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Research report

# Emotions and eating. Self-reported and experimentally induced changes in food intake under stress

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ABSTRACT

Two studies investigated the stress–eating relationship. The first examined self-reported changes in intake of snack foods, whilst the second investigated stress-induced overconsumption in a laboratory setting comparing high (HF) and low-fat (LF) snacks. Eighty-nine females completed the Dutch Eating Behaviour Questionnaire (DEBQ) [Van Strien, T., Fritjers, J. E. R., Bergers, G. P. A., & Defares, P. B. (1986). Dutch Eating Behaviour Questionnaire for assessment of restrained, emotional and external eating behaviour. *International Journal of Eating Disorders, 5*, 295–315] and a self-report measure designed to evaluate changes in eating in response to stress. Increased intake of HF snacks was associated with high emotional eating but not with restraint. A laboratory-based experiment compared intake of HF and LF snacks after ego-threatening and neutral Stroop colour-naming tasks. Intake was suppressed by 31.8% in restrained compared to unrestrained eaters across tasks. Restrained eaters consumed significantly less after ego-threat than after the neutral manipulation, but this was associated only with intake of the LF snack. Restrained eaters' intake of dried fruit was suppressed by 33.2% after ego-threat relative to the neutral task, despite a significant increase in hunger for this group following ego-threat. These results suggest that the type and variety of foods offered influences the link between stress and eating in laboratory settings. Further research should aim to replicate and extend these findings, with a view to informing potential interventions for stress-related eating.



## Introduction

A growing body of evidence suggests that stress affects health not only through direct physiological processes but also through changes in health behaviours such as food choice and intake. Survey findings indicate that people report increasing intake of high energy snack foods when stressed. For example, Oliver and Wardle (1999) administered a brief questionnaire to examine the relationship between self-reported stress and food intake. Overall, almost equal numbers of respondents reported increased and decreased intake in response to stress. However, stress was associated with increased consumption of high fat, highly palatable snack foods whereas more meal-type foods were consistently reported to be consumed less under conditions of stress. These findings were independent of gender and dieting status.

Weinstein, Shide, and Rolls (1997) asked participants to indicate changes in eating behavior in response to stress in general and to a recent specific stressful experience that lasted for at least a day. For females, overeating was correlated with a number of psychometric measures, including disinhibition and restrained eating. However, responses of undereating and no change were collapsed, eliminating the possibility of examining stress-induced undereating. More recently, Zellner et al. (2006) found that of those women who reported increasing their food intake when stressed, 71% were restrained eaters. In contrast, only 35% of those who reported no change or decreased intake were restrained.

Laboratory studies do not always find the restraint–stress interaction. For example, using anticipation of public speaking as a stressor, Oliver, Wardle, and Gibson (2000) found no effect of restraint. However, they did find that emotional eaters ate more sweet high-fat foods than non-emotional eaters. More recently, Wallis and Hetherington (2004) found that restraint and emotional eating were associated with enhanced intake of chocolate in their female sample in response to an ego-threatening Stroop colour-naming task. Indeed, a number of studies have found that ego-threatening stressors are associated with increased intake of highly palatable foods (e.g. Heatherton, Herman, & Polivy, 1991, 1992; Lattimore & Maxwell, 2004; Oliver et al., 2000; Polivy & Herman, 1999). This is consistent with Escape Theory (Heatherton & Baumeister, 1991) which proposes that

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overeating is caused by an attempt to shift attention away from an ego-threatening stimulus that causes aversive self awareness. This process of affect self-regulation moves attention away from negative self-appraisal, and towards the immediate stimulus environment (e.g. foods). However, minimally stressful tasks and those designed to be cognitively demanding rather than ego-threatening can also induce overconsumption (e.g. Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004; Ward & Mann, 2000). Furthermore, there is evidence to suggest that stress-related eating is not an effective coping mechanism. It does not serve to reduce distress either during the eating episode (Polivy, Herman, & McFarlane, 1994) or after eating has ended (Polivy & Herman, 1999). This is in contrast to a recently proposed animal model of stress-induced comfort eating (Dallman et al., 2003; Pecoraro, Reyes, Gomez, Bhargava, & Dallman, 2004), which suggests that preference for comfort foods under stress is associated with a comfort-food reduction in the activity of the HPA axis. However, the application of this model to humans will depend on the individual characteristics of the consumer. Comfort eating of highly palatable 'forbidden' foods tends to produce post-consumption guilt or general negative affect in some individuals (Hetherington & Macdiarmid, 1993; Wansink, Cheney, & Chan, 2003) and it seems that this is primarily associated with female gender. For example, Wansink et al. (2003), found that males tended to prefer more nutritious meal-related foods (such as steak, casseroles and soup), whereas females tended to prefer high-fat snack foods (such as chocolate and ice-cream). Females were more likely to report feeling less healthy and more guilty than males after eating comfort foods. However, this was not only associated with eating high-fat comfort foods, but it was also found with some more healthy meal-type foods. It is possible that the greater tendency of females to restrict food intake relative to males might be responsible for this greater likelihood of feeling guilty after consuming foods identified as comforting.

