Research report

Negative affect and cue-induced overeating in non-eating disordered obesity

Anita Jansen [*], Annoesjka Vanreyten, Tessa van Balveren, Anne Roefs, Chantal Nederkoorn, Remco Havermans

Maastricht University, Department of Clinical Psychological Science, P.O. Box 616, 6200 MD Maastricht, The Netherlands

A B S T R A C T

The recent separation of non-eating disordered obesity into a subtype that is high in negative affect and a subtype that is low in negative affect led to the hypothesis that the two subtypes would show opposite eating responses to typical triggers of overeating. Overweight/obese and normal weight participants, clustered into high and low negative affect subtypes, took part in an experiment using a control condition and two typically disinhibiting manipulations: negative mood induction and tasty food exposure. In accordance with the hypothesis, the negative mood induction and the food exposure elicited overeating in the overweight/obese high negative affect subtype. The overweight/obese low negative affect subtype did not eat more after negative mood induction and food exposure than without a trigger for overeating. Likewise, the normal weight participants did not show differential responses to the three manipulations. The increased vulnerability to overeating in this non-eating disordered overweight/obese subtype that is characterized by increased negative affect shows that individual differences play a crucial role in the way overweight/obese people handle temptations of the current environment. Being characterized by high negative affect makes it more difficult for the overweight/obese to resist temptations. Future studies into non-eating disordered obesity should consider the existence of these two subtypes.

© 2008 Elsevier Ltd. All rights reserved.

Introduction

Obesity nowadays is increasingly prevalent worldwide, and one of the main questions is why the obese overeat. Overeating is a phenomenon that has been studied extensively, but this mainly happened in relation to eating disorders. Risk factor models for eating disorders and self-reports during treatment put forward that, in particular, negative mood states and food exposure-induced urges are triggers of overeating in samples with eating disorders (see e.g., Carter, Bulik, McIntosh, & Joyce, 2001; Jansen, van den Hout, & Griez, 1990; Jansen, Broekmate, & Heymans, 1992; Vögele & Florin, 1996).

Laboratory experiments studying disinhibited eating in obese clinical groups are however rather scarce. One study in which obese eating disorder patients participated showed that a sad mood triggered overeating in the obese with eating disorders (Chua, Touyz, & Hill, 2004), but this was not the case in another study (Telch & Agras, 1996). Experiments using analogue samples of highly restrained eaters do support that both a negative mood induction and exposure to food cues, like seeing, smelling, and tasting flavorsome high calorie foods, are triggers that elicit

overeating in unsuccessful restrained eaters (Jansen & van den Hout, 1991; Schotte, Cools, & McNally, 1990). A robust finding in all these experiments with analogue samples is, however, that normal non-eating disordered samples show opposite eating behavior. Contrary to the overeating of clinical samples, they do eat less in a sad mood and after food exposure compared to control conditions (e.g., Jansen & van den Hout, 1991; Schotte et al., 1990).

In some recent studies, eating disorders were subtyped along dimensions of negative affect and most of the studies showed, among other things, that increased negative affect signaled more severe eating disorder symptoms, including overeating and vulnerability to disinhibition (Grilo, Masheb, & Wilson, 2001; Stice & Agras, 1999; Stice, Bohon, & Fischer, submitted for publication). The non-eating disordered obese are also at increased risk of depression, compared to normal weight people (Werrij, Mulkens, Hospers, & Jansen, 2006). However, the association between obesity and depression typically is weaker in the non-eating disordered obese than in clinical samples, implicating that obesity in itself is not necessarily depressing (Carr, Friedman, & Jaffe, 2007; Wardle, Williamson, Johnson, & Edwards, 2006). In line with this, Jansen, Havermans, Roefs, and Nederkoorn (submitted for publication) recently subtyped a non-eating disordered over-weight and obese sample along a negative affect dimension. The cluster analysis classified the sample into two mutually exclusive groups of about the same size, based on similarity in scores on

diverse negative affect measures that each taps a slightly different facet of negative affect, with minimal within-group and maximal between-group variation. Jansen et al. (submitted for publication) demonstrated the existence of a subtype that is high in negative affect and a subtype that is low in negative affect within this non-eating disordered sample of overweight and obese people.

Considering this recent subtyping of the non-eating disordered obese in a subtype that is high in negative affect and a subtype that is low in negative affect, it would be of theoretical and clinical interest to test experimentally whether the two subtypes show different eating responses to triggers of overeating. It could be hypothesized that it is a specific state-trait interaction that facilitates overeating. It might, in other words, be expected that the high negative affect overweight/obese subtype is more vulnerable to overeating in the presence of a disinhibiting cue (negative mood induction or food exposure) than the overweight/obese subtype that is low in negative affect. In the present study, it is tested whether the typically disinhibiting cues food exposure and negative mood induction, elicit overeating in the overweight/obese subtype that is high in negative affect. The low negative affect overweight/obese subtype might be expected to show the opposite behavior, like normal non-eating disordered samples do; eating less in a sad mood and after food exposure compared to control conditions. More specifically, the hypotheses that will be tested in the present study are: (1) high negative affect overweight/obese participants will overeat after negative mood induction and after food exposure compared to a control condition, and (2) low negative affect overweight/obese participants will eat less after negative mood induction and food exposure compared to a control condition. For all normal weight participants a same intake pattern as in the low negative affect overweight/obese participants is predicted; they are expected to consume less after a disinhibiting cue than without one.

