HOW THE COOKIE CRUMBLES: A LABORATORY STUDY OF DIETARY
RESTRAINT AND STRESS-INDUCED EATING BEHAVIOR.

by

THOMAS RUTLEDGE

B.A. The University of Alaska Anchorage

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

in

THE FACULTY OF GRADUATE STUDIES

Department of Psychology

We accept this thesis as conforming
to the required standard.

THE UNIVERSITY OF BRITISH COLUMBIA
August, 1996
© Thomas Rutledge, 1996
In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the head of my department or by his or her representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Psychology
The University of British Columbia
Vancouver, Canada

Date August 22, 1996
Abstract

We examined the relationship between stress, dietary restraint, and the consumption of sweet and salty foods in a female college population. Seventy-seven subjects completed a protocol consisting of distinct baseline, stress-induction, and recovery phases; during which blood pressure, heart rate, and self-reported affect levels were monitored. High and low-stress conditions were created according to the presence or absence of harassment statements delivered while subjects completed a series of challenging cognitive exercises during the stress-induction phase. Finally, the association between food consumption and stress recovery was explored by giving a portion of the high-stress subjects the opportunity to express their distress following the cognitive tasks. Our results supported two main effects: Subjects showing greater levels of cardiovascular arousal ate significantly less of both foods, whereas higher restraint scores were associated with increased consumption. The interaction between restraint and cardiovascular levels did not predict eating behavior, nor did self-reported affect. Lastly, no evidence was found to support the hypothesis that stress recovery would be associated with food consumption. These results support the addition of physiological stress variables in future studies of restraint and stress-related eating behavior.
# TABLE OF CONTENTS

## ABSTRACT

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## INTRODUCTION

- Stress
  - 1
- Eating behavior and dietary restraint
  - 2
- Eating behavior and stress recovery
  - 5
- Objective for the current study
  - 6

## METHODS

- Overview
  - 8
- Subjects
  - 9
- Questionnaires
  - 9
- Cognitive tasks
  - 10
- Physiological measurements
  - 12
- Procedure
  - 12
- Data reduction procedures
  - 15
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formation of subjective stress and restraint variables</td>
<td>16</td>
</tr>
<tr>
<td>RESULTS</td>
<td>17</td>
</tr>
<tr>
<td>Effectiveness of the stress task procedures</td>
<td>17</td>
</tr>
<tr>
<td>Primary analyses</td>
<td>18</td>
</tr>
<tr>
<td>Regression analysis</td>
<td>20</td>
</tr>
<tr>
<td>Analysis of recovery data</td>
<td>23</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>25</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>30</td>
</tr>
<tr>
<td>TABLES</td>
<td>36</td>
</tr>
<tr>
<td>FIGURES</td>
<td>40</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1 ...........................................................................................................................................36
Condition means at baseline and task time points for the diastolic, systolic, and heart rate indices

Table 2 ...........................................................................................................................................37
Zero order correlations between the Restraint Scale (RS), Eating Inventory, restraint component (R), composite stress index (stress), separate cardiovascular indices (heart rate, diastolic, and systolic), composite stress X restraint interaction term (SxR), cookie (cookie), chip (chip), and overall food consumption (food), time since previous meal (time), and positive and negative PANAS dimensions

Table 3 ...........................................................................................................................................38
Multiple regression results: Use of the composite stress, restraint component, and composite stress x restraint interaction terms in the prediction of post-stress food consumption
LIST OF FIGURES

Figure 1 .................................................................................................................................40
Mean food consumption for groups classified by restraint level and degree of cardiovascular arousal

Figure 2 .................................................................................................................................41
Diastolic recovery curves, measured in change scores relative to baseline, for the experimental-inhibition, experimental-inhibition, and low-stress conditions

Figure 3 .................................................................................................................................42
Systolic recovery curves, measured in change scores relative to baseline, for the experimental-inhibition, experimental-expression, and low-stress conditions

Figure 4 .................................................................................................................................43
Heart rate recovery curves, measured in change scores relative to baseline, for the experimental-inhibition, experimental-expression, and low-stress conditions
INTRODUCTION

Stress

Although there is a shared popular understanding of what constitutes "stress", scientific approaches to the study of stress have been troubled by an inability among researchers to arrive at a shared operational definition (Greeno & Wing, 1994). Differences in the way these researchers have conceptualized stress are unquestionably one of the leading causes of this difficulty (Lazarus, 1966; Linden, Earle, Gerin, & Christenfeld, 1996), but the problem is aggravated by the fact that stress can be measured via subjective measures (i.e. self-report), observations of behavior, or by monitoring physiological changes (Buck, 1988).

