower in pulling food pictures. Paslakis and colleagues interpreted this finding as absence of an approach bias toward food in individuals with AN, whereas HCs showed an approach bias toward food. With regard to body stimuli, there is sparse evidence in clinical samples. In two studies, Brockmeyer et al. (2020) assessed approach-avoidance biases toward thin and normal weight bodies in AN patients compared to HCs. In the first study, they used thin and normal weight avatar bodies with a standard face and found no differences in automatic approach-avoidance tendencies. In the second study, they again used thin and normal weight avatar bodies but positioned the participant's own face and another women's face on the bodies. They found that patients with AN approached thin bodies significantly faster when depicted as themselves than when depicted as another woman.

In sum, there is some evidence that an approach bias toward food may be missing in individuals with AN. Concerning body stimuli, evidence for an approach-avoidance bias in individuals with AN is still inconclusive. So far, no study has examined approach-avoidance biases toward food or body stimuli in individuals with BN or compared the strength of these biases between individuals with an AN or BN. Therefore, it was the aim of the present study to assess approach-avoidance biases toward food and body stimuli using implicit Approach-Avoidance Tasks (AAT) in individuals with AN, BN, and HCs. In these tasks, participants see pictures on a computer screen and use a joystick either to push the pictures away from themselves or to pull them toward themselves. When participants pull the joystick toward themselves, the pictures increase in size; when participants push the joystick away from themselves, the pictures decrease in size. This zooming effect evokes the visual impression that the picture is pulled closer or pushed away and thus generates a sensation of approach and avoidance (Rinck & Becker, 2007). In addition to the implicit tasks, we also assessed explicit ratings of food and body pictures. It is hypothesized that explicitly measured variables are particularly valuable for the prediction of deliberate, controlled behavior, whereas implicitly measured variables may be more important for the prediction of less controlled, more impulsive behavior (Friese, Hofmann, & Waenke, 2008). Therefore, the assessment of implicit biases may provide important information even though differences in explicit variables are already known.

We expected that individuals with AN would show a lack of approach bias toward high-calorie food, whereas individuals with BN would show an approach bias toward high-calorie food (i.e., they would be faster when pulling than pushing high-calorie food). With regard to low-calorie stimuli, no differences in response times were expected. Our study was planned and designed before the study by Brockmeyer et al. (2020) was published. Therefore, we expected that individuals with AN and BN would show an approach bias toward thin bodies (i.e., they would be faster when pulling than pushing thin bodies). With regard to normal weight bodies, we expected a stronger avoidance bias in individuals with AN (i.e., they would be faster when pushing than pulling normal weight bodies) compared to individuals with BN and HCs.

2 | METHODS

2.1 | Design

The present study was a cross-sectional study comparing individuals with AN, individuals with BN, and HCs. It included interview measures for diagnostic purposes, several questionnaires to describe the sample, two AATs to assess approach-avoidance tendencies toward high-calorie versus low-calorie food and thin versus normal weight bodies, and explicit ratings of the food and body stimuli.

2.2 | Sample and recruitment

The final sample included 104 individuals and consisted of 42 individuals with AN, 24 individuals with BN, and 38 HCs (16 students). Individuals with an ED were recruited from an inpatient clinic specialized in the treatment of EDs. Inclusion criteria for the AN and BN group were an AN or BN diagnosis according to DSM-5-criteria. Exclusion criteria for the AN and BN group were age < 18, pregnancy, substance abuse or misuse current or life time, bipolar disorder, psychotic disorder current or life time, schizophrenia, and suicidality. Exclusion criteria for the HC group were age < 18, pregnancy, BMI < 18.5, BMI > 25, and any current mental disorder. All participants provided written informed consent and received financial reimbursement for their participation. The local ethics committee approved the study.

2.3 | Procedure

Individuals with an ED were informed about the study in group therapy sessions and invited to participate in case of an AN or BN diagnosis at intake. Individuals for the HC group were recruited by using university e-mail lists and by distributing flyers in the university and public buildings. We used a telephone screening to assess inclusion and exclusion criteria for the HC group. A diagnostic session was scheduled with all participants. At the end of the diagnostic session, questionnaires were given to the participants, and another session within the next week was scheduled to carry out the experimental tasks. The experimental tasks (Food-AAT and Body-AAT) were administered in randomized order. Then, the participants rated the stimuli used in the tasks. Four items of the Grand Hunger Scales (Grand, 1968) were assessed before the experimental session started: time since last meal, hunger rating, amount of favorite food the participants could imagine eating, and time until next meal. Only participants whose last meal had taken place 2–4 hr (Paslakis et al., 2016) before the test procedure were included in the study, in order to ensure comparability in terms of satiety.

2.4 | Materials

2.4.1 | Interviews

Short diagnostic interview for mental disorders (Mini-DIPS) (Margraf, 1994): The Mini-DIPS is a structured diagnostic interview to assess current and lifetime DSM-IV diagnoses of the most frequent clinical disorders. We used an adapted version for DSM-5.

Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, fourth edition, Axis I (SCID-I) (Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997): The SCID-module for DSM-IV disorders is a widely used structured interview to assess axis I mental disorders. The criteria were adapted to the criteria of the DSM-5.

2.4.2 | Questionnaires

Beck Depression Inventory-II (BDI-II) (German version by Hautzinger, Keller, & Kühner, 2006): The BDI-II is a widely used self-report scale assessing depressive symptoms during the past 2 weeks. It includes 21 items, which are rated on scales from 0 to 3. All items are added up to form a total score. The total sum score ranges between 0 and 63, with higher scores indicating more severe depressive symptoms. Previous research has shown good internal consistency (Cronbach's α) in several clinical and nonclinical samples as well as high correlations with other measures of depression (Wintjen & Petermann, 2010). Internal consistency in the current sample was $\alpha = .96$.

Eating Disorder Examination Questionnaire (EDE-Q) (German version by Hilbert & Tuschen-Caffier, 2016): The EDE-Q is a widely used 28-item self-report measure to assess eating disorder symptomatology during the past 28 days. It comprises four subscales: restrained eating, eating concern, weight concern, and shape concern. Items are rated on scales from 0 (no days) to 6 (every day). The total mean score ranges between 0 and 6, with higher scores indicating more severe eating disorder pathology. Previous research has shown good internal consistency (Cronbach's α) in clinical and nonclinical samples for the total scale and the subscales; the total score and the subscales have also been found to reliably discriminate between individuals with an ED (AB, BN, atypical EDs) and individuals without an ED (Hilbert & Tuschen-Caffier, 2016). In the current sample, internal consistency was $\alpha = .97$ for the total score.

Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ) (German version by Knauss, Paxton, & Alsaker, 2009): The SATAQ is a 16-item self-report questionnaire to assess sociocultural influences on body image. It includes three subscales: awareness of the existence of the thin body ideal, internalization of this ideal and the perceived pressure to conform to media ideals. Items are rated on 5-point Likert-scales ranging from 1 (strongly disagree) to 5 (strongly agree). Total sum scores range between 6 and 30 for the internalization subscale and between 5 and 25 for the pressure and awareness subscales, with higher scores indicating stronger sociocultural influences on body image. Previous research indicated that all three subscales have adequate or good internal consistency. For girls, there were high correlations between the internalization and pressure subscales with both body dissatisfaction measures and weight and eating concerns, while awareness only moderately correlated with body dissatisfaction and weight and eating concerns (Knauss et al., 2009). In the current sample, internal consistency was $\alpha = .95$ for the total score and ranged between .84 and .93 for the subscales.