Evidence suggests that vulnerable individuals (restrained or emotional females) consume more than others after laboratory manipulations of ego-threatening stress when offered a single food (e.g. Wallis & Hetherington, 2004) and when offered a variety of foods (e.g. Lattimore & Maxwell, 2004). However, it is less clear whether they will necessarily consume more of a high-fat, highly palatable food when also offered a single, highly palatable, yet low fat alternative. This is one of the aims of the laboratory study reported here. In addition, the survey is designed to examine individual differences in real-world responses to environmental stress by considering the contributions of both restrained and emotional eating in a sample of young women.

## Study One

The aim of this study was to extend the findings of previous surveys (e.g. Oliver & Wardle, 1999; Weinstein et al., 1997; Zellner et al., 2006), primarily by considering the role of both restrained and emotional eating in stress-related snack intake in a free-living context. The study was intended to provide further characterisation of the stress-related diet in young women and, in particular, its relationship to individual differences in eating behaviour.

This survey examined frequency of reported overeating or undereating in response to both general and specific stressors. The association between stress and unhealthy snacking behaviours was examined by recording the reported frequency of eating more or less of specific high-fat, highly palatable snack foods under conditions of perceived stress. Finally, these associations were examined in relation to restrained and emotional eating status. It was predicted that restrained and emotional eating would be associated with reported increases in consumption of these foods at the time of the specified stressor.

### Method

#### *Participants*

Eighty-nine females were recruited from an undergraduate population using convenience sampling. Ages ranged from 18 to 21 (mean = 18.4; SD = 0.6) and BMI (based on self-reported height and weight) ranged from 15.8 to 28.9 (mean = 21.3; SD = 2.8).

#### *Measures*

##### *Perceived stress and eating questionnaire*

This was a modified version of the stress-induced eating questionnaire designed by Oliver and Wardle (1999). This measure required participants to indicate any changes in eating in response to stress in general and to a recent stressful experience. Response options were '*stop/stopped eating*', '*eat/ate less than usual*', '*eat/ate the same as usual*', '*eat/ate more than usual*', *and* '*binge/binged*'. A final set of questions targeted the amount eaten of three snack foods (crisps, chocolate, biscuits) around the time of the specific stressful experience. Response options were '*much less than usual*', '*less than usual*', '*same as usual*', '*more than usual*', '*much more than usual*', and '*I never eat this food*'. The final option allowed exclusion from the analyses of those who did not normally eat a particular food.

##### *Dutch eating behaviour questionnaire (DEBQ; Van Strien, Fritjers, Bergers, & Defares, 1986)*

Restrained and emotional eating were measured using the DEBQ. These scales have high internal consistency, external validity and factorial validity (Van Strien et al., 1986; Wardle, 1987). Based on a median-split of scores, participants were allocated to restrained or unrestrained and high or low emotional eating groups (medians = 2.8 and 3.0 respectively). Those with a score exactly on the median were included in the low groups.

#### *Data analysis*

As the data relied largely on non-continuous scales of measurement, the data were analysed using chi-squared analyses.

### Results

#### *Amount eaten under general stress*

In order to compare overeating and undereating in response to general stress, those who reported no change ($n = 8$) were excluded and the two highest response categories ('ate more than usual' and 'binged') and the two lowest response categories ('stopped eating' and 'ate less than usual') were combined for analysis. Of the remaining respondents almost equal numbers reported eating more (46.9%, $n = 38$) and eating less (53.1%, $n = 43$). Chi-square analyses were performed in order to examine differences according to restrained and emotional eating status. There was no relationship between reported amount consumed under general stress and restrained eating ($p > .05$). Emotional eaters were more likely to report overeating (61.1%, $n = 22$) than were non-emotional eaters (35.6%, $n = 16$), whereas non-emotional eaters were more likely to report undereating (64.4%, $n = 29$) than were emotional eaters (38.9%, $n = 14$); $\chi^2(1) = 5.2$, $p < .05$.

#### *Amount eaten under specific stress*

In order to compare over and undereating in response to a specific stressor those who reported no change ($n = 16$) were excluded and again, the two highest and the two lowest response

categories were combined for analysis. Overall, 39.7% ($n = 29$) reported eating more and 60.3% ($n = 44$) reported eating less. As with the previous analysis of eating responses to general stress, there was no relationship between amount consumed and restrained eating status ($p > .05$). However, the relationship between amount consumed and emotional eating status was significant; $\chi^2(1) = 9.2$, $p < .01$. Emotional eaters were more likely to report overeating (59.4%, $n = 19$) than were non-emotional eaters (24.4%, $n = 10$) and conversely, non-emotional eaters were more likely to report undereating (75.6%, $n = 31$) than were emotional eaters (40.6%, $n = 13$).