Unfortunately, each of these methods for measuring stress possess certain drawbacks. Research has shown, for example, that stress measures based on self-report instruments may be confounded by individual differences in response styles (Linden et al., 1996), and as a consequence often fail to correlate with corresponding behavioral and physiological changes (Gerin, Pieper, Marchese, & Pickering, 1992). Alternatively, behavioral observations require inferences to determine whether an experimental subject is "under stress", and are therefore prone to measurement error. Finally, although physiological markers are more easily quantified, these changes may due to a variety of influences, only some of which may be stress-related.

It is for these reasons that I will discriminate between these methods in the following text by using the term subjective stress to indicate the use of self-report measures, and the term physiological stress to indicate changes in cardiovascular or biochemical channels. Where the two forms of stress are found to co-occur in the laboratory, I will describe the event as experimental stress.
Eating behavior and dietary restraint

Measurements of dietary restraint as an individual difference variable have become increasingly important to stress and eating researchers in recent years (Ruderman, 1986). Dietary restraint theory suggests that individuals who chronically attempt to limit their food intake place themselves at increased risk for experiencing episodes of binge eating (Herman & Polivy, 1975; Polivy & Herman, 1985). Specifically, restraint theory contends that exposure to events involving emotional distress, dietary violations, or alcohol consumption can dispose these individuals towards binges by temporarily disrupting the self-control they typically force themselves to maintain over their eating (Ruderman, 1986). Laboratory research over the past two decades has tested this position with designs involving emotional stressors, taste tests, experimental "preloads", and even placebo alcohol ingestion, with results reliably supporting the prediction of increased eating by high-restraint participants (Greeno & Wing, 1994; Schotte, Cools, & McNally, 1990).

Researchers investigating stress-related eating behavior outside of the restraint literature, however, have found conflicting results. Naturalistic studies have frequently found decreases in food consumption in response to self-reported stress (Bellisle, et al, 1990; Stone & Brownell, 1994), as have a number of laboratory experiments (Reznick & Balch, 1977; Ruderman, 1983). Physiological changes observed in response to stress also appear to predict a decrease in eating. Hormonal and biochemical studies of eating behavior for example have shown a significantly delayed glucose response to food intake under stress, a reaction which should delay or inhibit eating behavior (Blair, Wing, & Wald, 1991; Wing, Blair, Epstein, & McDermott, 1990). A substantial body of naturalistic, laboratory, and physiological
Restrained eating

research therefore supports the conclusion that stress operates as an inhibitory factor for eating behavior and provides evidence for the stress-related physiological channels through which eating is suppressed, while the restraint literature demonstrates that the eating behavior of some individuals may be unaffected or even increased under stress.

A number of investigators have argued that this discrepancy could be resolved by examining variables that may be moderating the relationship between stress and eating behavior (Greeno & Wing, 1994). The results of several recent studies can be seen as evidence for this position. Stone and Brownell (1994) tested the notion that the disparities observed in eating research could be related to (1) gender differences, given the higher prevalence of restrained eating in women, or (2) to the lower severity of stressors that subjects are exposed to inside the laboratory. Using a three month prospective design, Stone and Brownell (1994) found however that a pattern of reduced food consumption by men and women was more common across all levels of subjective stress, with decreased eating becoming most frequent at moderate and high stress levels.

Although the outcome of this study favors a main effect interpretation for stress in reducing food consumption, it is important to note that a pattern of decreased eating was not universal. A significant minority of subjects increased their food intake, particularly among women at lower levels of stress. Given the absence of dietary restraint measures, and the questionnaire based method in which stress levels were determined, the main effect conclusion should be accepted with caution.

Grunberg and Straub (1992) also examined gender differences in a laboratory study designed to assess the consumption of sweet, salty, and bland foods by stressed and nonstressed groups. Subjective stress was again observed to predict an overall
decrease in eating. This result was superceded, however, by an interaction between stress and gender such that males in the stress group evidenced a consistent decrease in food consumption across all food types relative to the male control group, whereas stressed females increased their consumption of sweet and bland foods in comparison to female controls.

