Liking compared with wanting for high- and low-calorie foods in anorexia nervosa: aberrant food reward even after weight restoration

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ABSTRACT

Background: Recent frameworks for understanding food rewards recognize the role of separable affective and motivational processes (liking and wanting) in driving human eating behavior. Separate assessments of liking and wanting may aid in understanding the complex eating-related behaviors seen in anorexia nervosa (AN).

Objective: The aim of this study was to examine separately liking and wanting for foods of different energy densities in women at different stages of AN and in healthy volunteers at both an explicit and an implicit level.

Design: Explicit liking and wanting responses to high- and low-calorie foods were derived from analog ratings, whereas an implicit “wanting” measure was identified by using reaction time in a forced-choice procedure. Explicit and implicit processes were compared across 3 groups of AN participants (current AN, weight-restored AN, and recovered AN) and healthy volunteers.

Results: Currently underweight AN participants explicitly wanted high-calorie foods less than did the other groups. Both current and weight-restored AN groups demonstrated significantly less implicit “wanting” for high-calorie foods and more implicit “wanting” for low-calorie foods—an inverted pattern to never-ill participants.

Conclusions: The aberrant responses to food that characterize AN may be driven more by altered motivational salience ("wanting") than by explicit liking responses. This pattern of aberrant food reward appears to be independent of weight status. Examining the processes that motivate approach or avoidance of low- and high-calorie foods in AN may aid the development of targeted strategies to augment existing interventions.


INTRODUCTION

Individuals with a diagnosis of anorexia nervosa (AN)4 have a particularly complex relation with food in that they actively pursue weight loss through extreme dietary restriction and show an intense fear of energy-dense foods that they perceive as “fattening.” However, they remain preoccupied with food and eating and often display puzzling behaviors such as obsessively talking about food, ritualized eating practices, and a preference for low-fat, low-energy-dense foods (1–3). Thus, despite severely limiting energy intake, food seems to gain particular significance for individuals with AN (4).

Symptom-provoking food paradigms have been used in behavioral and neuroimaging studies to aid the understanding of reward-related behaviors, including eating, in AN (for reviews, see references 5–8). The results suggest a more complex relation with food reward than can be accounted for by conventional frameworks, which propose that individuals with AN are anhedonic, such as that of Davis and Woodside (9). For example, we previously reported a “greater” neural response to food in reward regions of the brain in recovered AN participants than in healthy control participants, which suggests an increased incentive salience attribution to food cues (4). Importantly, no significant between-group differences were found in subjective ratings of pleasantness or wanting for the stimuli. This suggests a dissociation between objective and subjective hedonic experiences, even after AN weight restoration and psychological recovery (4). Understanding the exact mechanisms through which the experience of reward becomes aberrant in AN is therefore important.

The semantics of language describing eating-related pleasure imply that food reward is more than simply liking the taste of a food. Humans also talk about wanting, craving, and impulsively desiring food. Berridge et al (10) suggest that separable brain mechanisms underpinning the response to reward can be iden-

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4 Abbreviations used: AN, anorexia nervosa; AN-C, current anorexia nervosa; AN-R, recovered anorexia nervosa; AN-W, weight-restored anorexia nervosa; BDI-II, Beck Depression Inventory, 2nd edition; CIA, Clinical Impairment Assessment; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, 4th edition; ED, eating disorder; EDE-Q, Eating Disorder Examination; HC, healthy control; LO-FPQ, Leeds-Oxford Food Preference Questionnaire; RT, reaction time; SCID, Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, 4th edition; STAI, State-Trait Anxiety Inventory; VAS, visual analog scale.

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tified, including liking (hedonic pleasure), wanting (incentive salience), and learning (predictions and associations). Liking and wanting can occur at both explicit conscious (wanting and liking) and implicit unconscious (“wanting” and “liking”) levels (11). It is suggested that the term “wanting” be used to refer to the unconscious incentive salience of a stimulus, as distinct from conscious wanting, reflecting a cognitively driven explicit desire (11). Whereas both liking and wanting responses are necessary to experience reward in the fullest sense, disruptions to this synergy may help explain disorders characterized by atypical responses to reward, such as depression, addictions, and eating disorders (EDs) (11–13).