Body Shape Questionnaire (BSQ) (German version by Waadt, Laessle, & Pirke, 1992): The BSQ is a 34-item self-report instrument to assess the dissatisfaction with one's own body during the last 4 weeks. Each item is scored on a scale from 1 (never) to 6 (always). All items are added up to form a total score. Total sum scores range between 34 and 204, with higher scores indicating higher levels of body dissatisfaction. Previous research has shown excellent internal consistency (Cronbach's α) in clinical (AN, binge-eating disorder) and nonclinical samples; the total score has also been found to reliably discriminate between clinical and nonclinical groups (Pook, Tuschen-Caffier, & Stich, 2002). In the current sample, Cronbach's alpha was .98 for the total score.

Food Craving Questionnaire (FCQ-T-r) (German version by Meule, Hermann, & Kubler, 2014): The FCQ-T-r is the reduced version of the FCQ, which assesses trait food craving. It includes 15 items, which are rated on scales from 1 (never) to 6 (always). All items are added up to form a total score. Total sum scores range between 15 and 90, with higher scores indicating higher levels of food craving. Previous research has shown high internal consistency (Cronbach's α) in nonclinical samples. Furthermore, scores of the FCQ-T-r were positively correlated with BMI and negatively correlated with dieting success (Meule et al., 2014). In the current sample, internal consistency was $\alpha = .95$ for the total score.

2.4.3 | Stimuli for the Food and Body Approach-Avoidance Tasks

Body stimuli

Twelve pictures of a thin woman and 12 pictures of a normal weight woman were used in the Body-AAT. The pictures were computer-generated (e.g., see Figure 1). Different versions of the two body templates (thin and normal weight) were created by varying the pose of the body (e.g., body turned left ways, body turned right ways). We presented the pictures without heads to ensure that participants evaluated only the body. The selection of the two body templates (thin, normal weight) was based on the results of a pilot study (Leins, Waldorf, Kollei, Rinck, & Steins-Loeber, 2018). In this pilot study, 66 female participants rated 32 pictures displaying computer-generated female bodies with regard to their weight (ultra-thin, thin, normal weight, overweight, obese) and the desirability of their shape on a 7-point Likert-scale ranging from "strongly agree" to "strongly disagree." The two body templates selected for the present study and a previous study (Leins et al., 2018) were (a) the one that was rated as the most desirable thin body picture (thin body) and (b) the one whose weight was rated as normal and as moderately desirable (normal weight body). Each picture was rendered with dark- and light-colored underwear, which was used in the Body-AAT as a reaction cue, with the color (light grey vs. dark grey) informing participants about the expected reaction (push vs. pull). To allow for the zooming effect, seven different sizes of each picture were constructed.

FIGURE 1 Example of pictures used in the Body Approach-Avoidance Task (thin body picture and normal weight body picture)

Food stimuli

Twelve pictures of different kinds of high-calorie food (burger, ice cream, pastries, potato chips, muffins, pasta bake, chicken nuggets, pancakes, pizza, fries, chocolate, and torte) and 12 pictures of different kinds of low-calorie food (apple, strawberry, mixed fruits, vegetables, cucumber, crispbread, mandarin, fruit salad, mixed salad,

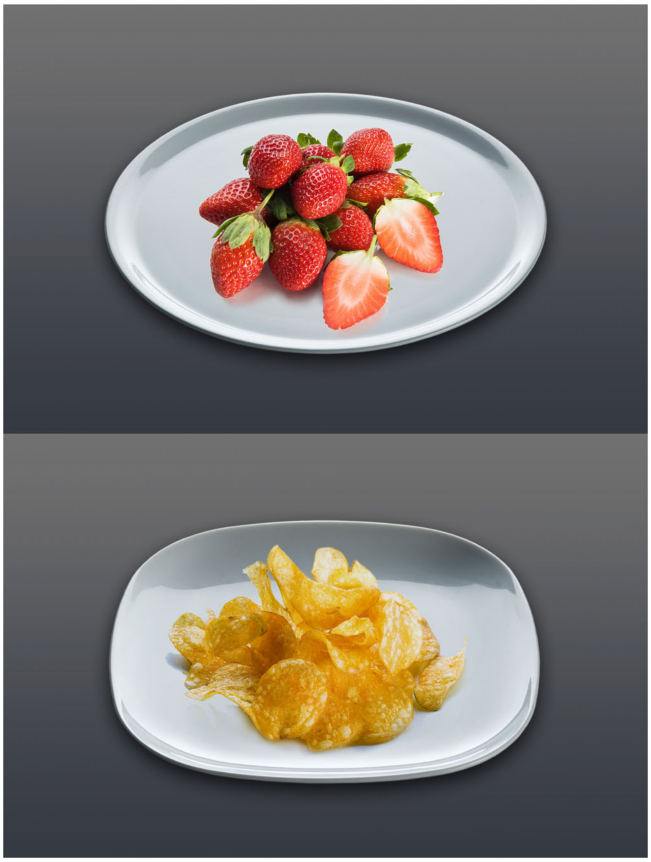

FIGURE 2 Example of pictures used in the Food Approach-Avoidance Task (low-calorie and high-calorie food picture)

asparagus, tomato salad, and fruits of the forest) were used in the Food-AAT. The selection of food stimuli was based on the 10 high- and 10 low-calorie stimuli used in an experimental Go/No-Go task by Meule, Hermann, & Kubler (2014). We added another four stimuli (two high-calorie stimuli: burger, chocolate, and two low-calorie stimuli: fruit salad and asparagus). In the high-calorie category, we replaced a picture used by Meule et al. (2014) displaying cheese with a picture displaying chicken wings as not all HCs may identify cheese as high calorie. We estimated the calorie content of all food stimuli using rating data provided for similar pictures in the Food Pics Database by Blechert, Meule, Busch, and Ohla (2014) to make sure that they were high and low calorie. We did not use the pictures from the Food Pics Database or another validated picture set, because analogous to the Body-AAT we included the reaction cue inside the pictures instead of using, for instance, the picture format as cue. Therefore, a professional photographer took pictures of the 12 high- and 12 low-calorie food stimuli that we had selected for the Food-AAT (e.g., see Figure 2). Each high- and low-calorie food was placed and photographed on a round plate and on a rectangular shaped plate, which was used in the AAT as reaction cue, informing participants about the expected reaction (push vs. pull). To allow for the zooming effect, seven different sizes of each picture were constructed.

2.4.4 | Food and Body Approach-Avoidance Task (Food-AAT, Body-AAT)

Food-AAT

In the Food-AAT, participants were shown color photographs of high- and low-calorie food items on a computer screen. They were asked to pull or push a joystick in response to the shape of the plate the food was placed on (round plate vs. rectangular plate) irrespective of the picture content (high- vs. low-calorie food). Pushing the pictures resulted in a reduction of the size of the picture, while pulling resulted in an increase. Half of the participants were instructed to pull round plates and push rectangular plates and the other half vice versa. The pictures of food were arranged in three blocks with each block comprising 48 trials. Each block included the following pictures: the 12 high-calorie foods on round plates, the 12 high-calorie foods on rectangular plates, the 12 low-calorie foods on round plates, and the 12 low-calorie foods on rectangular plates. In sum, each participant performed 144 trials.