The value of including specific food categories in the interpretation of stress-related eating behavior appears to be the clearest result from the Grunberg and Straub study (1992). The absence of dietary restraint measures again limits the extent to which these results can be reconciled with the restraint literature. Similarly, the reliance on self-report instruments for measuring and categorizing stress does not permit an integration of physiological interpretations for stress related eating.

Gender differences in both studies support a continued focus on female samples. Stress-induced eating is commonly perceived as a symptom of more pronounced eating disorder behaviors (Polivy, Herman, & McFarlane, 1994). Given this conceptualization, and the long-standing evidence showing a higher prevalence of eating disorder behaviors among women (Polivy & Herman, 1985), it is hardly surprising that women may also be more susceptible to eating under stress.

Synthesizing this collection of result generates several recommendations for current eating research. Perhaps most strongly, these findings indicate that empirical studies designed to bridge the gap between laboratory, prospective, and physiological research is a necessary next step to resolving the oftentimes inconsistent, and always complex, stress-eating relationship. In particular, research relying primarily upon female participants, utilizing multiple food options, and incorporating measurements of dietary restraint and physiological dimensions of stress could make a significant
contribution to our present understanding of stress-related eating.

Eating behavior and stress recovery

Curiously absent from the eating literature are empirical efforts to document the stress-related changes that occur as a result of eating. This absence is noteworthy given our current views on stress and eating behavior. A longstanding belief among eating researchers has held, for example, that food consumption may help to reduce anxiety for individuals prone to binge eating episodes (Kaplan & Kaplan, 1957). More recently, restraint theorists have conceptualized stress-induced eating as a means of escape or distraction from negative self-awareness (Polivy, Herman, & Heatherton, 1994). Both views suggest that food may have a palliative effect for some individuals, and imply that stress recovery could be a valuable area of inquiry for eating research.

Two questions appear to be of particular salience with respect to food consumption and stress recovery. The first and more general issue concerns the nature of the relationship between stress and eating behavior. That is, is recovery from stress affected by an individual's eating behavior, or vice versa, is their eating behavior influenced by the amount of stress they are under or their ability to recover from the experience? Tests of this relationship call for designs in which several dimensions and levels of stress are assessed, and in which stress can be measured at time points prior to, during, and following the stressful event.

The second question follows directly from restraint theory. High restraint scores have been found to predict increased eating in response to a variety of laboratory stressors (Greeno & Wing, 1994). Based in part upon this evidence, theorists have speculated that stress-induced eating may function for high-restraint
individuals as a way of coping with a negative self-image (Heatherton & Baumeister, 1991). Given this premise, it therefore seems of considerable interest to determine whether relief from stress or negative self-awareness is in fact obtained by high-restraint individuals as a result of eating.

**Objective for the current study**

We examined the relationship between distress, eating behavior, and stress recovery in the current study using a laboratory design familiar to cardiovascular reactivity researchers. The basic protocol consisted of distinct baseline, stress-induction, and recovery phases, during which physiology and affect were monitored using cardiovascular equipment and self-report instruments. Sweet and salty foods were available to subjects during the recovery phase, followed by an interval in which restraint levels were assessed using Herman and Polivy’s (1980) Restraint Scale and the Disinhibition factor items from Stunkard and Messick’s (1985) Three-Factor Eating Questionnaire. Distress was induced by having subjects complete a series of challenging cognitive exercises during the stress-induction phase. Such exercises have been used for decades by cardiovascular researchers, and validated for stress-induction purposes across dozens of studies (Manuck, 1994).

An exclusively female sample completed the study. Each subject was categorized prior to the study into either a low or high-stress condition to permit an analysis of eating behavior across several levels of stress. High-stress was created with the addition of verbal harassment statements delivered by a same-sex assistant at specific time points during the cognitive exercises. This method has proven effective at eliciting enhanced physiological changes in several studies (Glass et al., 1980).

A second manipulation was implemented at the completion of the stress-
induction phase. In order to examine the impact of differential stress recovery on eating behavior, we borrowed a procedure from a recent study in which the high-stress condition was dichotomized into expression and inhibition groups (Lai & Linden, 1992). Subjects assigned to the expression condition were given the opportunity to express their distress to the experimenter by giving written feedback about the behavior of the assistant. Inhibition subjects completed a hand-writing exercise during the same time interval. Lai and Linden (1992) found that this manipulation led to accelerated heart rate recovery for the expression subjects.