*Food choice in response to specific stressor*

Table 1 indicates that all three snack foods were reported to be consumed in greater quantities around the time of the specified stressor (crisps: 65.2%, $n = 43$; chocolate: 76.0%, $n = 57$; biscuits: 63.2%, $n = 43$). Further analysis found that increased intake of these snack-type foods was associated with emotional eating status only. Emotional eaters were more likely to report overeating potato chips (85.7%, $n = 24$), whereas an equal amount of non-emotional eaters reported overconsumption and underconsumption of this food type, $\chi^2(1) = 9.06$, $p < .01$. Again, they were also more likely to overeat biscuits (82.1%, $n = 23$), but the same number of non-emotional eaters reported overconsumption and underconsumption, $\chi^2(1) = 7.3$, $p < .01$. These findings remained when the 'no change' response category was added to the analyses (crisps: $\chi^2(2) = 9.1$, $p < .05$; biscuits: $\chi^2(2) = 8.8$, $p < .05$). As similar numbers of emotional and non-emotional eaters responded using this category (crisps: 8 emotional and 9 non-emotional; biscuits: 10 emotional and 7 non-emotional), this seems to be a reflection of the original finding that emotional eaters are more likely to report overeating these foods, whereas non-emotional eaters are equally likely to report overconsumption and underconsumption. Reported overeating of chocolate was greater than undereating in both emotional (88.2%, $n = 30$) and non-emotional eaters (65.9%, $n = 27$), $\chi^2(1) = 5.1$, $p < .05$. This indicates that overeating chocolate during specific stressors seems to be a generalised phenomenon in women. BMI did not yield a significant relationship to stress-related eating.

## Discussion

The results of this brief survey confirm and extend laboratory findings that stress is associated with unhealthy changes in food choice. An almost equal number of respondents reported overeating and undereating during general stress, whereas recent specific stressors elicited more reports of undereating than overeating. Changes in reported consumption were associated with different patterns of eating in emotional and non-emotional eaters. Emotional eaters were more likely to report overconsumption, and non-emotional eaters to report underconsumption under conditions of both general and specific stress. However, no differences in stress-related eating were found for restrained eaters. In their study, Oliver and Wardle (1999) reported that dieters were more likely than non-dieters to eat more in response to stress. In line with the findings of the present study, they found that increased consumption of snack-type foods was largely independent of dieting status.

This brief survey confirms previous findings (e.g. Oliver & Wardle, 1999) that overeating and undereating are reported almost equally often. However, undereating in the present study was more likely to be reported when considering a recent specific stressor, thus may reflect both memory for and salience of this experience. Stone and Brownell (1994) used daily ratings to examine stress-related changes in eating, and found differences between ratings on high-stress and low-stress days. On high-stress days 28% reported eating more and 72% reported eating less, which represents a similar pattern to that found in the present study (39.7% and 60.3% respectively). It is possible that questions relating to general and to specific/recent memories for emotional experiences target qualitatively different associations depending on strength of memory, and salience to the respondent.

Another aim was to assess the association between snacking behaviour and stress. In line with previous findings, respondents reported overeating crisps chocolate and biscuits in response to a specific stressor. Again, there was no association with restraint. This is in contrast to Zellner et al. (2006) who found that stress-related overeaters were more likely to be restrained than were those who expressed no change or undereating during stress. In addition, the majority of their stress-related overeaters reported increased intake of foods that they normally avoid (high energy, high fat snack foods).

Emotional eaters tended to report eating more of the specified snack foods under stress, whereas non-emotional eaters reported both under and overconsumption equally. Interestingly, the findings suggest that stress-related consumption of chocolate may be largely independent of emotional eating status. Increased intake was reported in both emotional and non-emotional eaters, although the proportion of emotional eaters was significantly greater than non-emotional.

Overall, this brief survey supports evidence that women, in times of stress seek comfort from foods, and that this comfort tends to be sought from foods with particular identities as highly palatable or 'forbidden'. The findings also suggest that emotional eating may be a crucial target for intervention in stress-related consumption, particularly regarding frequency of snacking and choice of snack foods.

## Study Two

Study one provided support for the observation from other surveys that vulnerable individuals consume an unhealthy diet at times of stress (e.g. Oliver & Wardle, 1999; Weinstein et al., 1997; Zellner et al., 2006). Experimental manipulations of stress-related eating have also observed that some susceptible individuals consume high-fat, highly palatable foods under conditions of negative stimuli or stressful emotion (e.g. Haynes, Lee, & Yeomans, 2003; Heatherton et al., 1991; Lattimore, 2001; Lattimore & Maxwell, 2004; Tanofsky-Kraff, Wilfley, & Spurrell, 2000; Wallis & Hetherington, 2004; Zellner et al., 2006). Study two investigated stress-related food choice in an experimental setting using the ego-threatening and neutral Stroop colour-naming tasks described in Wallis and Hetherington (2004). In that study it was found that

**Table 1**
Reported consumption of each food around the time of the specific stressor (table shows percentages of response category and count for each food type).

