EATING BEHAVIOR FOLLOWING STRESS IN WOMEN WITH AND WITHOUT BULIMIC SYMPTOMS[1]

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ABSTRACT

Objective: *This study examined the effects of an interpersonal stressor on subsequent calorie intake in females with* (N = *20) and without* (N = *20) significant bulimic symptomatology.* Method: *Subjects participated in two laboratory sessions that differed according to experimental condition (stress versus no stress), completed self-report measures of mood and anxiety before and after the experimental task, and were provided with an array of snack foods after each session.* Results: *Counter to the hypothesis, women with bulimic symptoms did not differentially increase their intake when exposed to stress. However, results for the intake of each macronutrient indicated that both bulimic and control women increased their consumption of carbohydrates following the stressor. Thus, stress was related to increased carbohydrate consumption by all subjects but did not differentially affect the consumption of women with bulimic symptoms.* Conclusions: *It may be that women with bulimic symptoms are not differentially vulnerable to eating in response to stress or that current laboratory paradigms are unable to detect differences in eating following a stressor.*

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INTRODUCTION

Bulimic symptomatology is widespread and problematic among college-aged women. Although only 0.5–2.0% of young adult women meet diagnostic criteria for bulimia nervosa, as many as 19% of young adult females suffer from subclinical binge eating problems (1,2). Substantial clinical data have implicated psychosocial stress in the etiology and maintenance of bulimic symptoms. Stress has been associated with the onset of bulimia nervosa (3) and the exacerbation of eating disorder symptoms (4). Stress and negative affect have also been related to the initiation of binge eating episodes (5–8), and researchers have hypothesized that binge eating serves as an escape from aversive self-awareness (9) or an attempt to elevate mood (10). However, despite correlational data that support an association between stress and eating, the nature of this relationship in women with eating disorder symptoms remains unclear, and controlled laboratory studies of stress-induced eating in this population are lacking.

Laboratory investigations of the effects of a stressor on subsequent eating behavior have been frequently used in the study of human eating behavior (for review see 11) and may help to elucidate the effects of stress on eating in women with bulimic symptoms. Controlled laboratory investigations of stress-induced eating, however, primarily have focused on either overweight subjects or habitual dieters, not on individuals with disordered eating. In particular, restraint theory[2] (12) has generated a considerable and relatively consistent body of laboratory research on stress and eating. College females, dichotomized according to their self-reported degrees of habitual dietary restraint, have been shown to increase their food consumption in response to experiencing frustrating failure situations (13), reading negative self-referent statements (14), watching provocative film segments (15,16), composing an advertising jingle (17), and anticipating speeches (18). Consistently, stressful events designed to disrupt the restrained eater's cognitive control over eating have resulted in measurable increases in consumption among female restrained eaters.

Nevertheless, two important lines of evidence suggest the need for further consideration of stress-induced eating among individuals with specific bulimic symptomatology. First, although dietary restraint is common among women who binge eat (19,20) and although some form of dietary control is pathognomonic of bulimia nervosa, dietary restraint is not specific to individuals with bulimic symptomatology. In fact, a majority of college-aged women endorse some degree of dietary concern, and researchers have described restrained eating as normative behavior among young Caucasian women (21). Second, recent studies have revealed inconsistencies in findings from the restraint literature (22–25). Restraint theory presumes that individuals who score high on assessments of dietary restraint display a uniform pattern of attitudes toward eating and that this pattern typifies all dieters. However, eating behavior appears to be more complex than the phenomena explained by the restraint construct (26). In particular, there has been conceptual confusion within the restraint literature between concern with dietary intake and the actual restriction of intake.

To date, only one study (27) has utilized a laboratory paradigm in the investigation of stress-induced eating in women with eating disorder symptoms. However, in this study, actual consumption following the stressor was not measured. Cattanach, Malley, and Rodin (27) investigated the physiological and affective reactivity of college females who reported high levels of eating disorder symptomatology and found an interaction between subjects' "urge to binge" and stress. Specifically, stress had a greater effect on the desire to binge in the subjects with eating disorder

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[2] According to restraint theory, individuals who chronically attempt to restrict food intake (i.e. "restrained eaters") exert cognitive controls over eating that supersede hunger and satiety sensations. Since the eating of habitual dieters is thus cognitively mediated, restraint theory postulates that events designed to override cognitive control, such as ingestion of a preload or emotional distress, should trigger overeating. Indeed, the failure to regulate the amount eaten following a preload ("counterregulation") in women who endorse a pattern of restrained eating has been frequently observed (e.g. 12,30).

symptoms than in the controls. In addition, eating-disordered subjects' desire to binge was affected to a greater extent by the interpersonal and social stressors than by other stress tasks. Although these data offered preliminary support for the hypothesis that stress induces eating in women with eating disorder symptoms, questions concerning the actual consumption subsequent to a stressor remain unanswered.