Method

Design, assessment and analysis

The dependent variable food intake was assessed during a bogus taste test after three different manipulations: negative mood induction, smelling tasty foods (exposure) and a control manipulation during which participants viewed a local festival movie. A between subjects design was used. Participants completed negative affect and eating disorder questionnaires before participating in the experiment. They were clustered into groups along the dimensions negative affect (high/low) and overweight (yes/no). Several ANOVAs (condition × affect × weight) were used to test the hypothesis, if appropriate followed by post hoc t-tests. The Ethical Committee of the Psychology Faculty approved the study.

Participants

An advertisement in a popular Dutch women's magazine (Margriet) asked for overweight women to take part in a questionnaire study. The questionnaire included the BDI, PANAS, RSE, EDE-Q and a binge eating questionnaire (see assessment) and participants were asked whether they were willing to take part in a laboratory study. Following the World Health Organisation (WHO), a Body Mass Index (BMI) of 30 or more was considered to reflect obesity and a BMI equal to or more than 25 was considered overweight. The 53 overweight and obese females that volunteered to participate were invited to take their own age-matched normal weight female control with them to make good matching on age and socio-economic status more likely; this procedure

yielded 38 controls. The participants ($n = 91$, all female) ranged in age from 21 to 53 years (M = 41.3, S.D. = 6.9) and in BMI from 17.5 to 47.1 (M = 30.4, S.D. = 8.6). The BMI of the overweight/obese group ($n = 53$, M = 36.4, S.D. = 6.0) was significantly higher than the BMI of the normal weight group ($n = 38$, M = 22.0, S.D. = 2.0), $t(89) = 14.2$, $p < 0.001$. The groups did not differ in age (obese: M = 41.0, S.D. = 6.3, normal weight: M = 41.6, S.D. = 7.6, $t < 1$).

The participants were divided in a low and a high negative affect group by means of an iterative K-means cluster analysis (Quick Cluster algorithm, SPSS), following the methodology of Jansen et al. (submitted for publication) and Stice and Agras (1999). The cluster analysis classifies a set of observations into two or more mutually exclusive unknown groups based on similarity in scores on a combination of variables. The analysis seeks to identify homogeneous subgroups of cases; it identifies a set of groups that both minimize within-group variation and maximize between-group variation. In the iterative (nonhierarchical) cluster analysis, cluster centers are repeatedly recomputed and early misclassifications are detected and corrected. The scores on the BDI, PANAS and RSE were selected as indicators of diverse flavors of negative affect and they were entered in the cluster analysis. Because the obese sample scored significantly higher on all negative affect scales, cluster analyses were done separately for the overweight (BMI > 25, $n = 53$) and the normal weight group (BMI ≤ 25, $n = 38$). Within each weight group, two clusters were identified that minimized within group variation and maximized the differences among the cases in the different clusters. The first cluster, the 'high negative affect' (HNA) cluster, included 26 obese participants (49% of the obese sample), and 13 normal weight participants (34% of the normal weight sample). The second cluster, the 'low negative affect' (LNA) cluster, included 27 obese participants (51% of the obese sample), and 25 normal weight participants (66% of the normal weight sample). Table 1 shows the descriptives of both clustered subtypes in each weight category, and their BMI's as well as Eating Disorder Examination Questionnaire (EDE-Q) scores. The obese high and low negative affect groups did not differ significantly in BMI, $t(51) < 1$, whereas the normal weight high and low negative affect groups did; the normal weight high negative affect group had a significantly lower BMI than the normal weight low negative affect group ($t(36) = 2.2$, $p < 0.05$).

Although the high and low negative affect obese subgroups did not differ in BMI, binge frequency and eating restraint, the high negative affect obese sample showed more eating-, weight-, and shape concerns than the three other groups. None of the normal weight participants reported binge eating, whereas 7 (13.5%) of the obese sample did. The high and low negative affect subtypes did not differ in the proportion of participants reporting binge eating (high negative affect: $n = 5$, low negative affect: $n = 2$, $\chi^2(1) = 1.77$, NS) and, in case they did report binge eating, the high and low affect groups did not differ in their binge frequency ($\chi^2(5) = 5.5$, NS). Binge frequency ranged from 1 to 4 times a week, two participants in each affect group binged two or more than two times a week (respectively 2 and 3 times a week in the HNA group, and 2 and 4 times a week in the LNA group).

Assessment

State mood: Current mood was measured with a shortened Dutch version of the Profile of Mood States (POMS; Wald & Mellenbergh, 1990), which included 8 items stating how participants felt at that moment: dejected, helpless, sad, lonely, unhappy, unworthy, gloomy, desperate. Answers were given on a 5-point Likert scale ranging from not at all (0) to extremely (4). Higher scores indicate a worse mood.