In those with AN, a common strategy to control hunger is excessive and driven consumption of low-energy-dense foods while restricting the intake of high-energy-dense foods (14, 15). To better understand the complex response to food in those with AN, it is therefore important to consider measures of liking and wanting for foods typically experienced as highly palatable, but also for foods with a low energy density or diet-compatible foods.

The current study used a previously validated computer procedure to index explicit liking compared with wanting and implicit “wanting” for high- and low-calorie food reward in individuals with a history of AN. It was predicted that individuals currently experiencing the psychopathological symptoms of AN (current AN and weight-restored) would show reduced explicit liking and wanting for high-calorie foods and increased implicit “wanting” for low-calorie foods compared with fully recovered AN participants and those never ill.

SUBJECTS AND METHODS

Study subjects

Sixty-four female participants who had experienced AN were recruited as well as healthy control (HC) participants (n = 41), matched for age and sex. The AN participants were divided into 3 clinical subgroups: recovered from AN (AN-R) (n = 22), weight-restored AN (AN-W) (n = 22), and current AN (AN-C) (n = 20).

General exclusion criteria for all participants included age <16 years or <65 years, insufficient English language skills, and male sex. The specific inclusion and exclusion criteria described below were designed to enable a valid differentiation between the 3 AN groups and between the AN groups and the HC participants. Ethical permission from the study was obtained from the South Central Research Ethics Committee as well as the University of Oxford. After a complete description of the study, all participants provided written informed consent.

AN-C participants

The specific inclusion criteria were a current diagnosis of AN according to the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV), as indexed by the Structured Clinical Interview for DSM-IV (SCID) (16) and not currently receiving inpatient treatment. Four of the 20 AN-C participants met criteria for AN binge-eating/purging subtype with the remaining 16 meeting criteria for the restricting subtype. Four participants were currently taking antidepressant medication, and 11 met criteria for current depression. Eight participants had met criteria for ≥2 psychiatric disorders in their lifetime (in addition to EDs).

AN-W participants

To be considered weight-restored, participants had to have a history of DSM-IV AN assessed by the SCID (16) and currently have a BMI (in kg/m²) ≥18. In addition, participants had to report significant ED symptoms, defined as 1) a global Eating Disorder Examination (EDE-Q) (17) score >1 SD above the community norms, 2) a Clinical Impairment Assessment (CIA) score of ≥16 (cutoff for clinical ED) (18), or 3) reported episodes of binge-eating, restrictive eating patterns, purging behavior, or excessive/driven exercise on the EDE-Q (thus meeting DSM-IV criteria for ED not otherwise specified). Four of the 22 AN-W participants previously met the criteria for AN binge-eating/purging subtype; the remaining 18 participants met the criteria for the restricting subtype. Seven participants were currently taking antidepressant medication, and 12 met the criteria for current depression. Ten participants had met the criteria for ≥2 psychiatric disorders in their lifetime (in addition to EDs).

AN-R participants

All recovered participants had a history of DSM-IV AN assessed by the SCID (16). To be considered recovered, participants had to 1) have maintained a BMI between 18.5 and 25 for at least the previous 12 mo (assessed by self-report), 2) score within 1 SD of the EDE-Q global mean scores for young women (19), and 3) not meet current criteria for a DSM-IV disorder (assessed by using the SCID; 16). Four of the 22 AN-R participants had previously met the criteria for the AN binge-eating/purging subtype, and the remaining 18 met the criteria for the restricting subtype. Participants who were taking maintenance antidepressant medication (n = 2) were not excluded from this group as long as they did not meet current criteria for a depressed mood assessed by using SCID (16) and Beck Depression Inventory, 2nd edition (BDI-II) (20) scores. Whereas none of the AN-R participants met the current criteria for depression, 17 had experienced a depressed episode in their lifetime. Although no current psychiatric disorders were diagnosed, 6 participants had a lifetime history of ≥2 psychiatric disorders (in addition to EDs). Two participants were excluded before the testing session because they reported that they were currently receiving psychological treatment of another psychiatric disorder.