Body-AAT

In the Body-AAT, participants were shown color photographs of thin and normal weight women in underwear. They were asked to pull or push a joystick in response to the color of the underwear (light grey vs. dark grey) irrespective of the picture content (thin vs. normal weight). Pushing the pictures resulted in a reduction of the size of the picture while pulling resulted in an increase. Half of the participants were instructed to pull light grey underwear and push dark grey underwear and the other half vice versa. The pictures of women were arranged in three blocks with each block comprising 48 trials. Each block included the following pictures: the 12 thin bodies with light grey underwear, the 12 thin bodies with dark grey underwear, the 12 normal weight bodies with light grey underwear, and the 12 normal weight bodies with dark grey underwear. In sum, each participant performed 144 trials.

In both AATs, each trial started by pushing the start button while the joystick was positioned in the middle position. This made a medium-sized picture appear in the center of the screen. The picture disappeared as soon as the joystick was moved completely in the correct direction. Time until the end of the full correct movement was used as reaction time (RT). Technically, this is equivalent to the interval between appearance and disappearance of the picture.

2.4.5 | Explicit rating of food and body stimuli

Food stimuli

Participants were asked to rate each of the 12 high calorie and each of the 12 low-calorie food pictures on visual analog scales ranging from 0 (not at all) to 100 (very much) by answering the following questions: (a) How much would you like to eat this food now? (urge to eat) and (b) How much would you regret it if you ate this food now? (regret).

Body stimuli

Participants were asked to rate one version of the thin body and one version of the normal weight body on visual analog scales ranging from 0 (not at all) to 100 (very much) by answering the following questions: (a) How normal do you think this body weight is? (b) How attractive do you think this body is? and (c) How desirable do you think this body is?

2.5 | Statistical analyses

We computed several univariate analysis of variance (ANOVAs) to compare groups with regard to sociodemographic variables and clinical variables.

For descriptive statistics and correlations, we computed compatibility effect scores (CES) by subtracting each participant's mean RTs in the pull conditions from the mean RTs in the corresponding push conditions. These scores reflect the relative strength of approach and avoidance tendencies: values that are more negative indicate more negative reactions, that is, stronger avoidance (Rinck & Becker, 2007).

For testing our hypotheses, we used several mixed ANOVAs with group (AN, BN, and HCs) as between subject factor and stimulus (food: high calorie vs. low calorie; body: thin vs. normal weight) and direction (pull vs. push) as within subject factors to analyze approach-avoidance tendencies in the Food-AAT and Body-AAT. Three individuals were excluded from the Food-AAT ($n = 2$ HCs) or Body-AAT ($n = 1$ individual with AN) due to too many errors. The cut-off for the error rates in both tasks was 12%, based on the distribution of error rates in box plots and exceedingly high error rates. Separately for the two tasks, the fastest 1% of all RTs of full correct movements and the slowest 1% of all RTs of these movements were excluded before aggregation. This led to the exclusion of one participant in the Body-AAT ($n = 1$ individual with BN). We computed mean RTs after the outlier exclusion. We also screened for outliers on a participant level by computing z-scores for RTs in both tasks for each group (AN, BN, and HCs). There were no outliers as defined by a z-score > 3.29.

We used several univariate ANOVAs with group (AN, BN, and HC) as the independent variable and explicit ratings as the dependent variables to analyze group differences with regard to explicit ratings. We used Tukey or Games Howell as post hoc tests depending on the homogeneity of variances. A two-tailed α of .05 was applied for all statistical tests. ANOVA is considered as a robust test even when sample sizes are unequal if variances are homogenous (Bühner & Ziegler, 2009). Effect sizes for ANOVAs are reported by partial eta squared. Döring and Bortz (2016) suggested the following cut-offs for partial eta squared: small: $\eta^2 = .01$, moderate: $\eta^2 = .06$, large: $\eta^2 = .14$. We computed 90% CI for partial eta squared using an SPSS syntax provided by http://core.ecu.edu/psyc/wuenschk/SPSS/SPSS-Programs.htm

3 | RESULTS

3.1 | Participants

The final sample consisted of 42 individuals with AN (mean age = 24.93, $SD = 5.30$), 24 individuals with BN (mean age = 26.83, $SD = 6.32$), and 38 HCs (mean age = 24.08, $SD = 3.36$). The groups did not significantly differ in age, $F(2, 101) = 2.29$, $p = .106$, $\eta^2 = .04$, or in education, Fisher's exact test = 2.94, $p = .216$; there were significant group differences in relationship status, $\chi^2(2) = 9.75$, $p = .007$. Importantly, the groups did not differ with regard to the time since last meal, $F(2, 101) = 1.95$, $p = .148$, $\eta^2 = .04$. However, individuals with AN and BN reported more hunger than HCs, $F(2, 101) = 28.04$, $p < .001$, $\eta^2 = .36$, whereas HCs reported a greater amount of their favorite food that they could imagine eating right now than individuals with AN and BN, $F(2, 101) = 19.28$, $p < .001$, $\eta^2 = .28$; there was no group difference in time until next meal, $F(2, 101) = 0.35$, $p = .704$, $\eta^2 = .01$. With regard to clinical variables, individuals with AN showed a lower BMI than the BN group and HCs, $F(2, 101) = 59.54$, $p < .001$, $\eta^2 = .54$. Expectedly, the ED groups significantly differed from HCs in several measures of psychopathology (all $ps < .001$): Individuals with AN and BN scored higher than HCs in depressive symptoms, eating disorder pathology, sociocultural influences on body image, and body dissatisfaction. Individuals with BN showed higher scores for food craving than the AN group and HCs. For descriptive data and comorbidities, see Tables 1 and 2.

3.2 | Food-AAT

A 3 (group: AN vs. BN vs. HC) × 2 (stimulus: high calorie vs. low calorie) × 2 (response: pull vs. push) mixed within-between ANOVA revealed a main effect of stimulus, $F(1, 101) = 58.72$, $p < .001$, $\eta^2 = .37$, 90% CI [0.25, 0.47], indicating that all participants reacted faster to low-calorie stimuli than to high-calorie stimuli. There was a small albeit significant main effect of direction, $F(1, 101) = 8.04$, $p = .006$, $\eta^2 = .07$, 90% CI [0.01, 0.17], indicating that all participants were faster when pushing pictures than when pulling pictures.

Importantly and with respect to our hypotheses, there was no significant Group × Stimulus × Direction interaction, $F(2, 101) = 0.94$, $p = .393$, $\eta^2 = .02$, 90% CI [0.00, 0.07], which indicated that individuals with AN, BN, and HCs did not differ in their approach-avoidance reactions to high-calorie and low-calorie food. There was, however, a significant Group × Stimulus interaction, $F(2, 101) = 5.49$, $p = .005$, $\eta^2 = .10$, 90% CI [0.02, 0.19]. Follow-up analyses indicated that even though all participants reacted slower to high-calorie than to low-calorie food, the difference was greater in individuals with AN compared to HCs, $F(1, 78) = 10.80$, $p = .002$, $\eta^2 = .12$, 90% CI [0.03, 0.24]. There was no significant difference between individuals with AN and individuals with BN, $F(1, 64) = 2.23$, $p = .140$, $\eta^2 = .03$, 90% CI [0.00, 0.13], and no significant difference between individuals with BN and HCs, $F(1, 60) = 1.93$, $p = .170$, $\eta^2 = .03$, 90% CI [0.00, 0.13]. The other interaction effects, Group × Direction, $F(2, 101) = 2.44$, $p = .093$, $\eta^2 = .05$, 90% CI [0.00, 0.12], and Stimulus × Direction, $F(1, 101) = 1.37$, $p = .244$, $\eta^2 = 0.01$, 90% CI [0.00, 0.07], were not significant. For descriptive data, see Table 3.