The present study therefore permitted an exploration of several aspects of the stress-eating relationship. The inclusion of physiological measurements, self-reported affect, and multiple food options allowed for tests of this relationship across separate food categories and several dimensions of stress. Second, the addition of dietary restraint measures and two stress categories gave us the opportunity to evaluate the potentially moderating role of restraint across low and high levels of stress. Finally, the manipulation of stress recovery provided a means of assessing questions concerning the relation(s) between differential recovery rates, physiological and self-report stress dimensions, low and high restraint status, and post-stress eating behavior.

Based on these design features, we hypothesized the following:

1) Stress, in the form of physiological and self-report indices, was expected to show a negative association with food consumption.

2) Dietary restraint scores were expected to be a positive predictor of food consumption, with higher scores corresponding to increased food intake. How restraint status would moderate, or interact with, stress and specific food categories
was of particular interest.

3) Third, we forecast that differential recovery rates would be present for the three stress conditions. Specifically, we believed that members of the expression group would show an enhanced rate of recovery relative to the inhibition and low-stress groups. The relationship between differential recovery, stress category, and food consumption was examined in an exploratory fashion. Facilitation of physiological or self-reported affect recovery among subjects with higher levels of food consumption would be interpreted to support the belief that food consumption could enhance stress recovery for these individuals.

4) Finally, we projected that increased eating following the stress task could enhance stress recovery among high-restraint subjects.

METHOD

Overview

Female college undergraduates were invited for a research study ostensibly assessing physiological reactivity to a set of laboratory stress tasks. All participants were requested to eat lightly and refrain from caffeinated beverages for 2 hrs prior to attending the study under the explanation that food and caffeine could artificially elevate their blood pressure readings. Subjects were randomly assigned to one of three conditions; two high-stress groups (an expression or inhibition group) or to the low-stress group.

Subjects in all conditions experienced a nearly identical sequence of events in the laboratory. After having a blood pressure cuff attached to their nonwriting arms, subjects went through a 15-min initial baseline phase during which resting blood pressure and heart rate readings were recorded, a 12-min cognitive task phase
wherein they were asked to complete three brief cognitive exercises (see below), and a 12-min recovery period during which blood pressure and heart rate readings were monitored as they returned to baseline levels. Self-report affect was measured at three time points; at the outset of the baseline phase, immediately following the cognitive tasks, and at the completion of the recovery period. The high-stress conditions differed in that subjects in these groups received interruption statements (see below) during their performance of the cognitive tasks, whereas low-stress subjects did not. In addition, expression subjects were given an opportunity to express their reactions to the interruptions with a questionnaire given immediately after the tasks. Inhibition and low-stress subjects were asked to perform a handwriting exercise for the same interval. The expression and inhibition groups were therefore identical preceding the post-task exercise. Finally, all participants were requested to complete a brief questionnaire during the recovery period, during which several palatable snack foods were available to them. At the completion of the recovery period, each participant completed a measure of dietary restraint prior to being debriefed.

Subjects

Subjects were 77 female undergraduate students recruited from the department subject pool. The age of the participants ranged from the late teens to early fifties, with the great majority falling between 19 and 23. Ethnic diversity was also projected to be of interest. The following ethnic breakdown was observed: 43% caucasian, 57% asian.

Questionnaires

The PANAS (Positive And Negative Affect Scales) was used at three time
RESTRAINED EATING

intervals to measure the subjects' level of emotional dysphoria. The PANAS was administered during the baseline phase, immediately following the cognitive tasks, and at the conclusion of the recovery period. The PANAS is a widely used and well validated instrument in psychological research (Watson, Clark, & Tellegen, 1988). The scales ask respondents to rate on a 5-point scale the degree to which they are currently experiencing 10 negative and 10 positive moods. Research has shown the positive and negative mood dimensions to be relatively uncorrelated (Diener & Emmons, 1984).