HC participants

Inclusion criteria for the HC participants included 1) current BMI between 18.5 and 25, 2) no first-degree relative with a current or past ED diagnosis (assessed by self-report), 3) no lifetime history of any Axis-I psychiatric disorder on the SCID for DSM-IV (16), 4) maintenance of a weight in the healthy range (BMI: 18.5–25) since menarche (assessed by self-report), 5) not currently engaging in dieting behavior (assessed by self-report), and 6) no multiple food intolerances or allergies (assessed by self-report). Six participants were excluded at screening because of a violation of one or more of the criteria detailed above, which left 41 participants for the analysis.
Measures

The SCID (16) was used to screen for DSM-IV Axis-I disorders. ED symptoms were measured by using the global score on the EDE-Q (17). The CIA (18) was used to assess the severity of psychosocial impairment because of ED symptoms. Both the EDE-Q and the CIA measure ED symptoms over the previous 28 d. Depression symptoms were measured by using the BDI-II (20), which measures depressive symptom severity over the past 2 weeks. Anxiety symptoms were measured by using the State-Trait Anxiety Inventory (STAI) (21), which is a 40-item self-report instrument that captures both state and trait anxiety. The Fawcett Clark Pleasure Scale (22) was used to measure self-reported hedonic responsiveness to a range of situations. To assess subjective states immediately before and after the task, participants completed a series of 100-mm visual analog scales (VASs) assessing “in the moment” mood (happiness, despondency, and anxiety) and appetite-related variables (hunger, thirst, desire to eat, and level of fullness).

Participants provided demographic information (age, ethnicity, and years in education), and height and weight (fully clothed) were taken to calculate BMI. Participants who were unable to be weighed provided self-report estimates. AN participants also provided information on their duration of AN illness, their lowest ever BMI, time in treatment, age of onset, and, where applicable, the duration of recovery (defined as the period of time in which problems with eating, weight, and shape did not significantly affect daily functioning).

Assessment of food reward: Leeds-Oxford Food Preference Questionnaire

Components of food reward were assessed by specifically adapting the original Leeds Food Preference Questionnaire, which is a well-validated tool, extensively described elsewhere (23–25). The task was modified such that separate measures of liking and wanting were assessed by using food stimuli varying along the dimensions of calorie content (high or low) and taste (salty or sweet). The modified measure was named the Leeds-Oxford Food Preference Questionnaire (LO-FPQ). High-resolution digital color photographs of 16 foods were used that could be organized equally into either separate generic categories of high calorie, low calorie, savory, and sweet or combined categories of high-calorie savory, high-calorie sweet, low-calorie savory, or low-calorie sweet. The photographs selected for use were based on pilot work in which 14 women who had experienced AN rated a database of images for taste, calorie content, appeal, and familiarity.

Stimuli were presented by using E-Prime (version 2.0) running on a 14.1-inch (35.8-cm) laptop screen and each measured 75 × 57 mm². The presentation of food images during the task was programmed automatically (in a random order for measures of explicit liking and wanting and in randomized combination for the forced-choice measure of implicit “wanting”). Responses were logged online.

Explicit liking and wanting trials

For the explicit rating trials, each of the 16 stimuli were presented one at a time on the computer screen and rated by using a 100-mm VAS anchored at each end by the statements “not at all” to “extremely.” Separate questions were used to distinguish ratings of explicit liking compared with explicit wanting for the food stimuli, which were presented in contrasting colors. For liking, the trial participants were asked, “How pleasant would it be to experience the taste of this food now?” For the wanting trials, the participants were asked, “How much do you want some of this food now?” The VAS were positioned below the stimuli, and participants used the mouse to move a centered cursor to the desired location on the scale. After a response had been made, the procedure automatically cycled to the next trial, and the cursor would return to the center of the rating scale. Mean ratings for each of the categories (high-calorie savory, high-calorie sweet, low-calorie savory, and low-calorie sweet) were automatically computed by the software (minimum – maximum: 0–100).