Accordingly, in the present investigation, we sought to determine whether changes in actual intake following a stress task differed between females with bulimic symptomatology and their asymptomatic peers. We also attempted to address limitations of previous studies by enhancing the ecological validity of the study design. Because social and interpersonal stressors have been frequently implicated in the initiation of a binge episode (3,28), we utilized an interpersonal stress task which has been shown to generate significant levels of anxiety (18,27). In addition, we offered a variety of food choices in an effort to account for potential differences in food preferences and provide a more valid analogue of natural eating behavior. Previous studies have generally offered only one food item (e.g. 17,18). However, this strategy not only poorly mirrors real life food choices, but may affect the results since the type of food presented has been shown to affect the amount consumed during stress (29). Finally, in response to previous citations of wide variability in calorie intake (e.g. 30), we used a repeated measure study design. Thus, in the choice of stressor, presentation of an array of food, and use of a within-subjects comparison, we sought to improve upon the designs of previous laboratory investigations of stress-induced eating.

METHOD

Study Design

The investigation used a 2 × 2 repeated measures design with group (symptomatic versus control) as the between-subject factor and condition (stress versus no-stress) as the within-subject factor. The order of conditions (stress versus no-stress) was counterbalanced across subjects. Subjects participated in two 60-minute sessions that differed according to experimental condition, stress (S) and no-stress (NS). In both conditions, subjects completed a brief neuropsychological battery (included as a sham task to disguise the purpose of the study) and ratings of hunger. During the stress condition, subjects were directed to prepare and deliver a speech about themselves. During the no-stress control condition, subjects were asked to relax quietly. Mood and anxiety were assessed before and after both experimental tasks. Following the task in both conditions, subjects were provided with an array of snack foods, and the number of calories consumed during the snack period was calculated.

Sample size was estimated through power calculations (31) based on the effect size found in a previous study using a non-clinical sample (18). Power calculations indicated that a repeated measures design with 20 subjects per group and an alpha of .05 had power of .80 to detect main effects and interactions.

Subjects

Subjects were 40 healthy, normal weight college females selected from the undergraduate psychology subject pool at the University of Pittsburgh. All subjects received course credit for their participation. On average, subjects were 18.5 (SD = 1.0) years of age and had a Body Mass Index (BMI) [weight (kg)/height $(m)^2$] of 22.4 (SD = 2.2). Thirty-nine of the 40 women were Caucasian; one woman was Asian.

TABLE 1
Subject Characteristics for Symptomatic (BUL) and Non-Symptomatic (CON) Subjects

Characteristic	BUL (N = 20)		CON (N = 20)		t (df = 38)	p-value
	M	(SD)	M	(SD)		
Age (years)	18.6	(1.2)	18.4	(0.8)	0.60	.55
Weight (lb)	135.2	(9.9)	135.2	(17.0)	<.00	1.00
BMI	22.6	(2.1)	22.2	(2.3)	0.69	.49
BULIT-R	100.2	(10.3)	43.5	(4.2)	22.90	<.001
Global Sx Index	1.3	(0.6)	0.5	(0.4)	4.70	<.001
Restraint	24.9	(3.9)	14.2	(3.8)	8.77	<.001
Social Desirability	13.1	(4.9)	15.0	(5.9)	1.08	0.29

Note: Global Sx Index = Global symptom index from the SCL-90-R; indicates an average number of symptoms and their severity (i.e. sum of scores/90).

Subject Selection: Female students in psychology classes (N = 314) volunteered to complete a packet of questionnaires consisting of the Bulimia Test-Revised (BULIT-R), a well-validated self-report assessment of bulimic symptomatology (32); the Restraint Scale (RS) (33), a measure of habitual dietary restraint; the Symptom Checklist (SCL-90-R) (34), a 90-item self-report assessment of psychiatric symptomatology; and an eligibility questionnaire designed to determine subjects' eligibility to participate in a study described as "an investigation of mood, hunger, and performance under different situations and at different times."