| | Much less than usual | Less than usual | Same as usual | More than usual | Much more than usual |
|---|---|---|---|---|---|
| Crisps* ($n = 83$) | 8.4 (7) | 18.1 (15) | 21.7 (18) | 49.4 (41) | 2.4 (2) |
| Biscuits* ($n = 85$) | 11.8 (10) | 17.6 (15) | 20.0 (17) | 43.4 (37) | 7.1 (6) |
| Chocolate* ($n = 84$) | 7.1 (6) | 14.3 (12) | 10.7 (9) | 46.4 (39) | 21.4 (18) |

* Significant emotional eating status differences (see text for details).

high restraint, regardless of emotional eating status, was associated with greater intake of chocolate after ego-threat than after the neutral task. The present study set out to investigate whether this effect remains or is diminished in the presence of a single low-fat palatable alternative alongside chocolate. This experiment was designed to clarify the impact of the ego-threat Stroop task on snack food choice, and to characterise traits associated with vulnerability towards unhealthy changes in food choice under such conditions. It was predicted that ego-threat would guide restrained and emotional females towards a 'forbidden' snack food (chocolate) rather than a low-fat alternative (dried fruit mix). In line with previous findings (Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004), it was predicted that this intake difference would not be contingent upon a significant impact of the ego-threat task on measures of negative affect in comparison to the neutral task.

## Method

### *Participants*

Twenty-six females were recruited via advertisements to take part in an investigation into the "relationship between food intake and personal characteristics". Participation was contingent upon liking of both foods and the ability to eat them with no adverse side effects. Prior to taking part, participants were screened for eligibility (i.e. no food allergies, physical illness, history of mental health problems, and eating disorders). The departmental ethics committee provided approval for the research design, informed consent was obtained from all participants, and the study was conducted according to the ethical standards laid down in the 1964 Declaration of Helsinki.

Individual differences in eating behaviour were assessed using the Restraint and Emotional eating sub-scales of the DEBQ (Van Strien et al., 1986; see Study One for further details). Participants were allocated to high and low groups on restrained and emotional eating using a median split of scores (2.6 for restraint and 2.5 for emotional eating). Those with a score exactly on the median were included in the unrestrained and non-emotional groups (high and low restraint $n = 13$; high emotional $n = 12$, low emotional $n = 14$). Groups did not differ significantly in age (high emotional $\mu = 23.7$, SE = 3.0, range = 18–51; low emotional $\mu = 30.8$, SE = 3.4, range = 18–57; high restraint $\mu = 26.7$, SE = 3.3, range = 18–51; low restraint $\mu = 28.4$, SE = 3.5, range = 18–57). The high and low emotional groups also did not differ significantly in BMI (high emotional $\mu = 24.8$, SE = 1.6, range = 19.5–35.1; low emotional $\mu = 23.7$, SE = .84, range = 19.0–32.3). However, the high restraint group had a significantly higher BMI ($\mu = 26.1$, SE = 1.5, range = 19.5–35.1) than did the low restraint group ($\mu = 22.4$, SE = .5, 19.0–25.6), $F(1,24) = 5.5$, $p < .05$, $\eta_p^2 = .19$).

### *State measures of appetite and mood*

Mood and appetite variables were assessed at three time points (baseline, post-task and post-snack). Subjective sensations of hunger and fullness were measured using 100 mm visual analogue scales (VAS) anchored with two extreme endpoints. Anxiety, stress and relaxation were assessed using the same method. In a review of the reliability and validity of VAS, Stubbs et al. (2000) concluded that they are sensitive to most experimental manipulations, have some ability to predict aspects of eating behaviour and show good test–retest reliability if used in within-subject, repeated measures designs where the effects of different manipulations are compared under similar circumstances.

A further measure of mood, the Positive and Negative Affect Scales (PANAS; Watson, Clark, & Tellegen, 1988) was administered at the same three timepoints. This 20-item checklist uses a five-point Likert scale and, like VAS, it is relatively brief and easy to administer and score. The scales are highly internally consistent, largely uncorrelated, and stable over a two-month period (Watson et al., 1988). The PANAS is widely used and has identified reliable decreases in positive affect and/or increases in negative affect after experimental mood manipulations (e.g. Oliver et al., 2000; Wallis & Hetherington, 2004).

### *Stroop tasks*

Ego-threatening and neutral (control) Stroop tasks were presented in counterbalanced order, with at least three days between the two conditions. Ego-threatening (e.g. worthless) and neutral words (e.g. wavering) were adapted from Waller, Watkins, Shuck, and McManus (1996). All tasks were presented on a computer screen (PC laptop) using SuperLab® software (Cedrus Corporation, 1999; Phoenix, Arizona). All word stimuli were displayed in the centre of the screen in uppercase Times New Roman of 32pt font size. Participants were required to name the print colour of each word (288 stimulus presentations in each condition) via a key press corresponding to one of four colours. Four keys were labeled with the relevant colour. Further details of the tasks can be seen in Wallis and Hetherington (2004).