Implicit “wanting” trials

Reaction times (RTs) to a behavioral forced-choice methodology was used as an indirect index of implicit “wanting.” Within this paradigm, each of the food stimuli was paired with another from a different food category. Participants were then asked to select the food that they “most want to eat now” using a keyboard response. Participants were instructed to respond as accurately and quickly as possible, and the RT (in ms) of each choice was measured. RT data were used as an implicit measure of “wanting”; by covertly measuring RT to the food stimuli, participants remained unaware of implicit changes in their behavior on the task, while remaining free to determine the direction of their choices. RTs were transformed into standardized scores (D-RT) by using a validated algorithm (26). Final scores were inverted for ease of interpretation; therefore, the higher the D-RT, the greater the implicit wanting for that food category relative to other categories in the task (with a score of 0 indicating no difference in the speed of response relative to alternative categories in the task).

Procedure

On arrival, participants completed the battery of questionnaires, and the SCID (16) was administered. Instructions for the LO-FPQ were shown, and participants completed a practice block of both tasks. The pretest VAS was then completed. After this, the LO-FPQ was delivered. To reduce order effects, both the stimuli and stimulus pairs were fully randomized across participants. After the task, participants completed the VAS for a second time and were debriefed.

Data analysis

Data from the LO-FPQ, collected by using E-prime, were exported to MS Excel via E-Data aid. MS Excel was used to calculate the variables for export to SPSS (version 18). Parametric data were analyzed by separate 3-factor ANCOVAs (group × taste × calorie content), with depression and anxiety (trait) as covariates. Interactions were verified by t tests with Bonferroni correction. Results from the task are reported with size effect (ηp²). The analyses were re-run excluding participants currently on antidepressants (n = 13) and excluding participants with a diagnosis of the binge-eating/purging subtype of AN (n = 12). Significant changes in the results after exclusion of these participants are highlighted.
comparisons were conducted by using a between-groups ANOVA to determine if the groups were comparable in terms of years in education and age and ratings on the pleasure scale. Significant group differences in BMI, ED symptoms, psychosocial functioning, depression, and anxiety (STAI and STAI state and trait subscales) were observed (Table 1). The AN-C and AN-W groups had significantly greater scores on the EDE-Q, CIA, STAI, and BDI-II than did the AN-R or HC group. The AN-R group reported significantly greater scores on the EDE-Q, CIA, STAI, and BDI-II than did the AN-C group. No significant differences in the ratings of happiness, despondency, and anxiety were found between AN-R and HC groups.

There were no significant differences in age of onset, time in treatment, or lowest ever BMI between the 3 AN groups (P > 0.05). However, there was a main effect of duration of illness [F(2,63) = 6.47, P = 0.003]. Post hoc tests showed that the AN-C group reported a significantly longer duration of illness than did the AN-W or AN-R group (P = 0.003).

**Explicit liking**

Mean ratings of explicit liking were significantly greater for the sweet food category than for the savory food category [F(1,99) = 5.25, P < 0.05, ηp² = 0.05] (see “Supplemental data” in the online issue). This remained significant after exclusion of the participants who were currently taking antidepressant medication from the analysis. When the participants with a diagnosis of the binge-eating/purging subtype of AN were removed from the analysis, a significant calorie × group interaction emerged [F(3,89) = 3.26, P < 0.05, ηp² = 0.10]. When only the restricting-type participants were examined, post hoc comparisons using the Games-Howell test (due to unequal sample size) showed that the restricting AN-C participants explicitly liked high-calorie foods less than did the HC participants (P < 0.05). No other significant main effects or interactions were observed.