As a measure of dietary restraint, Herman and Polivy's (1980) Restraint Scale and the 20-item disinhibition factor taken from Stunkard and Messick's (1983) Three Factor Eating Questionnaire were administered to all subjects following the recovery segment. The Restraint Scale has been used in dozens of previous studies examining emotional stress and laboratory eating behavior, and is particularly well suited for female college populations (Ruderman, 1986). The inclusion of the disinhibition factor items from the Three Factor Eating Questionnaire is not a frequent practice but is perceived valuable here due to the research associating higher scores on the scale with overeating in laboratory conditions (Shragger, Wadden, Miller, Stunkard, & Stellar, 1983). In addition, the factor was designed to assess eating triggered by emotional and social cues, which makes the item content ideally suited for this line of research. The two sets of restraint items were combined and interspersed with the 20-item Vulnerability to Stress scale (Miller & Smith, 1983) in order to partially conceal the intent of the questionnaire.

Cognitive tasks

General features. Participants completed three cognitive exercises during a
12-min period. Each of the tasks were 3 min in duration, and counterbalanced across participants. Instructions for the tasks were provided separately prior to the beginning of each task, adding approximately 3 min to this phase. Blood pressure readings were taken at minutes 1 and 2 during each task, providing a total of six readings. Instructions emphasized that the tasks were timed, and that the participants should give their best effort. For high-stress subjects, a trained research assistant interrupted the participant 90 seconds into the task in a firm but neutral fashion to deliver an "interruption statement" specific to that task (these statements follow the task descriptions provided below). Abbreviated versions of a mental arithmetic, stroop task, and a word scramble test were selected as the cognitive tasks. Details of each task are provided below.

**Tasks.**

a) **Mental arithmetic.** For this exercise, each participant was requested to begin with the number 2000, and count backwards from that number in steps of seven. Participants were told that the goal was to accurately count down as far from 2000 as possible in the 3-min interval. All counting was performed aloud and without the aid of pencil or paper; subjects were asked to start over when they believed they had gotten off track. For high-stress subjects, the assistant's interruption statement for this task was "You are subtracting way too slow, you need to work much faster."

b) **Stroop task.** For this exercise, each participant was given several pages filled with color words that were printed in various common colors (i.e. red, blue, green, etc., where the color of the word always differed from the meaning of word itself [e.g. the word red never appeared in a red font]). This task required that participants discriminate between what color the word meant, and the color it was actually printed
in. Participants were requested to work through as many of the words as possible, stating the color in which each word was printed. The interruption statement for this task was "You are making very poor time at this task, see if you can work more quickly."
c) Word scramble task. This exercise required subjects to make meaningful words out of a series of scrambled letter expressions. Participants were given a page containing 20 such word scrambles and asked to complete as many of the items as possible in the time allowed. All items were possible, and participants were asked to raise their hand to alert the assistant should they finish before the 3 min interval had expired (although this never happened). Answers were recorded on the page by the participant and not spoken aloud. The interruption statement for this task was "You have only about another minute for this task, you should have most of the items completed by now."

Physiological measurement

Blood pressure and heart rate information was collected from subjects using a Dinamap 845 Vital Signs Monitor (Critikon Corporation, Tampa/Florida). Validation work has shown the Dinamap to provide blood pressure values that directly correspond with intra-arterial measurements (Borow & Newburger, 1982). The monitor was used to assess physiological levels at regular intervals throughout the baseline, task, and recovery periods.

Procedure

Upon arrival at the laboratory, participants were greeted by the experimenter and provided with details of the procedure to follow. Specifically, participants were informed of the approximate length of the study and the steps involved, including the
baseline, cognitive tasks, and recovery period portions. Details of the tasks were not given at this stage. Subjects completed a consent form describing the purpose of the study as an investigation of physiological changes occurring under laboratory stress tasks and a brief questionnaire asking for the time since their last meal, their ethnic background, and whether they had any food allergies.