### *Test foods*

The two snack foods (Table 2) were presented on a tray with a glass of water.

### *Procedure*

Participants were provided with an information sheet outlining the general requirements of the research and gave written, informed consent. In order to ensure that hunger levels were similar on each test day, participants were instructed to consume only water for 3 h prior to attending the laboratory. Sessions took place between the hours of 11.00 am and 3.00 pm. The tasks were presented in counterbalanced order, with an interval of at least three days. On arrival at the laboratory, participants completed baseline 100 mm visual analogue scale (VAS) ratings of appetite (hunger and fullness) and mood (anxiety, relaxation and stress). An additional mood measure (PANAS) allowed assessment of both positive and negative affect. After these baseline ratings were taken, instructions were given for the Stroop task (further instructions were provided on screen) and participants were informed that their recall of these words would be tested later in the session. Post-task mood and appetite were assessed using

**Table 2**
Energy and macronutrient composition of foods (per 100 g).

| Food type | Food | Energy (kcal) | Carbohydrate (g) | Protein (g) | Fat (g) | Amount presented (g) |
|---|---|---|---|---|---|---|
| High-fat sweet | Chocolate | 525 | 56.8 | 7.8 | 29.4 | 150 |
| Low-fat sweet | Dried fruit[a] | 260.6 | 61.4 | 2.25 | 0.45 | 180 |

[a] Dried fruit mix: 60 g raisins, 60 g sultanas and 20 g each of chopped apricots, pineapple and papaya (Tesco brand). *Note*: 180 g of dried fruit provided in order to make the amount presented appear similar in size to that of chocolate (Cadbury Buttons®).

further VAS ratings, after which, participants were presented with the snack foods, instructed that they would be left alone for 10 min and that they could eat as much or as little as they wished. After any remaining food was removed, a final set of mood and appetite ratings was completed. The DEBQ was administered after taking part in both conditions. Height and weight were measured using a stadiometer (Leicester Height Measure, distributed by Seca Limited, Birmingham) and portable scales (Seca 770, Hamburg, Germany). Finally, the experimenter explained the true nature of the study.

### *Design and data analysis*

A mixed factorial design was employed in this study. The main hypotheses were analysed using ANOVA and simple effects were examined using Bonferroni tests. Given the high significant correlation between restraint score and BMI ($r = .48$, $p < .05$), it was not possible to account for the significantly higher BMI of the high-restraint relative to the unrestrained group in ANOVA (removing one statistically might act to remove the effect of the other variable). Therefore, in order to account for these differences, and to assess the relative contributions of BMI, restraint and emotional eating to intake, multiple regression analyses were conducted to examine intake in each of the two conditions. All tests were two-tailed, with $\alpha$ set at .05. Data are presented as mean ± standard error.

## Results

### *Mood measures*

Separate ANOVA on mood ratings revealed no significant differences at baseline for any of these measures, demonstrating that participants arrived for each session in similar mood states. Further analyses, using 2 (restraint or emotional status) × 2 (condition) × 3 (time-point) ANOVA revealed only main effects of time for all three VAS measures, indicating that anxiety and stress increased post-task and decreased post-intake (anxiety: $F(2,48) = 7.3$, $p < .01$, $\eta_p^2 = .23$; stress: $F(2,48) = 8.1$, $p < .01$, $\eta_p^2 = .25$), with the opposite pattern for relaxation, $F(2,48) = 6.7$, $p < .01$, $\eta_p^2 = .22$. Analysis of simple effects revealed that anxiety increased significantly ($p < .01$) from baseline ($\mu = 21.2$, SE = 3.8) to post-task ($\mu = 31.0$, SE = 4.7) whereas for stress rating this only approached significance (baseline $\mu = 29.9$, SE = 3.7; post-task $\mu = 36.7$, SE = 4.6; $p = .07$). Both ratings decreased significantly ($p < .01$) after consuming the snacks (anxiety $\mu = 20.5$, SE = 3.3; stress $\mu = 23.0$, SE = 3.6). There was a non-significant reduction in relaxation from baseline ($\mu = 62.8$, SE = 3.9) to post-task ($\mu = 53.2$, SE = 4.8) but a significant increase post-food ($\mu = 66.1$, SE = 4.4, $p < .01$).

Positive and negative affect were analysed using 2 (restraint or emotional eating status) × 2 (condition) × 3 (time point) ANOVA and revealed no main effects or interactions for negative affect. However, there was a significant condition × time interaction for positive affect, $F(2,48) = 7.5$, $p < .01$, $\eta_p^2 = .24$. Inspection of the data (see Fig. 1) indicates that positive affect decreased post-task after ego-threat, then increased to a level similar to baseline after access to the snacks. The opposite pattern was found in the neutral condition.