**Explicit wanting**

A significant main effect of calorie content was observed. Mean ratings of explicit wanting were significantly greater for the low-calorie-food category than for the high-calorie-food category [F(1,99) = 5.56, P < 0.05, ηp² = 0.05; see “Supplemental data”]
in the online issue]. A significant calorie × group interaction was found \[F(3,99) = 4.39, P < 0.01, \eta^2_p = 0.12\]. Post hoc comparisons using the Games-Howell test (due to unequal sample size) showed that the AN-C and the AN-W groups explicitly wanted high-calorie foods less than did the HC participants \((P < 0.05; \text{Figure 1})\). These results remained significant when the participants who were currently taking antidepressant medication or diagnosed with the binge-eating/purging subtype were removed from the analysis. No other significant main effects or interactions were observed.

Implicit “wanting”

For implicit “wanting,” a significant calorie × group interaction was found \[F(3,95) = 5.1, P < 0.01, \eta^2_p = 0.14\]. Post hoc tests showed that the AN-C and AN-W groups implicitly “wanted” high-calorie foods significantly less than did the HC participants \((P < 0.001; \text{Figure 2})\). The AN-C group also implicitly “wanted” the high-calorie foods significantly less than did the AN-R participants \((P = 0.02)\). For low-calorie foods, post hoc tests showed significantly greater implicit “wanting” in the AN-C and AN-W groups than in the HC group \((P < 0.001)\). A significant difference between the AN-C and AN-R groups was also found, with the AN-C group demonstrating significantly greater “wanting” for low-calorie foods than the AN-R group \((P < 0.05)\). These results remained significant when the participants who were currently taking antidepressant medication or diagnosed with the binge-eating/purging subtype were removed from the analysis. No other significant main effects or interactions were observed.

FIGURE 1. Explicit wanting across the groups for high-calorie (■) and low-calorie (□) foods. Paired lowercase letters indicate significant results at the \(P \leq 0.05\) level (3-factor ANCOVA; interactions were verified by Bonferroni-corrected \(t\) tests; adjusted \(P\) values are shown). Error bars represent SDs. AN-C, current anorexia nervosa \((n = 20)\); AN-R, recovered anorexia nervosa \((n = 22)\); AN-W, weight-restored anorexia nervosa \((n = 22)\); HC, healthy control \((n = 41)\).

FIGURE 2. Implicit wanting across the groups for high-calorie (■) and low-calorie (□) foods. Implicit wanting scores were assessed by transformed reaction times in the forced-choice paradigm (D-RT). The higher the D-RT values, the faster the reaction time (greater implicit wanting) for that food category relative to the other food categories in the task. Paired lowercase letters indicate significant results at the \(P \leq 0.05\) level (3-factor ANCOVA; interactions verified by Bonferroni-corrected \(t\) tests; adjusted \(P\) values are shown). Error bars represent SDs. AN-C, current anorexia nervosa \((n = 20)\); AN-R, recovered anorexia nervosa \((n = 22)\); AN-W, weight-restored anorexia nervosa \((n = 22)\); D-RT, standardized D score for reaction times; HC, healthy control \((n = 41)\).
Correlation of clinical variables with liking and wanting responses between groups

After correction for multiple comparisons, no significant associations were found between mean explicit liking or wanting or implicit “wanting” responses for high- and low-calorie foods between the groups and restraint (as measured by the EDE-Q), current BMI, pretest hunger, duration of illness, or lowest ever BMI.