Following these preliminary events, participants were led into an adjacent laboratory room and seated comfortably, after which the blood pressure cuff was attached to the subject's nondominant arm. The baseline procedure was briefly reviewed and participants were then asked to fill out an initial PANAS form, and provided with a selection of magazines to read while baseline measurements were obtained. The baseline phase lasted 15-min, with physiological readings taken at minutes 0, 4, 8, and 12. A table located to the left side of the subject contained a pitcher of water, napkins, and two bowls of snack food (one containing miniature chocolate chip cookies and the other vegetable thin snack crackers). Each food bowl was preset to a weight of 250 grams (a full bowl) for each subject and weighed at the completion of the study. The bowls were located equidistantly from the subject and easily within arms reach. The left-right position of the bowls was reversed for each subject to control for location. The rationale provided for the presence of the food was that since the participants had been unable to eat for several hours prior to the study, the snack food would be available for them following the completion of the cognitive tasks (not before that time, as again it could elevate their blood pressure levels). Following the explanation of the food, baseline details, and alerting them to the questionnaire and other reading materials, the experimenter departed and participants were alone in the room for the baseline period.
At the end of the baseline phase, the experimenter returned to explain the guidelines for the cognitive tasks. The experimenter was present before each task to provide specific instructions, but participants were alone while performing the tasks themselves. The experimenter explained that starting commands would be given by the assistant over an intercom device from an adjacent room. The assistant was able to observe the participant via a one-way mirror, and participants were informed that the assistant would interrupt if she believed the participant had made a mistake or gotten off-track during the exercises. All starting commands and interruption statements were scripted for standardization purposes, and delivered by a trained female research assistant at the specified intervals. Participants did not meet or have any visual contact with the research assistant during the study. Pilot studies have shown interruptions during stress tasks to be most effective when the participants have not had previous contact with the provoker (Lai & Linden, 1992). Participants in all conditions received the verbal starting commands for each task, but only the high-stress subjects received the interruption statements.

At the completion of the task phase, those subjects who were assigned to the expression condition completed a second PANAS, and then a form asking them to evaluate the assistant along a series of personality dimensions (friendly vs. unfriendly, competent vs. incompetent, etc). For the latter form, participants were requested to answer the evaluation in an open and frank manner in order to improve the design of the study, and told that the assistant would neither see the information nor suffer any undesirable consequences as a result. The evaluation involves six pairs of polar adjectives placed on a 0 to 10 scale concerning the experimenter's personality and performance, with 0 representing a very negative impression and 10 a very positive
impression.

Subjects in the inhibition and low-stress conditions also completed a PANAS form following the completion of the cognitive tasks, but then were requested to copy a neutral paragraph for the same interval to control for time and motor activity. The latter paragraph was a brief excerpt from a popular magazine describing a new irrigation method.

The recovery period began following this interlude. Participants were informed that several follow-up blood pressure and heart rate readings would be taken over the subsequent 12-min interval. Each participant was asked to complete a short questionnaire during the time, but could otherwise resume reading from the magazine selection. Participants were also told that they could help themselves to the food items for the duration of the study.

When this final testing phase was complete, the experimenter returned to remove the Dinamap cuff from the participant. The experimenter informed the participant that approximately 5 minutes would be needed to download the data from the blood pressure monitor, and asked the participant to fill out a final pair of questionnaires (the third PANAS and the Restraint/Vulnerability to Stress Scale) during the time they were waiting. The experimenter and assistant returned to debrief the participant when the questionnaires had been completed. Debriefing confirmed that no subjects had been aware that food consumption had been a component of the study.

Data reduction procedures

A total of 15 physiological readings were collected for each participant. For statistical purposes, the average of the final two baseline readings was employed to
create a stable standard of comparison. A composite measure of physiological stress for each individual was formed by standardizing the mean stress-task values for each of the three physiological variables, summing the Z-scores, and averaging the result (Rosenthal & Rosnow, 1991). In addition, a physiological stress x restraint interaction term was formed by taking the product of the composite physiological stress and restraint factor score (see below) for each participant.

Analysis of the food consumption data followed a similar logic. A composite measure of food consumption was formed by standardizing the raw food scores for the cookie and cracker options, summing the two Z-scores, and averaging the result. This composite term served as our primary dependent variable, and is accompanied by statistics for the separate cookie and cracker food categories.

Formation of subjective stress and restraint variables.

Positive and negative scores on the PANAS were calculated by summing the ten items composing each dimension. This method is in accordance with previous PANAS use (Watson, Clark, & Tellegen, 1988).

As anticipated, the zero-order correlation between the restraint scores from the Restraint Scale and Disinhibition factor of the Three Factor Eating Questionnaire was highly significant, r=.65, p<.001. In order to create a more stable composite variable from the two measures, a principal components analysis was conducted using the standardized versions of the two scales, and the factor scores for the unrotated first principal component retained for further analyses (both restraint measures correlated approximately .91 with this component). The first principal component from such an analysis represents the linear combination of the two restraint measures which contributes a maximum to their total variance (Harmon, 1976). Furthermore,
this component possesses maximum alpha reliability, and will therefore correlate optimally with other variables.

RESULTS

Effectiveness of the stress task procedure.