### *Intake*

Analysis of total weight of food consumed found that similar amounts were consumed in both conditions (ego-threat $\mu = 98.7$, SE = 9.7 g; neutral $\mu = 103.6$, SE = 10.2 g; $F(1,24) = .49$, $p > .4$). However, relative to unrestrained, high restraint individuals suppressed overall intake by 31.8% (restrained $\mu = 82.1$, SE = 11.1 g; unrestrained $\mu = 120.3$, SE = 13.3 g, $p < .05$, $\eta_p^2 = .17$). The interaction between condition and restraint approached conventional significance, $F(1,24) = 3.2$, $p = .08$. Inspection of the means indicated that unrestrained individuals consumed slightly more after ego-threat ($\mu = 124.0$, SE = 11.9 g) than after the neutral task ($\mu = 116.5$, SE = 14.3 g) whereas the opposite pattern was found for high restraint participants (ego-threat $\mu = 73.4$, SE = 11.9 g; neutral $\mu = 90.8$, SE = 10.3 g). This pattern did not emerge for emotional eating status.

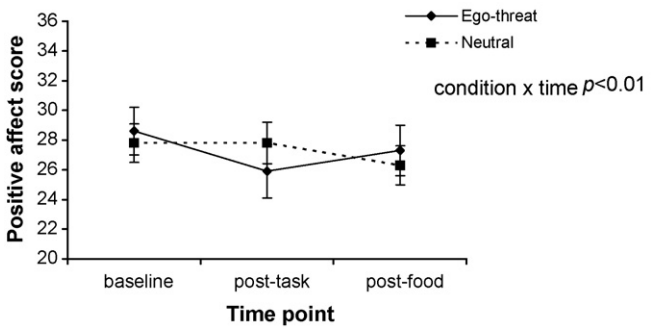


**Fig. 1.** Mean (±SEM) positive affect ratings at the three time points in the two conditions.

Analyses of amount of each food type consumed were conducted using separate repeated measures ANOVA. Comparisons of intake by emotional and non-emotional eaters found little difference between amounts of each food consumed in each condition. Relative to unrestrained, high restraint individuals inhibited intake of chocolate, regardless of condition, but this only approached significance, $F(1,24) = 3.9$, $p = .06$, $\eta_p^2 = .14$. However, analysis of dried fruit intake revealed a significant condition × restraint group interaction, $F(1,24) = 4.2$, $p < .05$, $\eta_p^2 = .15$. Unrestrained individuals consumed similar amounts in the ego-threat and neutral conditions. However, in high restrained eaters, intake of dried fruit was suppressed by 33.2% after ego-threat relative to the neutral task, $t(12) = 2.4$, $p < .05$, $d = 0.5$. See Fig. 2 for a full illustration of intake data.

### *Predicting intake using multiple regression analyses*

Hierarchical multiple regression analyses were conducted to assess the contribution of restraint and emotional eating to intake in each condition. As high restraint participants had a significantly higher BMI than unrestrained, this was entered as a covariate in the first block (enter method). As there was no significant collinearity

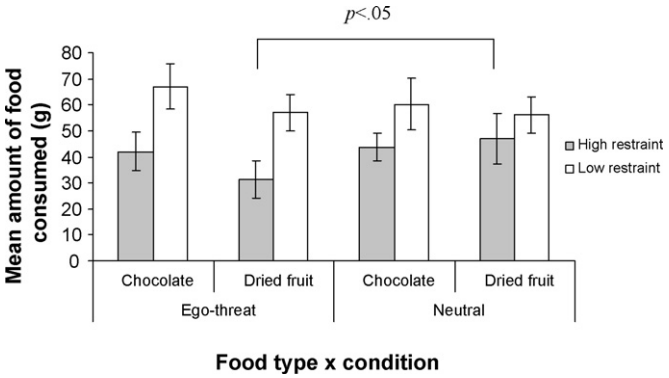


**Fig. 2.** Mean grams (±SEM) snack foods consumed in each condition by high and low restrained eaters.

between restraint and emotional eating scores ($r = .1$, $p = .6$) these two variables were added in the second block (stepwise method).

Significant models emerged for weight of food and energy consumed only in the ego-threat condition. BMI and emotional eating did not contribute to intake. However, restraint was a significant predictor such that higher scores indicated lower consumption. Restraint accounted for 31% of the variance in grams consumed, $F(2,23) = 5.2$, $p < .05$, and 27% of the variance in energy consumed, $F(2,23) = 4.3$, $p < .05$ (model for weight is illustrated in Table 3). Overall, this provides further evidence that restrained eaters exhibited successful inhibition of intake after ego-threat.

### *Appetite ratings*

Analyses of hunger and fullness (100 mm VAS) revealed no condition or individual differences at baseline. A significant condition × time × restraint status interaction for hunger ratings, $F(2,48) = 3.6$, $p < .05$, $\eta_p^2 = .13$, was explored further using separate 2 (condition) × 3 (time point) ANOVA for high and unrestrained groups.