Individuals reporting serious medical problems, pregnancy, alcohol or substance abuse, use of psychotropic medications, psychiatric diagnoses other than an eating disorder, and body weights above or below 15% of ideal body weight for their height (35) were excluded from further consideration. Two hundred and fourteen subjects met these preliminary screening criteria.

Subjects (N = 40) were then selected according to responses on the BULIT-R. A cutoff score of 88 (the top 10% of the sample) was used to select subjects with significant bulimic symptomatology (BUL). Thelen et al. (32) found that 37/38 subjects with bulimia nervosa comprised the top 10% of their sample of non-clinical women. Thus, we believed that the top decile was likely to represent a group with clinically significant bulimic symptoms. Women with scores in the 25–50 percentile range of all scores who did not report a history of an eating disorder served as asymptomatic controls (CON). Control subjects were selected from the second quartile because we believed this group to be more representative of a normal comparison group than women in the lowest quartile. As shown in Table 1, the selection criteria employed resulted in groups that differed significantly on BULIT-R scores, but did not differ in age, weight, or BMI.

Scheduling Procedure

The experimenter, who was blind to subjects' symptom status, contacted subjects by telephone to ask them to participate in the investigation. Women who agreed to participate were scheduled for two experimental sessions within a five-day period and were tested in the late afternoon (between 4:00 and 8:00 pm), a time when binge behavior is commonly reported (e.g. 36). Five women refused to participate due to scheduling conflicts or already having fulfilled their class credit requirements.

During this scheduling call, the women were reminded that the purpose of the investigation was to study mood and performance during different situations and at different times, and that

the investigators were interested in the effects of different moods on the ability to perform behavioral and cognitive tasks. To control for expectancy effects, subjects were informed that during each laboratory session they would be assigned to one of four possible experimental conditions, although only two experimental conditions were actually used (i.e. speech preparation and delivery versus relaxation). The four possible conditions were described as: (a) preparing and delivering a personal speech, (b) watching an emotionally disturbing film, (c) performing a stressful computer task, and (d) relaxing.

It was then explained that because food intake could affect performance on the behavioral and cognitive tasks, all subjects were being asked to refrain from eating for a few hours prior to each laboratory session. Subjects were not informed of our interest in the amount they ate, since a pretest awareness might have increased their inhibition toward eating in the laboratory or otherwise altered their eating behavior. Subjects were instructed to eat their typical breakfast and lunch and to fast for a minimum of 3.5 hours after lunch prior to the test session. Finally, the experimenter explained that a snack would be provided since we were asking them to refrain from eating for a considerable number of hours.

Experimental Procedure

Upon the subject's arrival at the initial session, the protocol was explained and compliance with the meal and fasting instructions was assessed. Subjects were directly queried by the experimenter about the foods eaten for breakfast and lunch and the times of these meals. Subjects also rated their level of hunger on a ten-point scale and completed baseline measures of mood [Profile of Mood States (POMS)] (37) and anxiety [State Trait Anxiety Inventory (STAI)] (38). All women reported that they had complied with the meal and fast instructions, and there were no differences between the groups in the length of the fast, $t(38) = 1.56$, $p = .13$, or levels of hunger, $t(38) = 0.98$, $p = .33$. There were also no differences in the length of the fast, $t(39) = 0.90$, $p = .38$, or subjective hunger, $t(39) = 0.89$, $p = .38$, between the two experimental sessions. On average, subjects fasted 4.6 ($SD = 0.7$) hours prior to each laboratory session.

Next, subjects completed a brief battery of neuropsychological tests and the STAI and POMS for a second time. The tests were administered as a sham task to maintain the explanation of the study as an "investigation of mood, hunger and performance."

Subjects were then assigned to either the Stress (S) or No-Stress (NS) condition in a counterbalanced order. In the stress condition, women were instructed to prepare and deliver a three-minute speech about their negative qualities, a task that has been effective in eliciting both physiological stress responses and an urge to binge eat in previous studies (18,27). The following script was read to subjects in the stress condition:

> *Today you have been assigned to the personal speech condition. Your task is to prepare and deliver a three-minute speech about your negative qualities. You should focus on aspects of your personality and things that you do that you don't like about yourself or that others don't like about you. It is important to address how these faults affect your relationships with others, such as your friends and family. You will present your speech in front of me, and I will be videotaping it so that it can be rated by a panel of psychology graduate students. The raters will be looking for how effectively you can deliver a speech and how likeable you are as a speaker. I'll show you a copy of the rating form the panel will use, and you'll see that your speech will be judged for a variety of qualities such as its openness, defensiveness, honesty, organization, and grammatical style.*

Subjects were given a copy of a rating form to read while the experimenter left the room and returned with a video camera. Subjects were then provided with paper and left alone for five minutes to prepare their speech. When the experimenter reentered the room the second time, subjects completed a final, posttask assessment of mood and anxiety, and, to maintain the credibility of the experimenter's description of the study, all subjects delivered their speech to the camera (although the camera was not actually recording).