As verification of the effects of the mood manipulation tasks, separate 3 x 2 (three conditions x baseline average-task average) between-within ANOVAs were conducted across the control and experimental conditions on the subjects' baseline to task scores for each of the three physiological variables (heart rate, systolic and diastolic blood pressure) and positive and negative affect dimensions of the PANAS measure. Means for the physiological variables at the baseline and six task time points are provided in Table 1. Statistical tests for each repeated factor were significant, F's(1,74)= 179.8, 171.0, 196.9, 25.1, and 9.7, all p's <.01 for the diastolic, heart rate, systolic, negative and positive PANAS scores respectively, indicating that reliable increases in blood pressure, heart rate, and self-reported negative affect, and decreases in self-reported positive affect, were present relative to baseline levels. The between factor was nonsignificant across all tests (F's <1.0 for all measures), suggesting that the addition of the interruption statements for the experimental conditions did not create additional stress on either the physiological or self-report measures. Multisample sphericity and homogeneity assumptions for the between-within statistics were assessed via Mauchley's and Bartlett's Box tests, respectively, and found to be nonsignificant (Winer, 1971), permitting the use of unadjusted F values for the interpretation of each test.
Primary analyses.

The relationship between physiological and subjective stress, dietary restraint, and food consumption was examined over the following steps. Initially, zero order intercorrelations for the restraint scores taken from the Restraint Scale, Three Factor Eating Questionnaire, and restraint factor formed by the components analysis, the individual physiological stress indices and composite stress score, the stress x restraint interaction variable, cookie, cracker, and overall food consumption variables, time since the participant's previous meal, and post-task PANAS scores for the positive and negative dimensions were examined. A preliminary assessment of the size and direction of these correlations across separate ethnic groups failed to show large differences. We therefore chose to report relationships based on the complete sample. These values are shown in Table 2.

Several important conclusions can be drawn from the expressed correlations. Subjective stress scores from the positive and negative dimensions of the PANAS measure failed to show a relationship with either the food or physiological stress variables. The individual and composite physiological stress measures however correlated significantly with cookie consumption, r's(77), -.29, -.34, -.28, and -.37, for the heart rate, diastolic, systolic, and composite stress variables respectively, and with
overall food intake, r's(77), -0.32, -0.25, -0.23, and -0.33, p's < 0.05. Correlations with cracker consumption were also negative, but nonsignificant. Finally, the restraint and physiological stress variables were found to be minimally correlated with one another r(77) = 0.09, p > 0.4, indicating the two measures may represent relatively independent predictors of eating behavior.

All three restraint variables were found to correlate positively with the food consumption variables, indicating that higher restraint scores were associated with increased food consumption. Clear differences were apparent, however, in the size of these correlations across separate food categories. The cracker and composite food variables showed moderate and statistically significant relationships with the restraint terms r's(77) .35-.39 for crackers and .28-.30 for overall consumption, all p's < .01, whereas cookie consumption could not be reliably predicted by dietary restraint levels, r's(77) < 1, p's > 0.4. Overall food consumption was therefore found to be reliably associated with both physiological stress and dietary restraint, whereas an analysis across the separate food categories showed that cookie consumption was related only to physiological stress, and that cracker consumption correlated only with the restraint variables.

The relationships observed between restraint and eating behavior were consistent across each of the Restraint Scale and Three Factor Eating Questionnaire measures, providing little evidence for discriminating between these instruments. Additional inspection of the two food categories revealed that subjects on whole consumed larger amounts of cookies than crackers (m's 12.2 & 6.8 grams for cookies and crackers respectively, t(76)= 3.39, p=.001). Finally, neither the restraint nor food consumption variables correlated with the amount of time since the subject's
previous meal. This result allowed us to eliminate the latter variable from succeeding analyses.

**Regression analysis.**

Prior to subjecting the restraint, composite physiological stress, restraint x physiological stress interaction, and composite food consumption variables to a regression analysis, we assessed the status of the assumptions underlying this procedure (Stevens, 1992). An examination of separate partial regression plots for the predictor variables, and a plot comparing standardized residuals and predicted values failed to reveal distinct patterns or clusters, giving no cause to question the assumptions of homoscedasticity and linearity. The status of the normality and independence assumptions was assessed by examining a histogram of standardized residuals. The validity of these assumptions was supported by the presence of a small number of outlying values.