Significant condition × time interactions were found for both the high, $F(2,24) = 4.0$, $p < .05$, $\eta_p^2 = .25$, and the unrestrained groups, $F(2,24) = 3.5$, $p < .05$, $\eta_p^2 = .23$. Paired *t*-tests revealed a significant increase in hunger (baseline = 36.5, SE = 5.5; post-task = 72.4, SE = 6.1) for the high restraint group after ego-threat, $t(12) = 2.4$, $p < .05$, $d = 0.14$, and a significant decrease (baseline = 60.9, SE = 6.6; post-task = 52.3, SE = 6.8) after the neutral task, $t(12) = 2.7$, $p < .05$, $d = 0.2$. A similar, but non-significant pattern emerged for the unrestrained group. These findings indicate that ego-threat was associated with increased hunger in restrained individuals, even though they consumed significantly less than those in the unrestrained group.

Analysis of fullness ratings produced a pattern largely consistent (i.e. opposite direction of changes) with hunger ratings. Closer inspection of a significant condition × time interaction, $F(2,48) = 4.1$, $p < .05$, $\eta_p^2 = .15$, found that ratings were similar at baseline (ET $\mu = 17.3$, SE = 2.6; Neutral $\mu = 19.3$, SE = 3.2) and post-task (ET $\mu = 15.8$, SE = 2.3; Neutral $\mu = 17.4$, SE = 2.7) in both conditions. Paired *t*-tests revealed that the increase in fullness from post-task to post-food was significant in both conditions (ego-threat: $t(25) = 5.3$, $p < .001$, $d = 1.6$; neutral: $t(25) = 11.3$, $p < .001$, $d = 2.7$). However, fullness was significantly greater after snack intake in the neutral than in the ego-threat condition, $t(25) = 2.7$, $p < .05$. This indicates that despite eating similar amounts in the two conditions, participants reported feeling less full after the ego-threatening stressor. Therefore, it is possible that stress may inhibit normal satiety sensations.

A significant condition × restraint interaction was also found for fullness ratings, $F(1,24) = 4.6$, $p < .05$, $\eta_p^2 = .16$. Inspection of the means suggests that there was no difference between conditions for unrestrained participants (ego-threat $\mu = 28.2$, SE = 2.6; neutral $\mu = 28.6$, SE = 2.9). However, for high restraint participants overall fullness ratings were significantly greater, $t(12) = 2.8$, $p < .05$, $d = 0.8$, in the control ($\mu = 37.5$; SE = 3.8) than in the ego-threat condition ($\mu = 26.1$; SE = 3.7). In line with hunger ratings, this might suggest a blunting of satiety sensations in high restraint participants in the ego-threat condition.

**Table 3**
Hierarchical multiple regression analysis predicting intake (total grams consumed) in the ego-threat condition.

| | *b* | SE *b* | *β* |
|---|---|---|---|
| Step 1 | | | |
| BMI | −.8 | 2.3 | −.08 |
| Step 2 | | | |
| BMI | 2.6 | 2.2 | 0.23 |
| Restraint | −33.9 | 10.6 | −.63* |

$R^2 = .006$ at step 1; $\Delta R^2 = .31$ at step 2.
* $p < .05$.

## Discussion

The aim of this study was to assess the contribution of restrained and emotional eating to intake of high- and low-fat sweet snack foods after completing ego-threatening and neutral tasks. In line with previous findings (Lattimore & Maxwell, 2004; Wallis & Hetherington, 2004), the tasks were similar in their effect on mood; post-task negative mood ratings were higher than baseline and returned to baseline levels after the snack period in both conditions. Measures of positive mood produced a pattern consistent with these changes. It was predicted that ego-threat would guide restrained and emotional eaters towards a 'forbidden' high-fat snack food (chocolate) rather than a low-fat alternative (dried fruit mix). Contrary to expectations, similar amounts of both foods were eaten in both conditions. Emotional eating did not contribute towards intake. However, examination of differences associated with restraint status produced some interesting, although unexpected findings.

Overall, high restraint participants maintained restriction of chocolate regardless of condition. However, examination of dried fruit intake revealed that unrestrained individuals consumed similar amounts in each condition, whereas high restraint was associated with relative restriction of this food after ego-threat compared with the neutral task. This was reflected in the regression analyses; although caution should be expressed due to the small sample size, these indicated that the lower intake of restrained eaters was associated only with the ego-threat condition. Interestingly, appetite ratings revealed that these individuals reported increased hunger after ego-threat, whereas the opposite was observed in the neutral condition. This pattern was not displayed in unrestrained participants. These findings suggest that high restraint individuals were successful in their attempt to limit intake, despite being more hungry after the ego-threat task, and indeed, they consumed less in both conditions relative to unrestrained individuals.

One possible explanation for these findings is that the dried fruit represented an inhibitory, diet-related cue, causing restrained individuals to successfully restrict chocolate, regardless of condition. However, this does not explain clearly why this group restricted intake of dried fruit after ego-threat relative to the neutral task. It might be simply that selective restriction of this food was preferable to restriction of chocolate after ego-threat. Alternatively, it is possible that these findings may be at least partially explained by the relatively low median scores for restraint (2.6) and emotional eating (2.5). These scores are somewhat lower than those observed in some of the research that has used similar methods (e.g. Wallis & Hetherington, 2004). Furthermore, the small to medium effect sizes observed suggests caution in the interpretation of findings. However, this is a preliminary study and as such, deserves replication and extension in order to confirm and clarify these effects.