3.3 | Body-AAT

A 3 (group: AN vs. BN vs. HC) × 2 (stimulus: thin vs. normal weight) × 2 (response: pull vs. push) mixed within-between

TABLE 1 Sociodemographic and clinical characteristics in individuals with anorexia nervosa (AN), bulimia nervosa (BN) and healthy controls (HC)

Variable		AN (n = 42)	BN (n = 24)	HC (n = 38)	Test statistic	p	Effect size η^2
Sociodemographic characteristics							
Age, years, M (SD)		24.93 (5.30)	26.83 (6.32)	24.08 (3.36)	$F(2, 101) = 2.29$	.106	.04
Relationship, n (%)	Without relationship	26 (61.9)	14 (58.3)	11 (28.9)	$\chi^2(2) = 9.75$	.007	
	With relationship	16 (38.1)	10 (41.7)	27 (71.1)			
Education, years, n (%)	< 10 years	2 (4.8)	2 (8.3)	0 (0.0)	Fisher's exact test = 2.94	.216	
	≥ 10 years	40 (95.2)	22 (91.7)	38 (100.0)			
Grand Hunger Scales							
Time since last meal, minutes, M (SD)		165.55 (37.32)	158.96 (37.73)	177.76 (40.55)	$F(2, 101) = 1.95$	.148	.04
Hunger, 0–6, M (SD)		0.43 (0.83)	1.04 (1.12)	2.39 (1.52)	$F(2, 101) = 28.04$	<.001	.36
Amount of favorite food, 0–6, M (SD)		1.21 (1.29)	1.46 (1.22)	2.92 (1.36)	$F(2, 101) = 19.28$	<.001	.28
Time until next meal, minutes, M (SD)		107.86 (47.27)	101.46 (44.05)	112.11 (52.86)	$F(2, 101) = 0.35$	.704	.01
Clinical characteristics							
Duration of illness, years, M (SD)		6.59 (6.24)	7.38 (6.60)		$F(1, 58) = 0.21$	.648	.00
Duration of inpatient treatment, weeks, M (SD)		6.88 (4.08)	6.38 (2.53)		$F(1, 60) = 0.30$	.588	.01
BMI, M (SD)		16.85_a (2.15)	22.21_b (2.84)	21.43_b (1.94)	$F(2, 101) = 59.45$	<.001	.54
BDI, total score, M (SD)		21.19_a (10.84)	24.04_a (10.76)	3.63_b (4.97)	$F(2, 101) = 50.94$	<.001	.50
EDE-Q, total score, M (SD)		3.12_a (1.34)	3.43_a (1.32)	0.76_b (0.75)	$F(2, 101) = 55.54$	<.001	.52
SATAQ, total score, M (SD)		57.79_a (14.87)	63.71_a (9.71)	42.11_b (13.87)	$F(2, 101) = 22.57$	<.001	.31
BSQ, total score, M (SD)		122.43_a (36.77)	138.25_a (30.60)	60.03_b (22.98)	$F(2, 101) = 60.63$	<.001	.55
FCQ-T-r, total score, M (SD)		35.60_a (13.13)	61.00_b (14.46)	27.08_c (7.17)	$F(2, 101) = 64.02$	<.001	.56

Note: Means in the same row that share the same subscripts do not differ at $p < .05$ in post hoc tests.
Abbreviations: BMI, body mass index; BDI, Beck Depression Inventory; BSQ, Body Shape Questionnaire; EDE-Q, Eating Disorder Examination Questionnaire; FCQ-T-r = Food Craving Questionnaire Trait reduced; SATAQ, Sociocultural Attitudes Towards Appearance Questionnaire.

ANOVA revealed a main effect of stimulus, $F(1, 101) = 6.28$, $p = .014$, $\eta^2 = .06$, 90% CI [0.01, 0.14], indicating that all participants reacted faster to normal weight bodies than to thin bodies. There was a significant main effect of direction, $F(1, 101) = 21.83$, $p < .001$, $\eta^2 = .18$, 90% CI [0.08, 0.28], indicating that all participants pushed the joystick faster than they pulled it.

Importantly and with respect to our hypotheses, there was no significant Group × Stimulus × Direction interaction, $F(2, 101) = 0.38$, $p = .683$, $\eta^2 = .01$, 90% CI [0.00, 0.04]. This indicated that individuals with AN, BN, and HCs did not differ in their approach-avoidance reactions toward thin and normal weight body stimuli. The other interaction effects, Group × Stimulus, $F(2, 101) = 0.67$, $p = .514$, $\eta^2 = .01$, 90% CI [0.00, 0.06], Group × Direction, $F(2, 101) = 1.57$, $p = .214$, $\eta^2 = .03$, 90% CI [0.00, 0.09], and Stimulus × Direction, $F(1, 101) = 1.80$, $p = .183$, $\eta^2 = .02$, 90% CI [0.00, 0.08], were not significant. For descriptive data, see Table 3.

TABLE 2 Current comorbid disorders in individuals with anorexia nervosa (AN) and bulimia nervosa (BN)

Variable	AN ($n = 42$)	BN ($n = 24$)
Current comorbidities, *n* (%)		
Screening for psychotic disorder	0 (0.0)	0 (0.0)
Bipolar disorder	0 (0.0)	0 (0.0)
Depressive disorder	6 (14.29)	10 (41.67)
Anxiety disorder	18 (42.86)	8 (33.33)
OCD and related disorder	4 (9.52)	2 (16.67)
Trauma-related disorder	2 (4.76)	2 (8.33)
Somatoform disorder	2 (4.76)	0 (0.0)
Sleep-related disorder	13 (30.95)	6 (25.00)
Screening for sexual dysfunction	16 (38.10)	7 (29.17)
Screening for impulse control disorder	0 (0.0)	0 (0.00)

3.4 | Explicit ratings of food and body stimuli

Individuals with AN and BN reported a lower urge to eat high-calorie food, $F(2, 101) = 32.55$, $p < .001$, $\eta^2 = .39$, and more regret if they ate high-calorie food than HCs, $F(2, 101) = 53.21$, $p < .001$, $\eta^2 = .51$. In addition, individuals with AN and BN reported a lower urge to eat low-calorie food and reported more regret if they ate low calorie food than HCs, $F(2, 101) = 13.70$, $p < .001$, $\eta^2 = .21$ and $F(2, 101) = 28.95$, $p < .001$, $\eta^2 = .36$. For descriptive data, see Table 4.