Table 1
Participant characteristics

	High negative affect subtype				Low negative affect subtype				$F(3, 87)$
	Overweight ($n = 26$)		Normal weight ($n = 13$)		Overweight ($n = 27$)		Normal weight ($n = 25$)		
	M	S.D.	M	S.D.	M	S.D.	M	S.D.	
BDI	17.2$_a$	5.5	11.0$_b$	4.0	8.0$_c$	4.0	3.5$_d$	2.7	46.4[*]
PA	24.5$_a$	4.9	26.6$_b$	4.8	33.1$_c$	6.0	34.6$_c$	4.7	20.9[*]
NA	30.0$_a$	7.1	22.5$_b$	7.0	16.7$_c$	4.1	14.5$_c$	3.8	40.1[*]
RSE	25.2$_a$	2.9	30.3$_b$	2.7	33.3$_c$	4.0	35.2$_d$	2.9	43.9[*]
BMI	37.0$_a$	5.6	21.1$_b$	2.0	35.8$_a$	6.4	22.5$_b$	1.8	67.7[*]
EDE-Q–R	2.2$_a$	1.4	0.2$_b$	0.5	1.8$_a$	1.0	1.0$_c$	1.2	11.4[*]
EDE-Q–EC	2.6$_a$	1.5	0.2$_c$	0.2	1.1$_b$	0.9	0.3$_c$	0.3	28.8[*]
EDE-Q–WC	3.8$_a$	0.8	0.8$_c$	0.9	2.6$_b$	1.1	1.2$_c$	1.0	39.6[*]
EDE-Q–SC	4.5$_a$	0.9	0.9$_c$	0.6	2.8$_b$	1.3	1.2$_c$	1.0	51.7[*]
EDE-Q–global	3.3$_a$	1.0	0.5$_c$	0.5	2.1$_b$	0.8	0.9$_c$	0.7	50.3[*]
Binges/week	0.3$_a$	0.7	0$_a$	0	0.2$_a$	0.8	0$_a$	0	1.4

Means not sharing similar subscripts within a row differ at $p < 0.05$. Means (M) and standard deviations (S.D.) for the BDI = Beck Depression Inventory (range 0–63, higher scores indicate more depression), PA = positive affect (range 10–50; higher scores indicate more positive affect), NA = negative affect (range 10–50; higher scores indicate more negative affect), RSE = Rosenberg Self-Esteem Scale (range 10–40; higher scores indicate more self-esteem), BMI = Body Mass Index, EDE-Q scores (=Eating Disorder Examination Questionnaire, range 0–6 for each subscale: R = eating restraint, EC = eating concerns, WC = weight concerns, SC = shape concerns, global = EDE-Q global score; higher scores indicate more eating disorder psychopathology) and number of binges a week.

[*] $p < 0.001$.

Appetite and craving: Appetite and craving were measured by 2 items, asking how much craving and appetite participants experienced at that moment. Answers were given on a 5-point Likert scale ranging from not at all (0) to extremely (4). Higher scores reflect more craving and more appetite.

Depression: The Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) was used to assess the severity of depressive symptoms. The BDI consists of 21 items that are scored on a 4-point Likert scale ranging from 0 to 3. A higher score indicates an increasingly depressed mood. Scores below ten are normal (Beck, Steer, & Garbin, 1988).

Positive Affect and Negative Affect (PANAS; Watson, Clark, & Tellegen, 1988): Positive and negative affect were measured with the positive and negative affect subscales of the PANAS. The positive affect (PA) subscale consists of 10 positive mood terms (attentive, interested, alert, excited, enthusiastic, inspired, proud, determined, strong, active) whereas the negative affect (NA) subscale consists of 10 negative mood terms (distressed, upset, nervous, scared, hostile, irritable, ashamed, jittery, afraid, guilty). Participants indicate how often they felt that way during the last 2 weeks on a 5-point Likert scale (from 1 = very slightly or not at all, to 5 = extremely). Each affect score is the sum of the ten items, ranging between 10 and 50, with higher scores reflecting more frequent experiences of positive or negative emotions. The validity, internal consistency, and test-retest reliability of the PANAS are good (Watson et al., 1988).

Self-esteem: The Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1979) was used to assess self-esteem. The RSE is a 10-item measure of general self-worth, with scores ranging between 10 and 40 and higher scores reflecting higher self-esteem. The validity, internal consistency, and test-retest reliability of the RSE are good (Rosenberg, 1979).

Taste test: Participants were presented with 3 kinds of snack foods (chocolate, savory nuts, and cookies) and 2 beverages rich in calories. The food was broken into small pieces and presented in separate bowls. One bowl contained about 200 g of chocolate (525 kcal/100 g), a second about 200 g of cookies (490 kcal/100 g), and a third about 150 g of savory nuts (519 kcal/100 g). Two drinks rich in fat and calories were made; a chocolate and a vanilla drink. The 400 ml chocolate drink consisted of 350 ml chocolate milk to which 50 ml cream was added (providing 120 kcal/100 ml). The vanilla drink consisted of 300 ml milk, 90 ml cream and 10 g of

vanilla sugar (providing 120 kcal/100 ml). The beverages were presented in paperboard cups with a lid and straw.