During the no-stress, control condition, women were told that they had been assigned to the relaxing and reading condition. They were provided with nature magazines and picture books and left alone for five minutes. To ensure that the timing of the mood assessments was consistent with that used in the stress condition, subjects completed the posttask mood questionnaires (STAI and POMS) after five minutes of relaxing, then continued to read and relax for an additional five minutes.

Upon completion of the experimental task in both conditions, subjects were told that they had almost finished for that day and that they would need to answer a few additional questions before leaving. The experimenter explained that before the last questions could be completed she needed "to check over my things to make sure that everything is complete, which generally takes me about ten minutes. Because I know that you haven't eaten for a while, I'll be taking you to another room where there are some snacks, and you can hang out there while you are waiting." Subjects were then led to a separate room where an array of foods consisting of M&Ms, miniature chocolate chip cookies, cheese crackers (Ritz), potato chips, pretzels, and small boxes of raisins were displayed on a table along with some magazines, a pitcher of water, and several glasses. The experimenter casually gestured toward this table and told subjects to help themselves to whatever they wanted.

Four of the six foods chosen for this study (M&Ms, cookies, cheese crackers, and potato chips) were selected to be food types often preferred by binge eaters (i.e. sweets, salty snacks, cookies, and pastries) (39) and were thus high in both fat and calories. Pretzels and raisins were selected to provide an adequate range of food types and macronutrients. The foods were presented in bowls that had been weighed and were filled so that the amount eaten would not be detectable upon visual inspection. In addition to helping to disguise our measurement of their eating, an abundance of food was offered in an effort to increase subjects' perceptions that these snacks were available for several people.

Subjects were left alone in this room with the food for ten minutes. The experimenter then returned and subjects completed a final set of questions that differed according to the day of testing. On the first day of testing, regardless of condition, subjects completed the Marlowe-Crowne Social Desirability Scale (MCSDS) (40), an assessment of the extent to which an individual attempts to conform to perceived societal norms. At the conclusion of the second and final session, women completed ratings of food preferences for the foods used in the investigation and a postexperimental questionnaire asking them to comment on the purpose of the study. Subjects were asked to rate on a ten-point Likert scale (1 = not at all convinced and 10 = extremely convinced) the extent to which they were convinced we were interested in their mood and performance. Food preferences for the foods used in the investigation were also assessed by ratings on a ten-point Likert scale ranging from "very strongly dislike" to "very strongly enjoy."

After subjects were dismissed, food bowls were weighed on a balance beam food scale and the amount eaten was determined by subtracting the postsession weight from the presession weight. Calories and macronutrient content per gram of food were determined using the information provided on the nutrition labels of each product. The caloric content was then summed for all the foods. Macronutrient calories were also added across each of the foods, and the percentage of carbohydrates, fat, and protein for each subject was calculated.

RESULTS

Baseline Differences Between Symptomatic and Control Subjects

A series of t-tests was conducted to examine differences between BUL and CON subjects on baseline characteristics relevant to the investigation. A Bonferroni correction was applied to control for multiple comparisons completed with data from the SCL-90-R, reducing the alpha level to .005 for these comparisons. Consistent with previous reports, BUL subjects reported significantly higher levels of overall psychiatric distress, $t(38) = 4.70$, $p < .001$ (Table 1). As expected, BUL subjects also endorsed significantly higher levels of dietary restraint than CON controls, $t(38) = 8.77$, $p < .001$. However, there were no differences between the groups in social desirability, $t(38) = -1.08$, $p = .29$.