Individuals with AN reported that they found the normal weight body less attractive than individuals with BN, who scored lower than HCs, $F(2, 101) = 14.98$, $p < .001$, $\eta^2 = .23$. Individuals with AN and BN reported that they found the normal weight body less desirable than HCs, $F(2, 101) = 12.95$, $p < .001$, $\eta^2 = .20$. Individuals with AN and BN assumed that the normal weight body was less normal weight than HCs, $F(2, 101) = 17.32$, $p < .001$, $\eta^2 = .26$. There were no group differences with regard to the thin body (all *p*s > .05). For descriptive data and further test statistics, see Table 4.

3.5 | Post hoc correlational analyses between approach-avoidance tendencies and self-report questionnaires

We further explored the relationship between approach-avoidance tendencies and self-report questionnaires by computing Pearson's

TABLE 3 Descriptive data for mean reaction times (ms) and compatibility effect scores in the Food-AAT and Body-AAT in individuals with anorexia nervosa (AN), bulimia nervosa (BN), and healthy controls (HC)

Variable	AN ($n = 42$)	BN ($n = 24$)	HC ($n = 38$)
Food-AAT			
High-calorie food pull	906.63 (137.79)	905.11 (115.08)	846.57 (96.63)
High-calorie food push	876.01 (117.01)	878.15 (104.22)	847.45 (90.96)
CES high-calorie food	−30.62 (78.49)	−26.96 (48.51)	0.88 (54.31)
Low-calorie food pull	865.72 (132.69)	871.37 (97.38)	835.02 (96.09)
Low-calorie food push	842.23 (114.51)	862.69 (94.68)	832.34 (85.05)
CES-low calorie food	−23.49 (67.56)	−8.67 (39.15)	−2.68 (58.53)
Body-AAT			
Thin body pull	742.27 (99.72)	767.78 (75.54)	718.25 (64.87)
Thin body push	720.65 (95.91)	739.89 (75.37)	707.44 (71.58)
CES thin body	−21.62 (45.91)	−27.89 (37.12)	−10.81 (35.72)
Normal weight body pull	733.56 (97.42)	758.87 (87.14)	707.44 (68.93)
Normal weight body push	723.66 (85.47)	735.16 (77.91)	699.78 (74.03)
CES normal weight body	−9.90 (45.61)	−23.71 (44.86)	−7.65 (44.79)

Note: CES = Compatibility effect score, which is computed by subtracting each participant's mean reaction times in the pull conditions from the mean reaction times in the corresponding push conditions; the scores reflect the relative strength of approach-avoidance tendencies; negative scores indicate avoidance and positive scores indicate approach-tendencies.
Abbreviations: AAT, Approach-Avoidance Task.

TABLE 4 Explicit ratings of food and body stimuli in individuals with anorexia nervosa (AN), bulimia nervosa (BN), and healthy controls (HC)

Variable		AN (n = 42)	BN (n = 24)	HC (n = 38)	Test statistic	p	Effect size η^2
Food stimuli							
High-calorie food	Urge to eat	19.10_a (20.32)	21.73_a (20.65)	53.13_b (19.69)	$F(2, 101) = 32.55$	<.001	.39
	Regret	84.23_a (21.63)	83.08_a (25.38)	31.60_b (27.71)	$F(2, 101) = 53.21$	<.001	.51
Low-calorie food	Urge to eat	41.44_a (26.19)	42.82_a (32.66)	68.71_b (17.36)	$F(2, 101) = 13.70$	<.001	.21
	Regret	35.57_a (23.45)	24.91_a (25.12)	2.80_b (5.37)	$F(2, 101) = 28.95$	<.001	.36
Body stimuli							
Thin body	Normal weight	48.87 (29.44)	40.05 (23.36)	49.01 (28.38)	$F(2, 101) = 0.95$	.392	.02
	Attractiveness	57.64 (28.46)	62.04 (29.10)	56.24 (27.67)	$F(2, 101) = 0.32$	.727	.01
	Desirability	53.60 (31.65)	56.36 (36.16)	49.57 (32.39)	$F(2, 101) = 0.33$	.717	.01
Normal weight body	Normal weight	51.98_a (26.94)	65.62_a (24.16)	83.71_b (20.43)	$F(2, 101) = 17.32$	<.001	.26
	Attractiveness	33.21_a (23.29)	48.60_b (25.24)	63.70_c (26.35)	$F(2, 101) = 14.98$	<.001	.23
	Desirability	27.93_a (25.07)	35.48_a (25.67)	57.07_b (27.49)	$F(2, 101) = 12.95$	<.001	.20

Note: Means in the same row that share the same subscripts do not differ at p < .05 in post hoc tests.

TABLE 5 Correlations between implicit approach-avoidance tendencies and self-report questionnaires in the whole sample (n = 104)

Self-report questionnaire	CES high-calorie food	CES low-calorie food	CES thin body	CES normal weight body
BDI total score	−.143	−.017	−.083	−.032
EDE-Q total score	−.121	−.047	−.079	−.082
EDE-Q restraint	−.168	−.056	−.042	−.113
EDE-Q eating concern	−.099	−.019	−.054	−.113
EDE-Q weight concern	−.051	−.022	−.082	−.073
EDE-Q shape concern	−.131	−.069	−.102	−.057
SATAQ total score	−.138	.007	−.088	.011
SATAQ awareness	−.136	.041	−.037	.053
SATAQ internalization	−.171	.008	−.119	.000
SATAQ pressure	−.050	−.021	−.057	−.011
BSQ total score	−.138	−.030	−.063	−.040
FCQ-T-r total score	−.021	.079	−.122	−.014

Note: CES = Compatibility effect score, which is computed by subtracting each participant's mean reaction times in the pull conditions from the mean reaction times in the corresponding push conditions; *p < .05.
Abbreviations: BDI, Beck Depression Inventory; BSQ, Body Shape Questionnaire; EDE-Q, Eating Disorder Examination Questionnaire; FCQ-T-r, Food Craving Questionnaire Trait reduced; SATAQ, Sociocultural Attitudes Towards Appearance Questionnaire.

product–moment correlations. We found no significant correlations between approach-avoidance tendencies and self-report questionnaires. For an overview of the correlations, see Table 5.

3.6 | Post hoc analysis of anorexia nervosa subtypes

Of the n = 42 individuals with AN, 28 individuals belonged to the restrictive subtype. We repeated our mixed ANOVAs, considering only these individuals with AN belonging to the restrictive subtype. Concerning the Food-AAT, results were comparable to the results reported above (cf. 3.2): there were significant main effects of stimulus, $F(1, 87) = 58.23$, $p < .001$, $\eta^2 = .40$, 90% CI [0.27, 0.50], and direction, $F(1, 87) = 8.32$, $p = .005$, $\eta^2 = .09$, 90% CI [0.02, 0.19]. There was no significant Group × Stimulus × Direction interaction, $F(2, 87) = 1.40$, $p = .251$, $\eta^2 = .03$, 90% CI [0.00, 0.10]. However, we found a significant Group × Stimulus interaction, $F(2, 87) = 5.49$, $p = .006$, $\eta^2 = .11$, 90% CI [0.02, 0.21]. Follow-up analyses showed that individuals with restrictive AN significantly differed from HCs, $F(1, 64) = 11.05$, $p = .001$, $\eta^2 = .15$, 90% CI [0.04, 0.28], indicating that although all participants reacted slower to high-calorie than to low-calorie food, the difference was greater in individuals with restrictive AN compared to HCs. There were no differences between individuals with AN and BN, $F(1, 50) = 2.73$, $p = 105$, $\eta^2 = .05$, 90% CI [0.00, 0.17], or individuals with BN and HCs, $F(1, 60) = 1.93$,

$p = .170$, $\eta^2 = .03$, 90% CI [0.00, 0.13]. The other interaction effects, Group × Direction, $F(2, 87) = 2.54$, $p = .084$, $\eta^2 = .06$, 90% CI [0.00, 0.13], and Stimulus × Direction, $F(1, 87) = 2.74$, $p = .102$, $\eta^2 = .03$, 90% CI [0.00, 0.11], were not significant.