Eating disorder psychopathology: A Dutch translation of the EDE-Q (EDE-Q; Fairburn & Beglin, 1994) was used to measure eating psychopathology. The EDE-Q is the questionnaire version of the Eating Disorder Examination (EDE) that measures specific eating psychopathology. The EDE-Q assesses eating restraint, eating concerns, weight concerns, shape concerns and behavioral features of eating disorders, like binge eating and inadequate compensation behaviors. The four concern subscales range from 0 to 6, reflecting the severity or frequency of symptoms (higher scores mean more severe or more frequent symptoms).

Binge eating: The EDE-Q assesses episodes of binge eating and inappropriate compensatory behaviors. Because of its self-report format, the EDE-Q might over- or underestimate the presence of objective binge eating (defined as the consumption of an objectively large amount of food in a relatively short period of time during which a loss of control is experienced). Therefore, a self-composed second binge eating assessment was added that consisted of 9 questions that asked for the presence of the DSM-IV diagnostic criteria for Binge Eating Disorder. It was asked whether, in the past 3 months, the participant ate an objectively large amount of food within a short period of time, lost control over eating, ate more rapidly than normally, ate until she felt uncomfortably full, ate alone, ate without physical hunger, and felt ashamed, guilty and depressed afterwards. The presence of binge eating thus was determined in two ways. A first indication was derived from the answers on EDE-Q questions, and the second indication of binge eating was derived from the DSM-IV criteria assessment. A participant was considered positive for binge eating if both the EDE-Q questions and the DSM-IV criteria were indicative of objective binge eating. For the positive participants, the frequency of binge eating was determined.

Body Mass Index (BMI): Weight and height were measured (without shoes, in clothes) and BMI (kg/m^2) was calculated.

Procedure

A month before participating in the experiment, all participants had completed a questionnaire including the BDI, RSE, PANAS, EDE-Q and questions about their age, weight and eating behavior

(including binge eating). Testing was each day between 11.45 a.m. and 12.45 a.m., just before lunch. The participants were instructed to have their normal breakfast and they did not eat from 1.5 h before the start of the study. On each testing day, two groups of participants, one obese and one normal weight group, were randomly assigned to one of three conditions: food exposure, negative mood induction or the neutral condition. After entering the lab, participants completed the state mood and appetite/craving questionnaires. Then the manipulation procedure was explained and the manipulation took place for 10 min. After the manipulation, state mood and appetite/craving were determined again. Next, the taste test, lasting 10 min, followed. Participants were instructed to taste the foods and drinks, and to complete the taste-questionnaire. They were invited to eat and drink as much as they liked or needed to complete the taste test. A questionnaire led the participant through the tasting process, with for example questions about palatability, saltiness, sweetness, and the number of tastes that could be distinguished within one food item. The amounts of food and beverages were measured before and after the taste test, and caloric intake was calculated afterwards. After the taste test was finished, each participant's weight and height were determined. Travel costs were reimbursed and all participants received a gift voucher. All participants were debriefed by regular mail after the experiment was completely finished.

Manipulations

All manipulations were done in groups of 4–10 participants. Each participant had her own chair and desk, and they were separated from each other by using large folding screens. During the instructions, all participants could see the experimenter who was in front of the room. During the actual mood and exposure manipulations participants were unable to see the other participants because they were sitting behind their own desks between the folding screens. In the control condition participants watched a video in groups, being able to see each other. However, during the taste tests all participants in all conditions were unable to see each other from behind their desks between folding screens.

Negative mood induction: The mood induction was done in a large room with dimmed lights and the induction intended to elicit a negative mood. Participants were explained that they would listen to a piece of music and that they had to give in to the feelings that the music elicited. Before they started listening, they were asked to think of something very unpleasant that once happened to them and during which they personally felt very bad. It was explained that the unpleasant experience should have been a kind of a personal tragedy that elicited negative feelings. They got 3 min to remember a bad occurrence, and wrote down three key words of their personal tragedy. They were instructed to close their eyes and to keep thinking of the bad experience while the music played, and to give in to the feelings the music and the memory elicited. The lights were dimmed, while the music (Prokofiev's Russia under the Mongolian Yoke, half speed) played for 10 min. Earlier studies showed this piece of music elicits a sad mood when it is played at half speed (Clark, 1983).

Food exposure: The food exposure was performed in a lab that was designed as an eating café with a real bar. The exposure intended to elicit increased appetite and craving through the intense smelling of tasty foods. All participants were given three bowls with food: chocolate, cookies, and savory nuts. They were instructed to take a piece of food, to hold it close to the nose and to smell it intensely. The experimenter modeled the 10-min food exposure, and made sure that all food items were intensely smelled and that participants concentrated on the smell of the food. Earlier studies showed that this kind of food exposure elicits strong craving in participants (Jansen & van den Hout, 1991; Jansen et al., 1992).

Control condition: The control manipulation was done in a large neutral office and the manipulation intended to keep participants in a neutral mood. The participants watched a 10-min video of a typical local festival parade.