DISCUSSION

The aim of this study was to compare elements of food reward (explicit liking and wanting and implicit “wanting”) between women at different stages of AN illness and HC participants. We predicted that individuals experiencing the psychopathological symptoms of AN (whether currently underweight or weight-restored) would show less explicit liking and wanting for high-calorie foods and greater implicit “wanting” for low-calorie foods than would recovered AN participants and those never ill. Consistent with this prediction, individuals currently experiencing clinically significant symptoms of AN (whether underweight or weight-restored) showed significantly lower explicit wanting and implicit “wanting” for high-calorie foods and greater implicit “wanting” for low-calorie foods than did the HC group. When participants with the binge-eating/purging subtype of AN were removed from the analysis, the AN-C participants also reported significantly less explicit liking for high-calorie foods. The AN-R participants did not differ significantly from the HC participants in any food reward indexes. These data provide evidence that the underconsumption of high-calorie foods and the overconsumption of low-calorie foods that characterize AN may be driven more by aberrant motivations—toward low-calorie foods and away from high-calorie foods—than by an inability to experience the hedonic properties of food.

Few previous studies have attempted to distinguish liking compared with wanting for food in AN. One recent study using visual and olfactory food cues found that AN participants (restricting type only) reported less sensory pleasure for high-energy-dense food than did HC participants, but no difference was found in liking response for the low energy-dense foods (27). Regarding the motivation to eat, the AN participants showed lower wanting for low- and high-energy-dense foods. Therefore, this particular study did not show the inverted wanting response to low- compared with high-calorie foods that was found in the AN participants in the current study. The variance in results was likely due to the different paradigms used and to the lack of implicit measures, but may also be explained by the smaller sample size and heterogeneity in the clinical characteristics of the AN participants. Nonetheless, Jiang et al (27) concluded that cognitive symptoms of the disorder, for example concern about weight gain, may influence food intake more than a general inability to experience pleasure.

Interestingly, a recent review of behavioral and neurophysiological data on responsiveness to food-related cues in obesity concludes that eating behavior in obese individuals may be associated with increased motivation for food consumption, without necessarily any greater explicit pleasure derived from the actual tastes properties of the food (28). In a similar manner, the data reported here support the notion that AN is associated with decreased motivation to engage in eating high-calorie foods and increased implicit “wanting” (incentive salience) for low-calorie foods accompanied by a lesser change in the explicit liking response. Thus, it could be that in both obesity and AN, attitudinal and/or higher cognitive factors override the hedonic value of food. This would support current frameworks of AN that propose that ruminative preoccupation about control of eating and the body override sensory information, such as the palatability of food (2, 3, 7, 29), and challenge the notion that eating behaviors in AN are driven by a general inability to experience reward (9).

Importantly, the study showed that individuals with AN—both those who were underweight and thus meeting full DSM-IV criteria and those who were weight restored yet with continuing clinically significant ED psychopathology—displayed aberrant explicit and implicit wanting responses to food reward similar to those of the AN-R and HC participants. Moreover, no correlation between current BMI and the liking or wanting indexes was found. This suggests that the findings are not driven purely by low weight, but rather by the psychopathology itself or processes underpinning it (3, 29). Potentially, aberrant wanting responses could contribute to the high rates of relapse seen in AN after weight restoration (30). This hypothesis is supported in part by the finding that the AN-R participants, who had healthy weights and low ED symptoms, did not differ from the HC participants in explicit liking and wanting or implicit “wanting” for high- or low-calorie foods.

It is interesting that currently underweight AN participants reported significantly lower explicit and implicit wanting for the high-calorie foods than did the recovered AN and never-ill participants, whereas the weight-restored participants showed only significantly lower implicit “wanting” as compared with the HC participants. One possible explanation was that, when asked explicitly about wanting to eat high-calorie foods, individuals who have regained weight after AN may be able to modulate their response, perhaps because of successful cognitive treatment, so that they are more in line with those who were never ill. However, their subconscious reactions to low- compared with high-calorie food (as measured by the implicit “wanting” task) remain unchanged. Alternatively, it could be that the biological effects of starvation in the current AN participants may affect appetite and/or taste; thus, high-calorie foods become less “wanted” implicitly and explicitly compared with the weight-restored participants.