With regard to the Body-AAT, results were also comparable to the results reported above (cf. 3.3): there were significant main effects of stimulus, $F(1, 87) = 9.87$, $p = .002$, $\eta^2 = .10$, 90% CI [0.02, 0.21], and direction, $F(1, 87) = 18.77$, $p < .001$, $\eta^2 = .18$, 90% CI [0.07, 0.29]. There were no significant interaction effects, Group × Stimulus, $F(2, 87) = 0.08$, $p = .923$, $\eta^2 = .00$, 90% CI [0.00, 0.02], Group × Direction, $F(2, 87) = 1.55$, $p = .218$, $\eta^2 = .03$, 90% CI [0.00, 0.10], Stimulus × Direction, $F(1, 87) = 1.85$, $p = .177$, $\eta^2 = .02$, 90% CI [0.00, 0.09], and Group × Stimulus × Direction, $F(2, 87) = 0.43$, $p = .655$, $\eta^2 = .01$, 90% CI [0.00, 0.05].

4 | DISCUSSION

We used two implicit AATs with food and body stimuli to assess approach-avoidance tendencies in individuals with AN compared to individuals with BN and HCs. To the best of our knowledge, this is the first study that assessed approach-avoidance tendencies in AN, BN, and HC. In addition to these implicit tasks, we used explicit ratings to assess individuals' evaluations of food and body stimuli. The results indicated that there were no differences in approach-avoidance tendencies toward food or body stimuli in individuals with AN or BN compared to HCs. However, individuals with AN and BN differed from HCs in their explicit ratings of high- and low-calorie food; individuals with AN and BN also differed from HCs in the explicit ratings of the normal weight body. There were no group differences in the explicit evaluation of the thin body.

Contrary to our hypotheses, we found no group differences in approach-avoidance tendencies toward high- versus low-calorie food. These results are not in line with previous studies. Veenstra and de Jong (2011) found an approach tendency for low-calorie food but not for high-calorie food in adolescent patients with AN. Similarly, Neimeijer et al. (2015) and Neimeijer et al. (2019) found reduced approach tendencies for high-fat food in adolescent patients with AN. Methodological differences, sample differences, and sample size differences between the present study and previous research may explain the diverging findings. Neimeijer et al. (2015), Neimeijer et al. (2019) and Veenstra and de Jong (2011) used the Affective Simon Task (AST) and Stimulus Response Compatibility Task (SRCT) including food versus neutral stimuli. In the present study, we used the AAT including high-calorie versus low-calorie food stimuli. Our stimuli choice may have led to smaller effects compared to tasks including food versus neutral stimuli. Furthermore, previous studies included adolescent patients, who may exhibit stronger approach and avoidance biases. In addition, the sample sizes in previous studies were larger compared to our study. Thus, previous studies examining adolescent samples may have achieved more power.

Paslakis et al. (2016) examined approach-avoidance tendencies toward food in adult patients with AN. They found that patients with AN were generally slower in pulling both high-calorie and low-calorie food pictures than HCs, and they interpreted this finding as absence of an approach bias toward food in individuals with AN, whereas HCs showed an approach bias toward food. In our study, we did not find that effect. Methodological issues may explain the diverging results. The HC group in the study by Paslakis et al. (2016) included only medical students, whereas our HC sample also included participants from the working population. It may be that an approach bias toward food is especially pronounced in student samples or that student samples differ in some other aspect from the working population (e.g., achievement motivation). Furthermore, Paslakis et al. (2016) used the picture format as reaction cue in their implicit AAT, whereas we used the shape of the plate the food was placed on. It may be that the shape of the plate was harder to discern compared to the picture format resulting in smaller or no effects.

Contrary to our hypotheses, there were no group differences in approach-avoidance tendencies toward thin and normal weight bodies. These results are partly in line with previous research. Brockmeyer et al. (2020) conducted two studies using the AAT including thin and normal weight avatar bodies. They only found differences between adult patients with AN and HCs when the participants' own faces were positioned onto the avatars' bodies. Brockmeyer et al. (2020) suggested that identification may be a crucial component of biased body evaluation. The findings of the present study support this conclusion.

It is interesting to note that individuals with AN were especially slow compared to HCs when responding to high-calorie versus low-calorie stimuli. Schuck, Keijsers, and Rinck (2012) found a similar effect in individuals with pathological skin picking and interpreted this finding as distraction in response to stimuli with strong affective loading. However, this interpretation remains highly speculative and there may be other potential reasons for this effect such as measurement artifacts or encoding difficulties.

The lack of connection between the results in the implicit AATs and explicit food and body ratings needs to be discussed. In explicit food ratings, individuals with AN and BN reported less urge to eat and stronger regret if they ate any kind of food, whereas the implicit Food-AAT suggested a greater affective response to high-calorie food stimuli only in individuals with AN. In explicit body ratings, individuals with AN and BN differed from HCs in the evaluation of the normal weight body, whereas there were no differences in the implicit Body-AAT. One explanation is that implicit and explicit measures assess related but distinct constructs (Nosek, 2007). Furthermore, two process models such as the reflective-impulsive model by Strack and Deutsch (2004) assumed that automatic impulses are often in conflict with more deliberate evaluations in the reflective system (Friese et al., 2008). Supporting this assumption, Paslakis et al. (2020) summarized recent studies and concluded that discrepancies between implicit and explicit biases were associated with unhealthy eating behavior and disinhibited eating. For example, Veenstra and de Jong (2010) found that restrained eaters displayed relatively strong automatic approach tendencies toward food items, whereas such enhanced approach tendencies were absent in unrestrained eaters. In self-reports, restrained eaters showed no difference between craving for high-fat food and low-fat food, whereas unrestrained eaters reported more craving for low-fat food than for high-fat food. The researchers concluded that in overeating, the presence of enhanced automatic approach tendencies together with the absence of reduced deliberate craving for high-fat food might cumulatively contribute to a dysfunctional eating pattern. Thus, discrepancies between the implicit and explicit system may explain the conflicting dieting-overeating pattern in restrained eating (Veenstra & de Jong, 2010).

There were also no significant correlations between implicit approach-avoidance tendencies and self-report questionnaires of psychopathology. This is in line with previous research (Kahn & Petróczi, 2015). One interpretation is that self-report questionnaires refer to symptoms during the past weeks or assess traits, whereas implicit approach-avoidance tendencies assessed with AATs are influenced by state dependent factors such as hunger and mood (Loijen et al., 2020) or other variables such as stimulus selection, individual liking or disliking of the stimuli.