Results

Manipulation check

Changes in state mood, appetite and craving from before to after the manipulation were analyzed for all manipulations. Table 2 gives the mean scores and standard deviations. Paired pre–post t-tests show that all manipulations succeeded: during food exposure both appetite and craving significantly increased whereas mood did not change. During the negative mood induction, mood significantly decreased (higher scores mean worse mood) and also appetite decreased whereas craving did not change significantly. In the control condition, a significant increase in mood was found, whereas craving and appetite did not change. It was concluded that all manipulations were successful.

Hypothesis testing

It is hypothesized that the high negative affect obese participants will overeat after negative mood induction and food exposure compared to a control condition, whereas the low negative affect obese participants are expected to show the opposite effect: they will eat less after a typically disinhibiting cue than without one. For all normal weight participants a same intake pattern as in the low negative affect obese participants is predicted.

The hypothesis states that the crucial difference will be found between the control condition vs. the other two conditions. To increase the power of the overall main analysis, the mood and food exposure were combined; a mean score for intake in the mood and the exposure condition was calculated, representing the 'cue condition'. The data were analyzed in a 2 (Negative Affect: high vs. low) × 2 (Condition: cue vs. control) × 2 (Group: obese vs. normal weight) ANOVA, with the total number of calories consumed

Table 2
Manipulation checks

Manipulation↓	Mood					Appetite					Craving				
	Pre		Post		t	Pre		Post		t	Pre		Post		t
	M	S.D.	M	S.D.		M	S.D.	M	S.D.		M	S.D.	M	S.D.	
Food exposure ($n = 34$)	0.23	0.44	0.19	0.39	1.1	1.7	1.3	2.2	1.4	2.9**	1.1	1.4	1.7	1.5	3.2**
Mood induction ($n = 29$)	0.23	0.36	0.85	0.88	4.4**	1.2	1.3	0.8	1.3	2.6*	0.76	1.0	0.66	1.1	0.9
Control condition ($n = 28$)	0.24	0.37	0.12	0.22	2.5*	1.3	1.3	1.3	1.3	0.3	1.2	1.3	1.4	1.5	1.2

Mean scores (M) and standard deviations (S.D.) on state mood (range 0–4; higher scores indicate worse mood), appetite (range 0–4; higher scores indicate more appetite) and craving (range 0–4; higher scores indicate more craving) questionnaires before (pre) and after (post) the manipulations. **$p < 0.01$, *$p < 0.05$.

during the taste test as the dependent variable. Data of one obese participant were not analyzed; she did not eat and drink because of a self-reported 'specific food intolerance'. No main effects were found for Group, $F(1, 89) = 1.3$, NS, Negative Affect, $F < 1$, NS, or Condition, $F < 1$, NS, but consistent with our hypothesis, a close to significant Group $\times$ Negative Affect $\times$ Condition interaction was found, $F(1, 89) = 3.8$, $p = 0.055$.

Fig. 1 shows the mean intake in the conditions, for the weight and affect groups. The figure shows differences between the weight groups, therefore additional 2 (Negative Affect: high vs. low) $\times$ 2 (Condition: cue vs. control) ANOVA's were done within the obese and normal weight groups separately. For the obese group, the ANOVA showed no main effects for Condition and Negative Affect (both F's < 1) but a significant Negative Affect $\times$ Condition interaction $F(1, 51) = 6.1$, $p = 0.017$. The intake pattern of the high negative affect obese over conditions differed significantly from the intake pattern of the low negative affect obese: the obese high in negative affect consumed more in the cue conditions compared to the control condition, whereas the low negative affect obese consumed less in the cue conditions compared to the control condition. Further t-tests showed that the high affect obese subtype ate significantly more in a cue condition (M = 488 kcal, S.D. = 198), compared to the neutral condition (M = 341 kcal, S.D. = 125), $t(23) = 1.9$, $p = 0.034$, one-tailed. The low affect obese subtype ate about the same in a cue condition (M = 356 kcal, S.D. = 173) compared to the neutral condition (M = 489 kcal, S.D. = 235), $t(25) = 1.6$, $p = 0.06$, one-tailed, see Fig. 1. For the normal weight participants, no main or interaction effects emerged (all F's < 1.5), showing that the high and low negative affect normal weight subtypes did not differ in their intake pattern over conditions.