The study did not show any significant differences in terms of liking and wanting for high- or low-calorie foods between the HC and AN-R groups. This diverges from the neuroimaging literature, in which neural differences in processing food-related stimuli between the AN-R and HC groups was shown (4, 31, 32). In a previous study by our group (4), no differences in subjective reports of explicit liking and wanting for food tastes and pictures were found between HCs and AN-R participants, despite significantly different neural activation in reward regions of the brain. It could be that, after recovery, individuals are able to modulate or override their responses to food stimuli in a more adaptive manner despite underlying differences in neural reward circuits.

It is intriguing that, when the participants with the binge-eating/purging subtype of AN were removed, a significant difference emerged in the explicit liking responses: the AN-C participants reported significantly less liking for the high-calorie foods than did the HC participants. Whereas this finding should
be treated as preliminary, one possibility is that individuals who engage in pure restriction engage to a greater degree in explicit strategies to override appetitive drives to eat as compared with those who will lose control on occasion and binge eat on energy-dense foods. This would support the results of a recent neuroimaging study that found greater activation in regions of the brain involved in rumination and cognitive and emotional regulation in restricting-type AN participants than in binge-eat/purge-type AN participants (33).

Hunger ratings before the test relied on self-report measures, which may be considered a limitation given that research has identified AN individuals with deficits in interoceptive awareness and thus may have an impairment in detecting hunger (34). Future studies would benefit from manipulating levels of satiety and controlling for caloric intake using a preload, as was done in previous studies using a similar task (25, 35). A small number of participants were currently taking antidepressant medication, which could be considered a limitation because there is evidence that such psychoactive medication can affect performance on information-processing tasks in AN (36). Analyzing the data without these participants did not change the results, which suggests that antidepressants did not significantly contribute to the between-group differences reported. The number of participants in each group was small, which resulted in modest effect sizes. This also meant that we were unable to compare binge-eating/purging and pure restricting AN participants. Future research with larger sample sizes of each subtype of AN would therefore be advantageous. Last, a limited stimulus pool was used in this study; thus, the results may have been more influenced by individual food preferences than by confrontation with a larger stimulus pool with more variance.

The LO-FPQ measured explicit liking and wanting and attempted to index “implicit” wanting for food, yet the learning subcomponent of reward was not measured (as discussed in reference 37). The measure of implicit “wanting” or incentive salience is limited in that it is indirect and will benefit from cross-validation by more direct measures of brain processes, for example by using neuroimaging. In addition, learning is an essential component in decision making regarding eating-related behavior, which was not indexed in this study, and may also be important in AN (11). Future work examining reward processing in AN would benefit from the measurement of learning in addition to liking and wanting.

This study supports the hypothesis that liking and wanting for food reward are 2 separate psychological processes that contribute to aberrant eating behaviors in individuals with AN. The results suggest that individuals experiencing the psychopathological symptoms of AN (whether current or weight restored) may not have difficulties experiencing the hedonic (liking) properties of rewarding food, but rather show a reduced desire to consume energy-dense foods and instead exhibit a greater motivational drive (implicit “wanting”) to consume low-calorie foods. This is likely to reflect the overvalued ideation about controlling eating, weight, and shape that is central to cognitive theories of AN (3, 38) and may be explained by increased cognitive control processes. The data therefore emphasize the need to move beyond conceptualizing eating behavior in AN as a symptom of anhedonia and rather examine the processes that may motivate approach or avoidance of low- and high-calorie foods. With the use of this approach, it may be possible to develop targeted interventions such that healthy balanced eating, appropriate to energy demands, is liked, wanted, and preferred to the restrictive eating practices that individuals with AN adopt, even after weight restoration.

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The authors’ responsibilities were as follows—FAC: designed the research, conducted the research, wrote the manuscript, and had primary responsibility for the final content; GF: designed the research, provided the experimental task, performed the statistical analysis, and wrote the manuscript; and RJP: designed the research and wrote the manuscript. The Sir Jules Thorn Charitable Trust and Higher Education Funding Council for England had no role in the design, implementation, analysis, or interpretation of the data. The authors reported no conflicts of interest.

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