Another discrepancy in our findings is that in explicit food ratings, individuals with AN and BN did not differ in their urge to eat any kind of food, whereas self-report measures indicated that individuals with BN showed higher scores for trait food craving in the FCQ-T-r. This discrepancy may reflect differences between state food craving (i.e., urge to eat the food right now) and a general experience of food craving as assessed with the FCQ-T-r.

It is interesting to note that in explicit ratings of body stimuli, the groups only differed with regard to the normal weight body, but not with regard to the thin body. This may be explained by the notion that all young women are subject to the same beauty ideal favoring a thin body. With regard to the normal body, individuals with AN and BN rated the body as less normal weight, less attractive and less desirable than HCs. Individuals with AN rated the normal weight body as less attractive than individuals with BN. This is consistent with the intense fear of weight gain, which is especially pronounced in AN (Treasure, Duarte, & Schmidt, 2020). Individuals with EDs, especially individuals with AN, appear to reject normal weight bodies, whereas HCs are more accepting in their desirability and attractiveness ratings.

Individuals with AN, BN, and HCs did not differ in the time since last meal. However, they differed in hunger ratings with individuals with AN and BN reporting less hunger than HCs. This is in line with previous research (Neimeijer et al., 2019; Veenstra & de Jong, 2011) and may indicate a disturbed perception of hunger and satiety in individuals with EDs. Neimeijer et al. (2019) consider time since last meal as more objective measure of current hunger. Still, subjective hunger may influence approach-avoidance tendencies. For future research, it will be important to examine hunger and other state dependent features of approach-avoidance mechanisms such as mood or feeling depressed or stressed (Loijen et al., 2020).

When interpreting our findings, some limitations should be acknowledged. First, due to the lack of an a priori power analysis and a small sample size, our study may not have sufficient power to detect small effects. Future studies will need to examine larger samples to obtain enough power to detect small effects (Loijen et al., 2020). The effect sizes and CIs in our study may be useful to conduct a priori power analyses in future research assessing approach-avoidance biases in EDs. Second, all patients included in the present study were undergoing inpatient treatment. Although no differences were observed between AN und BN regarding treatment duration, we cannot exclude that treatment had affected approach-avoidance biases toward food and body. Given that research on approach-avoidance biases in AN and BN is sparse, future studies are warranted to identify moderators like duration of illness or duration of treatment to enhance our understanding of conflicting results and to elucidate the role of implicit compared to explicit processes. Third, the representability of our stimuli may be a limitation. Five of our low-calorie stimuli were fruits containing more sugar than other low-fat food such as vegetables. Furthermore, our high-calorie food stimuli only included unhealthy food items. Therefore, a more representative collection of low-fat and high-fat food items may have led to different results (cf. Veenstra & de Jong, 2011). Future studies may also profit from the use of individualized high- and low-calorie stimuli instead of a standardized stimuli set and it appears important to use pictures of one's own body instead of standardized avatar bodies. Fourth, we did not use a neutral stimulus category in our study. Therefore, we could not control for nonspecific approach-avoidance tendencies for example, due to differences in pulling power or strength. Therefore, future studies should include a neutral category. Fifth, we used avatars as body stimuli in the Body-AAT. Real body pictures, for instance, from magazines, would have been ecologically more valid and may have led to different results. However, avatar bodies have several advantages over real body pictures: Avatars are comparable in terms of picture characteristics such as brightness, color, and contrast. Furthermore, body shape and weight of avatars can be adapted to represent different weight classes. Using thin and normal weight body pictures from magazines, for example, model pictures, may trigger comparison processes and may therefore distract individuals. Sixth, we only used two different bodies in the Body-AAT. This limits the generalizability of the results.

In conclusion, we found no biases in approach-avoidance tendencies toward high- versus low calorie foods and toward thin versus normal weight bodies in our sample. Future studies with larger samples and sufficient power to detect small differences are necessary to examine approach-avoidance tendencies in individuals with EDs. Differences in explicit ratings are consistent with current treatment approaches that use interventions to tackle dietary restraint and dietary rules, as well as with interventions focusing on body image concerns. Future studies are warranted to replicate our findings, especially regarding the absence of approach-avoidance biases toward food and body stimuli in BN as no previous studies investigating this aspect are available.

CONFLICT OF INTEREST

The authors have no conflict to declare.

DATA AVAILABILITY STATEMENT

Data available from the first author upon request.

ORCID

Ines Kollei https://orcid.org/0000-0003-3005-3608

Sabine Steins-Loeber https://orcid.org/0000-0002-7651-0627

REFERENCES

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Association.

Blechert, J., Meule, A., Busch, N. A., & Ohla, K. (2014). Food-pics: An image database for experimental research on eating and appetite. *Frontiers in Psychology*, *5*, 617. https://doi.org/10.3389/fpsyg.2014.00617

Brockmeyer, T., Burdenski, K., Anderle, A., Voges, M. M., Vocks, S., Schmidt, H., … Friederich, H. C. (2020). Approach and avoidance bias for thin-ideal and normal-weight body shapes in anorexia nervosa. *European Eating Disorders Review*, *28*(5), 536–550. https://doi.org/10.1002/erv.2744

Brockmeyer, T., Friederich, H. C., Küppers, C., Chowdhury, S., Harms, L., Simmonds, J., … Schmidt, U. (2019). Approach bias modification training in bulimia nervosa and binge-eating disorder: A pilot randomized controlled trial. *International Journal of Eating Disorders*, *52*(5), 520–529. https://doi.org/10.1002/eat.23024

Brockmeyer, T., Hahn, C., Reetz, C., Schmidt, U., & Friederich, H. C. (2015). Approach bias and cue reactivity towards food in people with high versus low levels of food craving. *Appetite*, *95*, 197–202. https://doi.org/10.1016/j.appet.2015.07.013

Bühner, M., & Ziegler, M. (2009). *Statistik für Psychologen und Sozialwissenschaftler [Statistics for psychologists and social scientists]*. München, Germany: Pearson Studium.

Döring, N., & Bortz, J. (2016). *Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften [Research methods and evaluation in social and human sciences]*. Berlin, Germany: Springer.

Fairburn, C. G., Cooper, Z., & Shafran, R. (2003). Cognitive behaviour therapy for eating disorders: A "transdiagnostic" theory and treatment. *Behaviour Research and Therapy*, *41*(5), 509–528. https://doi.org/10.1016/s0005-7967(02)00088-8

Friese, M., Hofmann, W., & Waenke, M. (2008). When impulses take over: Moderated predictive validity of explicit and implicit attitude measures in predicting food choice and consumption behaviour. *British Journal of Social Psychology*, *47*, 397–419. https://doi.org/10.1348/014466607X241540

Glashouwer, K. A., Brockmeyer, T., Cardi, V., Jansen, A., Murray, S. B., Blechert, J., … Werthmann, J. (2020). Time to make a change: A call for more experimental research on key mechanisms in anorexia nervosa. *European Eating Disorders Review*, *28*(4), 361–367. https://doi.org/10.1002/erv.2754

Grand, S. (1968). Color-word interference: An investigation of the role of vocal conflict and hunger in associative priming. *Journal of Experimental Psychology*, *77*(1), 31–40.

Hautzinger, M., Keller, F., & Kühner, C. (2006). *BDI II - Beck-Depressions-Inventar - Manual [BDI II - Beck depression inventory - manual]*. Frankfurt am Main, Germany: Harcourt Test Services.