To figure out whether the exposure and mood conditions were both acting as a disinhibitor for in particular the high negative affect obese group, two further ANOVAs were performed to separately test, respectively, the specific disinhibiting effects of the negative mood induction vs. control manipulation and the specific disinhibiting effects of the food exposure vs. control manipulation within the obese group. The 2 (Condition: mood vs. control) $\times$ 2 (Negative Affect: high vs. low) ANOVA showed neither a main effect for Condition, $F < 1$, nor for Affect, $F < 1$, but again a significant Condition $\times$ Affect interaction emerged, $F(1, 30) = 4.9$, $p = 0.035$. Also the 2 (Condition: exposure vs. control) $\times$ 2 (Negative Affect: high vs. low) ANOVA showed neither a main effect for Condition, $F < 1$, nor for Affect, $F < 1$, but a significant Condition $\times$ Affect interaction, $F(1, 35) = 4.4$, $p = 0.045$. Further t-tests showed that the high negative affect obese subtype ate significantly more after negative mood induction (M = 492 kcal, S.D. = 208), compared to the neutral condition (M = 341 kcal, S.D. = 125), $t(14) = 1.8$, $p < 0.05$, one-tailed. In contrast, the low negative affect obese subtype ate about the same after negative mood induction (M = 345 kcal, S.D. = 162), compared to the neutral condition (M = 489 kcal, S.D. = 235), $t(13) = 1.4$, $p = 0.09$, one-tailed. The high negative affect obese subtype also ate significantly more after food exposure (M = 485 kcal, S.D. = 202) compared to the neutral condition (M = 341 kcal, S.D. = 125), $t(15) = 1.7$, $p = 0.05$, one-tailed. The low negative affect obese subtype did not eat less after the exposure (M = 364 kcal, S.D. = 187) than in the neutral condition (M = 489 kcal, S.D. = 235), $t(17) = 1.3$, $p = 0.11$, one-tailed.

To conclude, the present data support the main part of our hypothesis. The data show that the obese participants who are high in negative affect overeat after a negative mood induction and after food exposure, whereas the obese participants low in negative affect did not. But the normal weight participants did not consume less after a negative mood induction and food exposure than in the neutral condition.

Discussion

In the present study, it was tested whether the high negative affect subtype of a non-eating disordered overweight and obese sample overate after negative mood induction and after exposure to the smell of tasty foods, compared to a neutral condition. It was found that they did: the high negative affect overweight/obese subtype ate significantly more after negative mood induction and tasty food exposure than after a neutral manipulation, whereas the low negative affect overweight/obese subtype did not. Like the low negative overweight/obese subtype, the normal weight high and low negative affect subtypes did not show different responses to the manipulations.

Finding this differential eating response in overweight/obese subtypes that differ in their levels of negative affect, might be considered a validation of subtyping the non-eating disordered overweight/obese in a high and low negative affect group (see also Jansen et al., submitted for publication). The present data also show that emotional and behavioral factors do play a major role in a large part of the non-eating disordered obesity. First, a substantial part of this overweight/obese non-eating disordered sample – about half of them – showed increased negative affect scores and could be typified as a negative affect subtype. Their mean BDI score was 17; a score between 10 and 18 is indicative of mild to moderate depression, and higher scores indicate moderate to severe depression (Beck et al., 1988). Second, the high negative affect subtype not only showed increased negative affect, they also showed behavioral responses that were found to be characteristic for eating disorders; they overate after being confronted with
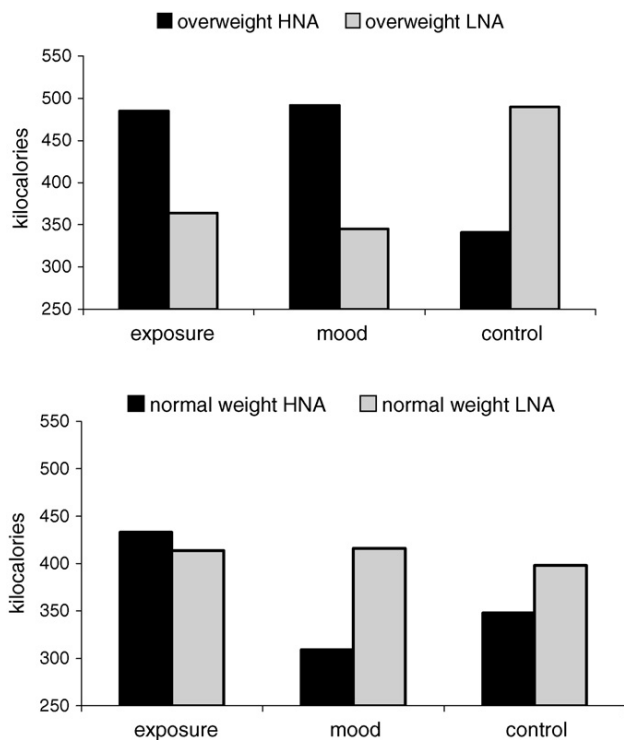

Fig. 1. Kilocalorie consumption for the subtypes high (HNA) and low (LNA) in negative affect after food exposure (exposure), negative mood induction (mood) and in the control condition (control). The upper part shows the overweight/obese participants, the lower part the normal weight participants.

triggers that usually disinhibit the eating disordered. These data thus point to increased vulnerability to overeating in this non-eating disordered overweight/obese subgroup that is characterized by increased negative affect.

A limitation of the present study is that expert diagnostic interviews were lacking, to ensure that the participants had no eating disorders. The sample was considered non-eating disordered on base of a self-report screening. While the self-report binge eating assessment showed no differences in binge frequency between all groups, 4 possible bingers were identified in the present sample. Two high and two low negative affect overweight participants might have met the diagnostic criteria for Binge Eating Disorder (BED) because they reported, respectively, 2, 2, 3 and 4 self-defined binges a week, thereby meeting the frequency criterion. Interestingly though, the high negative affect subtype did not show more binge eating than the low negative affect subtype: the potential BEDs were both high and low in negative affect. Considering the differential eating response to the negative mood and exposure challenges of both subsamples, each having just as much (2) potential bingers, suggests that the conceivable binge eating of these few participants could not have been crucial.