Stress Manipulation

To examine the effectiveness of the stress manipulation, a 2 (group: BUL versus CON) × 2 (condition: S versus NS) × 3 (time: Baseline versus Premanipulation versus Postmanipulation) repeated measures analysis of variance (ANOVA) was conducted with self-reported anxiety (i.e. STAI scores) as the dependent measure. As expected, there was a significant Condition × Time interaction, $F(2,76) = 80.41$, $p < .001$. Paired t-tests comparing changes in anxiety from premanipulation to postmanipulation between the two conditions were then used to examine the condition by time interaction as per the a priori hypotheses. As Figure 1 illustrates, anxiety increased after the stress manipulation and decreased following relaxation for all subjects. Mean changes were 9.88 (SD = 8.09) in the stress condition and −5.88 (SD = 4.96) in the no-stress condition, $t(39) = 9.8$, $p < .001$. In addition, the main effects of group, $F(1,38) = 8.79$, $p = .01$, and condition, $F(2,76) = 28.83$, $p < .001$, were significant. BUL subjects consistently reported more anxiety than did the controls, and all subjects reported more anxiety in the stress condition than the no-stress condition.

Results of separate 2 (group) × 2 (condition) × 2 (time) repeated measures ANOVAs using the negative affect subscales of the POMS (i.e. tension, dejection, and anger) as dependent measures confirmed the effectiveness of the stress manipulation (all $ps < .001$). Differences between BUL and CON subjects' affective responses to the stress manipulation and changes in mood over the period from baseline to immediately prior to the manipulation (i.e. following the neuropsychological tests) were also explored, and no significant differences between the groups were found. Thus, the results for anxiety and negative affect indicated that the stress manipulation successfully elevated anxiety and negative affect.

Stress-Induced Eating

Total Intake: To test the primary hypothesis of a difference in intake following the stressor between BUL and CON subjects, a 2 (group: BUL versus CON) × 2 (condition: NS versus S) repeated measures ANOVA was conducted using the total calories eaten as the dependent measure. As shown in Table 2, the groups did not differ in the total number of calories consumed, $F(1,38) = 1.71$, $p = .20$. Moreover, the hypothesized interaction between symptom status and condition was not observed, $F(1,38) = 1.58$, $p = .22$, indicating that the difference in caloric intake between the stress and no-stress conditions was, on average, similar for both BUL and CON subjects. Although the interaction was not significant, a separate one-way repeated measures ANOVA (condition: NS versus S) revealed a non-significant trend, shown in Figure 2, for the caloric intake of BUL subjects to be greater following the stressor, $F(1,19) = 3.76$, $p = .07$. In contrast, the intake of the CON subjects did not change between the two conditions, $F(1,19) = 0.13$, $p = .72$. Specifically, BUL subjects increased their intake by an average of 64.0 (SD = 147.4) calories in the stress condition, compared to an increase of 10.1 (SD = 122.8) calories by the CON subjects.

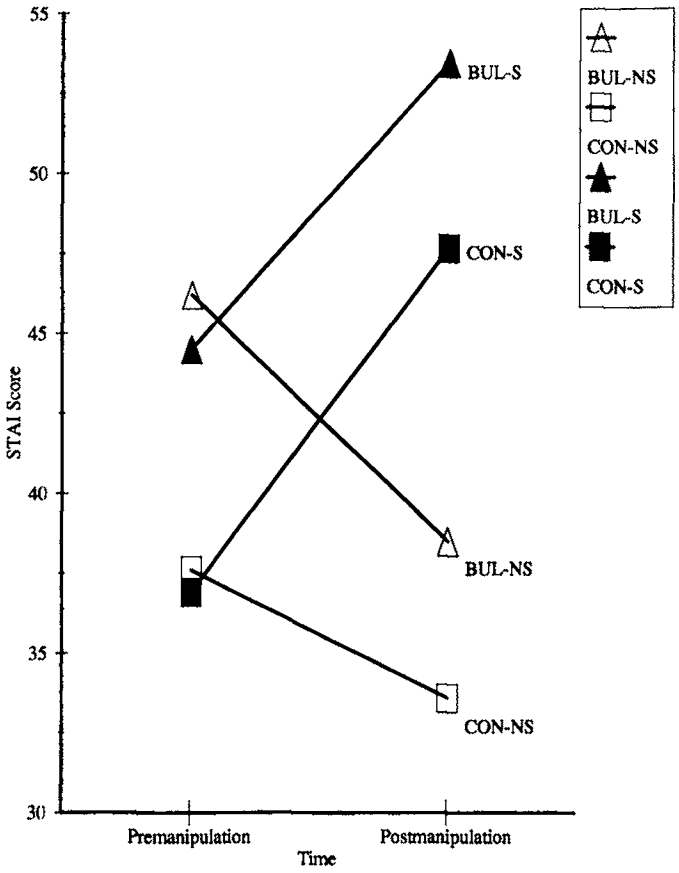

FIGURE 1: Anxiety scores pre- and poststress manipulation for symptomatic (BUL) and control (CON) subjects in stress (S) and no-stress (NS) conditions.