Hilbert, A., & Tuschen-Caffier, B. (2016). *Eating Disorder Examination-Questionnaire Deutschsprachige Übersetzung [Eating Disorder Examination-Questionnaire German version]*. Münster, Germany: Verlag für Psychotherapie.

Jansen, A. (2016). Eating disorders need more experimental psychopathology. *Behaviour Research and Therapy*, *86*, 2–10. https://doi.org/10.1016/j.brat.2016.08.004

Kahn, S., & Petróczi, A. (2015). Stimulus-response compatibility tests of implicit preference for food and body image to identify people at risk for disordered eating: A validation study. *Eating Behaviors*, *16*, 54–63. https://doi.org/10.1016/j.eatbeh.2014.10.015

Kakoschke, N., Kemps, E., & Tiggemann, M. (2017). Approach bias modification training and consumption: A review of the literature. *Addictive Behaviors*, *64*, 21–28. https://doi.org/10.1016/j.addbeh.2016.08.007

Knauss, C., Paxton, S. J., & Alsaker, F. D. (2009). Validation of the German version of the Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ-G). *Body Image*, *6*(2), 113–120. https://doi.org/10.1016/j.bodyim.2009.01.002

Leins, J., Waldorf, M., Kollei, I., Rinck, M., & Steins-Loeber, S. (2018). Approach and avoidance: Relations with the thin body ideal in women with disordered eating behavior. *Psychiatry Research*, *269*, 286–292. https://doi.org/10.1016/j.psychres.2018.08.029

Loijen, A., Vrijsen, J. N., Egger, J. I. M., Becker, E. S., & Rinck, M. (2020). Biased approach-avoidance tendencies in psychopathology: A systematic review of their assessment and modification. *Clinical Psychology Review*, *77*, 101825. https://doi.org/10.1016/j.cpr.2020.101825

Margraf, J. (1994). *Diagnostisches Kurz-Interview bei psychischen Störungen [Short diagnostic interview for mental disorders]*. Berlin, Germany: Springer.

Meule, A., Hermann, T., & Kubler, A. (2014). A short version of the food cravings questionnaire-trait: The FCQ-T-reduced. *Frontiers in Psychology*, *5*, 190. https://doi.org/10.3389/fpsyg.2014.00190

Neimeijer, R. A., de Jong, P. J., & Roefs, A. (2015). Automatic approach/avoidance tendencies towards food and the course of anorexia nervosa. *Appetite*, *91*, 28–34. https://doi.org/10.1016/j.appet.2015.03.018

Neimeijer, R. A., Roefs, A., Glashouwer, K. A., Jonker, N. C., & de Jong, P. J. (2019). Reduced automatic approach tendencies towards task-relevant and task-irrelevant food pictures in anorexia nervosa. *Journal of Behavior Therapy and Experimental Psychiatry*, *65*, 101496. https://doi.org/10.1016/j.jbtep.2019.101496

Nosek, B. A. (2007). Implicit-explicit relations. *Current Directions in Psychological Science*, *16*(2), 65–69. https://doi.org/10.1111/j.1467-8721.2007.00477.x

Paslakis, G., Kuhn, S., Schaubschlager, A., Schieber, K., Roder, K., Rauh, E., & Erim, Y. (2016). Explicit and implicit approach vs. avoidance tendencies towards high vs. low calorie food cues in patients with anorexia nervosa and healthy controls. *Appetite*, *107*, 171–179. https://doi.org/10.1016/j.appet.2016.08.001

Paslakis, G., Scholz-Hehn, A. D., Sommer, L. M., & Kühn, S. (2020). Implicit bias to food and body cues in eating disorders: A systematic review. *Eating and Weight Disorders*, *26*, 1303–1321. https://doi.org/10.1007/s40519-020-00974-9

Pook, M., Tuschen-Caffier, B., & Stich, N. (2002). Evaluation des Fragebogens zum Figurbewusstsein (FFB, deutsche Version des Body Shape Questionnaire) [Evaluation of the German version of the body shape questionnaire]. *Verhaltenstherapie*, *12*, 116–124. https://doi.org/10.1159/000064375

Rinck, M., & Becker, E. (2007). Approach and avoidance in fear of spiders. *Journal of Behavior Therapy and Experimental Psychiatry*, *38*, 105–120. https://doi.org/10.1016/j.jbtep.2006.10.001

Schuck, K., Keijsers, G., & Rinck, M. (2012). Implicit processes in pathological skin picking: Responses to skin irregularities predict symptom severity and treatment susceptibility. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*(1), 685–691. https://doi.org/10.1016/j.jbtep.2011.09.004

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review*, *8*(3), 220–247. https://doi.org/10.1207/s15327957pspr0803_1

Treasure, J., Duarte, T. A., & Schmidt, U. (2020). Eating disorders. *Lancet*, *395*(10227), 899–911. https://doi.org/10.1016/s0140-6736(20)30059-3

Veenstra, E. M., & de Jong, P. J. (2010). Restrained eaters show enhanced automatic approach tendencies towards food. *Appetite*, *55*, 30–36. https://doi.org/10.1016/j.appet.2010.03.007

Veenstra, E. M., & de Jong, P. J. (2011). Reduced automatic motivational orientation towards food in restricting anorexia nervosa. *Journal of Abnormal Psychology*, *120*(3), 708–718. https://doi.org/10.1037/a0023926

Waadt, S., Laessle, R. G., & Pirke, K. (1992). *Bulimie. Ursachen und Therapie [Bulimia nervosa: Etiology and therapy]*. Berlin, Germany: Springer.

Williamson, D. A., White, M. A., York-Crowe, E., & Stewart, T. M. (2004). Cognitive-behavioral theories of eating disorders. *Behavior Modification*, *28*(6), 711–738. https://doi.org/10.1177/0145445503259853

Wintjen, L., & Petermann, F. (2010). Testbesprechung Beck-Depressions-Inventar Revision (BDI–II) [Psychometric evaluation of the Beck depression inventory]. *Zeitschrift für Psychiatrie, Psychologie und Psychotherapie*, *58*(3), 243–245.

Wittchen, H.-U., Wunderlich, U., Gruschwitz, S., & Zaudig, M. (1997). *SKID I. Strukturiertes Klinisches Interview für DSM-IV. Achse I: Psychische Störungen. Interviewheft und Beurteilungsheft. Eine deutschsprachige, erweiterte Bearbeitung der amerikanischen Originalversion des SCID-I. [Structured diagnostic interview for DSM-IV axis I disorders. Extended German version of the SCID-I]*. Göttingen, Germany: Hogrefe.

Woud, M. L., Anschutz, D. J., Van Strien, T., & Becker, E. S. (2011). Measuring thinspiration and fear of fat indirectly. A matter of approach and avoidance. *Appetite*, *56*(2), 451–455. https://doi.org/10.1016/j.appet.2010.12.012

How to cite this article: Kollei, I., Leins, J., Rinck, M., Waldorf, M., Kuhn, M., Rauh, E., & Steins-Loeber, S. (2022). Implicit approach-avoidance tendencies toward food and body stimuli absent in individuals with anorexia nervosa, bulimia nervosa, and healthy controls. *International Journal of Eating Disorders*, *55*(1), 85–97. https://doi.org/10.1002/eat.23638