Like binge eating, increased BMI's usually are considered to be the main determinants of overeating in the obese. But the BMI of the present high negative affect subtype was not higher than the BMI of the low negative affect subtype. It might therefore be concluded that also the height of the BMI cannot be held responsible for the difference in overeating response between the high and low negative affect subtypes. The subtyping in high and low negative affect is critical.

This subtyping of the non-eating disordered overweight/obese in a low and high negative affect group along the affect dimension might be of prognostic and clinical utility. Stice et al. (submitted for publication) found the subtyping of individuals with bulimia nervosa along a dietary-affect dimension predictive of eating pathology, distress, functional impairment, treatment seeking and a persistent clinical course. Research into the predictive validity of the negative affect subtyping for weight course (predicting differential weight change) and maladaptive eating behavior (predicting increased emotional eating and cue induced overeating) in the non-eating disordered overweight/obese would be highly interesting.

It is also of interest to study whether treatment needs and treatment responses to weight loss programs differ between the high and low negative affect subtypes. In earlier studies, Nauta, Hospers, Jansen, & Kok (2000) showed that increasingly negative self-schema's were associated with increased depression in the obese. The authors also showed that pure cognitive therapy is effective in treating the obese, in particular in reducing their concerns and depression (Nauta, Hospers, & Jansen, 2001; Nauta, Hospers, Kok, & Jansen, 2000). Werrij et al. (submitted for publication) also showed that cognitive therapy was highly beneficial for the non-eating disordered overweight/obese, in particular for a subgroup with higher depression scores that may very well have matched the negative affect subtype. These data suggest that cognitive therapy might in particular be indicated for the highly negative affect subtype, although they have no eating disorder at all, and although obesity formally is not considered to be a mental or behavioral disorder (Devlin, 2007).

Obesity reflects an imbalance between energy intake and energy expenditure, and that imbalance often is considered to follow from certain genetic conditions within a 'toxic' environment. It might be worthwhile to also realize the relative influence of psychological determinants of obesity to enable prevention or to guide intervention strategies. The present data show that individual differences play a crucial role in the way overweight/obese people

handle temptations of the current environment: being characterized by high negative affect makes it more difficult for the overweight/obese to resist modern temptations.

Apart from lacking a clinical diagnostic interview, there are some more limitations to this study. The sample was modest in size for so many cells, partly because of the selection method for the controls that was done to guarantee good matching on age and socio-economics. This made it necessary to combine both cue conditions for adequate first analyses. Also, the experiment was performed in groups and it is unsure whether this might have prevented participants from giving in completely to their feelings and urges. Although the data were statistically significant and in the predicted direction, a replication using larger cell sizes and individual testing is needed to confirm the present conclusions.

The strength of this study is that it focused on actual eating behavior of two subtypes of non-eating disordered overweight/obesity in a controlled experimental design. That was never done before, and despite the methodological weaknesses, the results are robust, showing that only the high negative overweight/obese subtype overeats in a negative mood and after food exposure, and not the low negative overweight/obese subtype. Our conclusion is that subtyping the non-eating disordered overweight/obese shows some predictive validity and we think that future studies into non-eating disordered overweight/obesity should consider the existence of these two subtypes, to learn more about overweight/obesity and to improve the efficacy of treatments.

References

Beck, A. T., Steer, R. A., & Garbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clinical Psychology Review, 8*, 77–100.

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*, 651–671.

Carr, D., Friedman, M. A., & Jaffe, K. (2007). Understanding the relationship between obesity and positive and negative affect: The role of psychosocial mechanisms. *Body Image, 4*, 165–177.

Carter, F. A., Bulik, C. M., McIntosh, V. V., & Joyce, P. R. (2001). Cue reactivity as a predictor of outcome with bulimia nervosa. *International Journal of Eating Disorders, 31*, 240–250.

Chua, J. L., Touyz, S., & Hill, A. J. (2004). Negative mood-induced overeating in obese binge eaters: An experimental study. *International Journal of Obesity, 28*, 606–610.

Clark, D. M. (1983). On the induction of depressed mood in the laboratory: Evaluation and comparison of the Velten and Musical procedures. *Advances in Behaviour Research and Therapy, 5*, 27–49.

Devlin, M. J. (2007). Is there a place for obesity in DSM-V? *International Journal of Eating Disorders, 40*, S83–S88.

Fairburn, C. G., & Beglin, S. J. (1994). The assessment of eating disorders: interview or self-report questionnaire? *International Journal of Eating Disorders, 16*, 363–370.

Grilo, C. M., Masheb, R. M., & Wilson, G. T. (2001). Subtyping binge eating disorder. *Journal of Clinical and Consulting Psychology, 69*, 1066–1072.

Jansen, A. (1998). A learning model of binge eating: Cue reactivity and cue exposure. *Behaviour Research and Therapy, 36*, 257–272.