## General discussion

These studies demonstrate that survey and experimental methods of assessing stress-induced eating do not always produce complementary findings. The survey found reported changes in eating under stress for emotional but not for restrained eaters. However, the experimental study found differences for restrained eaters only, although not in the predicted direction. In contrast to

some experimental findings, restrained eaters did not disinhibit intake after ego-threat relative to the neutral task. In fact, their pattern of intake suggests that dried fruit might act as a diet reminder, although it was restrained eaters' intake of dried fruit, and not chocolate, that was suppressed in the ego-threat relative to the neutral condition. Experimental evidence indicates that the disinhibition effect associated with ego-threat and challenging conditions is influenced by the type and variety of foods made available. The findings of the survey suggested that a potential intervention for those who use foods as a coping strategy could be the provision of healthier snack foods. Furthermore, the experiment suggests that the presence of a low-fat alternative might reduce the likelihood of disinhibition occurring in response to situations that might normally induce overeating.

Overall, the pattern of previous findings might suggest that restrained eaters will disinhibit after stress manipulations only when presented with a single high-fat food (e.g. Wallis & Hetherington, 2004) or multiple high- and low-fat items (e.g. Lattimore & Maxwell, 2004). However, the evidence for the latter proposal is equivocal. Studies that have presented a single high-fat food item (e.g. ice-cream or chocolate) tend to find the restraint × stress interaction (e.g. Boon, Stroebe, Schut, & Ijntema, 2002; Heatherton et al., 1991; Lattimore, 2001; Polivy & Herman, 1999; Tanofsky-Kraff et al., 2000). Ward and Mann (2000) presented a range of high-fat items only and also found this effect. However, studies that have included a more varied selection of foods do not necessarily demonstrate disinhibition in restrained eaters (e.g. Oliver et al., 2000). When presented with multiple items, it is possible that restrained eaters are simply responding to variety, which stimulates intake in all individuals (Rolls & Hetherington, 1989). This occurs not only in the laboratory but also in real-world environments (Zandstra, de Graaf, & van Trijp, 2000). In the present study only two foods were presented (one high- and one low-fat sweet snack food) and restrained individuals were successful in their attempt to restrict intake in both conditions. This might suggest that, if given a choice of a single high-fat and a single low-fat snack food this would reduce the likelihood of disinhibition in restrained eaters, possibly because the low-fat item acts as a diet reminder. In contrast, presentation of only a single high-fat palatable food might increase the likelihood of disinhibited eating, as there is no low-fat alternative. This is consistent with Mann and Ward (2004) attentional myopia explanation, which proposes that narrowing attention to a task high in cognitive load results in disinhibited eating when cues promoting action are more salient (e.g. cues relating to the taste of food), whereas when inhibiting cues are more salient (e.g. diet cues), restraint is maintained.

There are a number of limitations to the survey that necessitate caution in interpretation of the data. This brief survey of female college students had a limited sample size and restricted age range, factors which constrain the generalisability of the findings. Furthermore, by its nature, this method relies on self-reported assessment of behaviour and simple tests of association. Despite these concerns, the findings are generally consistent with similar survey studies. However, this study suggests slight differences in eating-related responses to general and specific stress and therefore highlights the need to consider these separately in any future research based on self-report measures. Although, in contrast to findings from laboratory research, there was no association between restraint status and stress-related eating, the survey provides evidence that emotional eating might be a crucial factor in the stress–eating relationship, at least when examined by self-report methods. On the other hand, it must be acknowledged that a further, unmeasured variable might be responsible for these findings.

Evidence suggests that relative levels of restrained and emotional eating might be associated with differences in affective responses (e.g. Macht & Mueller, 2007) and in chocolate intake after ego-threatening and cognitively demanding tasks (e.g. Wallis & Hetherington, 2004). It was not possible to examine these potential interactive effects in either of the studies reported here. However, future research should aim to examine this further. Additional limitations of the experimental study include a relatively small sample size, although this study benefitted from within-subject comparisons and thus minimised unexplained variance associated with individual differences. It also remains to be seen whether the findings from the experimental study can be replicated under conditions of high demand as well in association with the ego-threat related stimuli reported here. Furthermore, additional research is required to clarify the types of ego-threat that are associated with increased or decreased eating and changes in food choice.

In conclusion, the survey supported a link between emotional eating and unhealthy changes in food choice, whereas the experimental study provided evidence that for restrained eaters, the type and variety of foods offered can also predict intake in the laboratory. Providing a single low-fat alternative alongside a single high-fat food resulted in maintenance of restraint following ego-threat. These findings could have implications for interventions designed to promote healthy changes in food choice, particularly in those susceptible to eating under conditions of emotional stress. However, the exact nature of such interventions remains to be tested.

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