The effect of the speech task on the amount eaten did not appear to be related to hunger or the length of the fast. For both conditions, correlations between the amount of calories consumed and both subjective hunger and the number of hours fasted were not significant (r values ranged from −.12 to .04). Subjects' beliefs about the purpose of the experiment, ratings of self-consciousness while eating, and the relationship between these variables and consumption were also explored. Interestingly, there was a tendency for BUL subjects to report feeling more self-conscious while eating than the controls, $t(38) = 1.87$, $p = .07$, but ratings of self-consciousness were not related to intake (r = .08 and .10 for

TABLE 2
Means and (Standard Deviations) of Calories Eaten by Food Types and Macronutrient Content for Symptomatic (BUL) and Control (CON) Subjects

	Group				ANOVA Results					
	BUL		CON		Group		Condition		Interaction	
	No-Stress	Stress	No-Stress	Stress	F	*p*	F	*p*	F	*p*
Total Calories	191.9 (126.8)	255.5 (159.5)	287.7 (231.0)	297.8 (186.0)	1.71	.20	2.98	.09	1.58	.22
Binge Calories	100.9 (100.2)	139.3 (147.0)	246.4 (226.6)	275.2 (251.4)	6.05	.02	6.12	.02	0.13	.73
Non-binge Calories Macronutrients	91.0 (96.1)	100.6 (85.8)	41.3 (46.6)	49.7 (49.0)	5.43	.03	1.27	.27	0.01	.94
Carbohydrates (KCal)	102.1 (87.8)	142.2 (104.2)	147.8 (119.1)	162.7 (111.7)	1.06	.31	7.40	.01	1.56	.22
Fat (KCal)	50.5 (47.5)	72.8 (64.3)	116.3 (105.3)	108.3 (72.6)	5.65	.02	0.44	.51	2.00	.17
Protein (KCal)	11.0 (10.6)	14.8 (11.7)	14.6 (12.9)	14.6 (8.9)	0.28	.60	2.05	.16	2.17	.15
Carbohydrate %	47.5 (21.4)	51.1 (20.2)	45.2 (21.3)	56.4 (11.7)	0.09	.76	5.05	.03	1.35	.25
Fat %	25.9 (16.5)	26.4 (14.7)	33.9 (19.2)	32.9 (13.9)	2.51	.12	0.01	.90	0.12	.74
Protein %	5.1 (2.6)	5.3 (2.8)	4.7 (2.6)	5.7 (2.1)	0.00	.98	2.06	.16	0.73	.40

Note: df = 1, 38 for each F test.

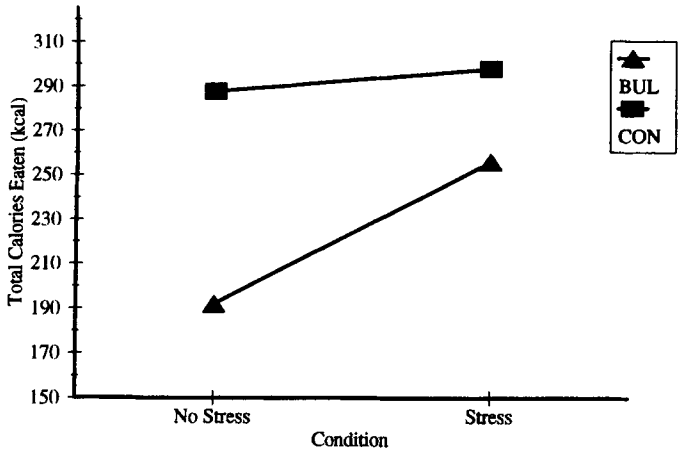

FIGURE 2: Total calories eaten for symptomatic (BUL) and control (CON) subjects by condition.