Jansen, A., Broekmate, J., & Heymans, M. (1992). Cue exposure vs. self-control in the treatment of binge eating: A pilot study. *Behaviour Research and Therapy, 30*, 235–241.

Jansen, A., Havermans, R., Roefs, A., & Nederkoorn, Ch. (submitted for publication). Jolly Fat or Sad Fat? Subtyping non-eating disordered obesity along an affect dimension. *Appetite*.

Jansen, A., & van den Hout, M. (1991). On being led into temptation: 'Counterregulation' of dieters after smelling a 'preload'. *Addictive Behaviors, 5*, 247–253.

Jansen, A., van den Hout, M., & Griez, E. (1990). Clinical and non-eating disordered binges. *Behaviour Research and Therapy, 28*, 439–444.

Martinez-Mallén, E., Castro-Fornieles, J., Lázaro, L., Moreno, E., Morer, A., Font, E., Juian, J., Montserrat, V., & Toro, J. (2007). Cue exposure in the treatment of resistant adolescent bulimia nervosa. *International Journal of Eating Disorders, 40*, 596–601.

Nauta, H., Hospers, H., & Jansen, A. (2001). One-year follow-up effects of two obesity treatments on psychological well-being and weight. *British Journal of Health Psychology, 6*, 271–284.

Nauta, H., Hospers, H. J., Jansen, A., & Kok, G. (2000a). Cognitions in obese binge eaters and obese non-binge eaters. *Cognitive Therapy and Research, 24*, 521–531.

Nauta, H., Hospers, H., Kok, G., & Jansen, A. (2000b). A comparison between a cognitive and a behavioral treatment for obese binge eaters and obese non-binge eaters. *Behavior Therapy, 31*, 441–461.

Rosenberg, M. (1979). *Conceiving the self*. New York, NY: Basis Books Inc Publishers.

Scott, K. M., Bruffaerts, R., Simon, G. E., Alonso, J., Angermeyer, M., de Girolamo, G., et al. (2008). Obesity and mental disorders in the general population: Results from the world mental health surveys. *International Journal of Obesity, 32*, 192–200.

Schotte, D. E., Cools, J., & McNally, R. J. (1990). Film-induced negative affect triggers overeating in restrained eaters. *Journal of Abnormal Psychology, 99*, 317–320.

Stice, E. (2001). A prospective test of the dual-pathway model of bulimic pathology: Mediating effects of dieting and negative affect. *Journal of Abnormal Psychology, 110*, 124–135.

Stice, E. (2002). Risk and maintenance factors for eating pathology: A meta-analytic review. *Psychological Bulletin, 128*, 825–848.

Stice, E., & Agras, W. S. (1999). Subtyping bulimic women along dietary restraint and negative affect dimensions. *Journal of Consulting and Clinical Psychology, 67*, 460–469.

Stice, E., Agras, W. S., Telch, C. F., Halmi, K. A., Mitchell, J. E., & Wilson, G. T. (2001). Subtyping binge-eating disordered women along dieting and negative affect dimensions. *International Journal of Eating Disorders, 30*, 11–27.

Stice, E., Bohon, C., & Fischer, K. (submitted for publication). Subtyping women with bulimia nervosa along dietary and negative affect dimensions: Further evidence of reliability and validity.

Telch, C. F., & Agras, W. S. (1996). Do emotional states influence binge eating in the obese? *International Journal of Eating Disorders, 20*, 271–279.

Toro, J., Cervera, M., Feliu, M. H., Garriga, N., Jou, M., Martinez, E., & Toro, E. (2003). Cue exposure treatment of resistant bulimia nervosa. *International Journal of Eating Disorders, 34*, 227–234.

Vanderlinden, J., Grave, R. D., Fernandez, F., Vandereycken, W., Pieters, G., & Noorduin, C. (2004). Which factors do provoke binge eating? An exploratory study in eating disorder patients. *Eating and Weight Disorders, 9*, 300–305.

Vögele, C., & Florin, I. (1996). Psychophysiological responses to food exposure: An experimental study in binge eaters. *International Journal of Eating Disorders, 21*, 147–157.

Wald, F. D. M., & Mellenbergh, G. J. (1990). De verkorte versie van de Nederlandse vertaling van de Profile of Mood States (POMS) (Shortened version of the Dutch translation of the Profile of Mood States (POMS). *Nederlands Tijdschrift voor de Psychologie, 45*, 86–90.

Wardle, J., Williamson, S., Johnson, F., & Edwards, C. (2006). Depression in adolescent obesity: Cultural moderators of the association between obesity and depressive symptoms. *International Journal of Obesity, 30*, 634–643.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measurements of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063–1070.

Werrij, M. Q., Mulkens, S., Hospers, H., & Jansen, A. (2006). Overweight and obesity; the significance of a depressed mood. *Patient Education and Counseling, 62*, 126–131.

Werrij, M. Q., Jansen, A., Mulkens, S., Elgersma, H., Ament, A., & Hospers, H. J. (submitted for publication). Adding cognitive therapy to dietetic treatment prevents relapse in obesity.