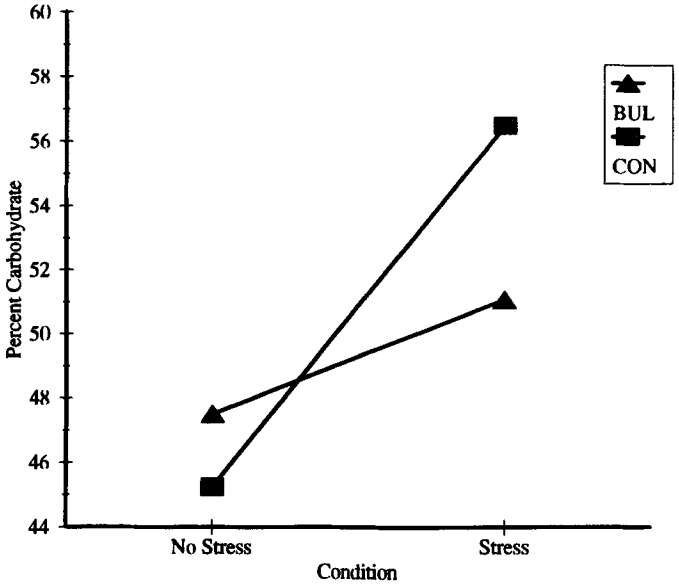

FIGURE 3: Percent of carbohydrate calories for symptomatic (BUL) and control (CON) subjects by condition.

total calories on stress and no-stress days respectively). The groups did not differ in their beliefs about the purpose of the investigation.

Macronutrient Differences: Consumption data were also examined by macronutrient type. A series of 2 (BUL versus CON) × 2 (NS versus S) repeated measures ANOVAs was conducted on both the percent intake of carbohydrate, fat, and protein and the caloric intake of each macronutrient (see Table 2). These analyses revealed a significant main effect of condition on the percent of calories from carbohydrates. As illustrated in Figure 3, both BUL and CON subjects increased the percent intake of carbohydrates following the stressor, $F(1,38) = 8.79$, $p = .005$. There were no significant effects for the percentage of fat or protein consumed, although BUL subjects ate significantly fewer fat calories under both conditions than did controls, $F(1,38) = 5.65$, $p = .023$.

Binge Versus Non-Binge Foods: A related question involved potential differences in the intake of typical binge foods (i.e. cookies, M&Ms, cheese bits, and potato chips) and non-binge foods (i.e. pretzels and raisins) between the groups. A 2 (group: BUL versus CON) × 2 (condition: NS versus S) × 2 (food type: Binge versus Non-Binge) repeated measures ANOVA was conducted on the calories from binge foods and non-binge foods. The results indicated a significant Group × Food Type interaction, $F(1,38) = 9.58$, $p = .004$. Follow-up t-tests revealed that in both the stress and no-stress conditions, BUL women consumed significantly fewer calories from binge foods, $p = .02$, and significantly more calories of the non-binge foods, $p = .03$, than did the controls.

DISCUSSION

This study tested the hypothesis that a speech task designed to increase anxiety and negative affect would result in an increase in the amount eaten by women with symptoms of bulimia nervosa. Contrary to this hypothesis, the stressor did not significantly alter the consumption of women with bulimic symptoms relative to their peers. Thus, although symptomatic and control subjects differed in self-reported eating behavior and psychiatric symptomatology, and although the stress manipulation was effective, our results do not confirm the hypothesis that stress differentially affects the intake of individuals with bulimia nervosa. There are two potential explanations for this failure to confirm the hypothesis: (a) the relationship between stress and eating does not differ between individuals with bulimia nervosa and their peers, or (b) the methodology of this

study precludes the detection of existing differences in eating behavior.

The Relationship Between Stress and Eating

In general, the increases in overall intake following the stressor were small, and despite the use of a within-subjects design, the variability in amount eaten was considerable. Thus, although moderate increases in intake are consistent with data from previous investigations (e.g. 17,18), the effects of stress on eating are difficult to evaluate. Nevertheless, the results suggest that stress does affect eating in women with and without symptoms of bulimia nervosa. Specifically, although this study was not designed to test the effects of stress on macronutrient intake, all women increased their intake of carbohydrates following exposure to stress. This effect of stress on the intake of carbohydrates is interesting in light of recent theories about the relationship between carbohydrate consumption and serotonin (41), a neurotransmitter with putative roles in the modulation of mood and the regulation of satiety (42,43). Researchers also have speculated that individuals with eating disorders suffer from dysregulated serotonergic functioning and have suggested that this population may be differentially vulnerable to the mood elevating effects of carbohydrates (44). In this investigation, however, the effects of the stressor on macronutrient intake were not specific to the symptomatic women. Thus, it is possible that the increased carbohydrate intake reflects an effort by both groups of women to modulate negative moods.

The macronutrient analyses must, however, be considered exploratory. Four of the six food choices that were high in carbohydrates were also high in fat. Thus, selection of fat and carbohydrates was confounded. Moreover, the subjects' choice of foods was constrained to the six snack items offered. Because of these limitations, future work designed to examine macronutrient selection following stress is needed.

It is also possible that the constraints imposed by the laboratory setting differentially altered the eating behavior of the symptomatic subjects as compared to their peers. These methodological issues are explored below.

Methodological Limitations

Because the results of this study fail to confirm the hypothesis that stress differentially affects the eating of women with bulimic symptoms, it is important to consider elements of the study design that may relate to the failure to detect differences. Laboratory studies of eating are common and have been vital to the understanding of human eating behavior (45). However, the use of this methodology may affect the potential to detect differences in the effects of stress on eating for several reasons.

First, the potential sacrifice of generalizability to subjects' eating behavior outside of the lab may be particularly important in laboratory research conducted on women with eating disorders. For example, it is possible that the symptomatic women experienced an increased urge to eat following the stressor, as has been reported by others (27), and delayed satisfying this urge until the completion of the laboratory session. Although the results of a recent study conducted on restrained eaters suggested that subjects do not overeat in the period immediately following a laboratory manipulation designed to disinhibit eating (22), women with bulimic symptoms may experience considerably more anxiety about laboratory eating than restrained eaters. Eating-disordered subjects may, therefore, be more likely than restrained eaters to postpone eating until following the laboratory session.

In addition, the exposure to a large array of foods, many of which were "forbidden foods," and the artificial environment in which subjects were invited to eat may have further increased subjects' anxiety about eating. The finding that symptomatic subjects were more likely than controls to report feeling self-conscious about their eating in the laboratory offers preliminary support for the idea that the women with bulimic symptoms experienced a more pronounced increase in self-awareness when invited to eat in the laboratory. Laboratory paradigms in which subjects are observed over the course of a day or more may be necessary to detect the effects of stressors on subsequent eating. Alternatively, laboratory stressors may be experienced differently than natural stressors and may not be sufficiently arousing to affect the eating behavior of women with eating disorders.

Finally, two additional features of the current laboratory study design may have minimized the likelihood of detecting between-group differences in calorie intake. First, this study was conducted on a sample of women with bulimic symptomatology. Because the subjects may not have met diagnostic criteria for bulimia nervosa, it can be argued that they did not adequately represent the population of eating-disordered individuals. We selected subjects for this study according to scores on the BULIT-R, an instrument that has been shown to successfully identify women with bulimia nervosa in non-clinical samples (32), and the 20 symptomatic women selected reflected the top 10% of the sample of women who had been screened. Additionally, previous research (32) has indicated that women in a non-clinical sample who meet diagnostic criteria for bulimia nervosa score, on average, 104.5 on the BULIT-R. The mean BULIT-R score in this sample of symptomatic subjects was 100.2 (SD = 2.3). Thus, the symptomatic subjects were likely to represent a group of women with clinically significant symptoms.

Second, the validity of the stress task may be criticized. However, we selected an interpersonal speech stress task because of its theoretical relevance to women with eating disorders. Interpersonal stressors have been shown to elicit more anxiety than other commonly used stress tasks (18) and to promote an urge to binge eat in eating-disordered subjects (27). Moreover, the fact that both symptomatic and control women alike reported significant increases in anxiety and negative affect following the stressor suggests that the results of this investigation are a result of the stress task itself.

In summary, this study complements a growing body of research on the relationship between stress and eating and demonstrates the ability of stress to affect intake. Importantly, because the design and methodology of this study represent an effort to address limitations of previous laboratory studies of eating, the lack of observable differences in stress-induced eating between women for whom stress has been hypothesized to affect eating and their non-disordered peers raises questions about the utility of short-term, laboratory analogue studies to examine the effects of stress on eating. Eating is a complex, multifactorial behavior, and there are many challenges in the investigation of stress-induced eating. Although the use of a laboratory paradigm offers important advantages, naturalistic investigations in both disordered and non-disordered samples may be increasingly important to improve our understanding of the variables that mediate the effects of mood on eating.

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