Subsequent to this examination, a hierarchial multiple regression analysis was performed using the composite physiological stress term, restraint principal component, and physiological stress x restraint interaction terms to predict composite food consumption. The composite stress variable was given initial entry into the equation in order to assess the incremental contribution of the restraint construct. Similarly, incremental contributions of the interaction term were assessed by including this variable at the third step. Results from this analysis, comprising the R^2 and multiple R values, beta weights for each predictor, F and F change values, and corresponding probability levels, are shown in Table 3.
The three variable model produced a highly significant result, $F(3,73) = 5.42, p=.002$, lending support for the predictive potential of these factors. A closer scrutiny of the model steps revealed that the composite stress and restraint variables reliably predicted food consumption, whereas the interaction term failed to account for a meaningful degree of additional variance, $F$'s 9.0, 6.74, and 0.04 respectively. The small intercorrelation between the restraint factor and composite stress index, coupled with the nonsignificant association between the interaction term and food consumption, supports an interpretation based on main effects. Specifically, this pattern of results suggests that physiological stress had a consistent dampening effect on overall eating behavior across dietary restraint levels, but also that higher restraint levels remain associated with increased food consumption.

As witnessed in the earlier correlations, the association between food consumption and dietary restraint largely reflected an increase in cracker consumption by participants with higher restraint scores. Similarly, increased cardiovascular levels were associated predominantly with a decrease in cookie consumption, with crackers affected to a lesser extent.

To provide an illustration of this pattern, we created a $2 \times 2$ table of food consumption means categorized by high and low groupings of the restraint and composite physiological stress variables (via median splits), and plotted the cell means for the cookie, cracker, and overall food categories. The result is shown in Figure 1 below.
As indicated, high-restraint individuals show small to moderately elevated levels of overall food and cracker consumption at both physiological stress levels relative to low restraint participants, but where food consumption means across all three food categories is lower in those evidencing higher levels of physiological arousal. Note that the most pronounced differences in food consumption between high and low restraint participants occurred in the high-restraint, low-stress vs. the low-restraint, high-stress conditions. The high-restraint, low-stress group consumed more than twice as many crackers, and also more than doubled the total food intake of the low-restraint, high-stress group (m's 9.8 vs. 3.64 grams for crackers, and 22.6 vs. 10.91 grams for overall food intake). Bonferonni corrected (at .025) F-tests of these differences proved significant, F's 6.59 and 7.17 for crackers and overall consumption, p's = .01. The high-restraint, high-stress group also showed increases in cookie, cracker, and overall food consumption relative to the low-restraint, high-stress group (m's 11.25, 6.25, and 17.5 for cookie, cracker and overall consumption), but these were not statistically significant (p's > .1).

As a final interpretive step, a search for influential cases or variables was performed using a series of diagnostic procedures. Initially, Mahalanobis D and parallel Cook's D statistics were calculated for each participant. Several Mahalanobis values merited closer scrutiny, but, as all had corresponding Cook's d values lower than 1, none were judged to profoundly affect the size of the regression coefficients (Norusis, 1992). This conclusion was supported by a scrutiny of leverage scores, few
evidencing values larger than p/N.

Analysis of recovery data.

The exploration of recovery data was intended to address two interrelated questions: First, were differential recovery rates present for the expression vs. the inhibition and low-stress groups, and if so, were these differences associated with eating behavior? Second, was food consumption a facilitator for stress recovery among restrained eaters?

In testing the initial question, we hypothesized that the inhibition and low-stress conditions would show attenuated recovery rates relative to the expression group due to the former group's inability to diffuse negative feelings generated by the cognitive tasks. Five physiological and two subjective recovery readings were collected across each of the three conditions. We calculated change scores (recovery point - baseline) for the physiological data points in order to illustrate groups recovery curves while controlling for baseline levels. Figures 2, 3, and 4 illustrate the post-task recovery curves in change scores relative to baseline for each condition on the diastolic, systolic, and heart rate indices respectively. Subsequently, separate 3 x 5 (condition x recovery points) between-within ANOVA's were carried out using raw scores for each physiological variable and 3 x 2 (condition x post-task and post-recovery time points) between-within ANOVA's using the positive and negative PANAS scores. Significant within effects were interpreted to indicate a reliable degree of recovery over the recovery time points, whereas between effects suggested that the recovery process differed between the groups. All interaction effects were nonsignificant (F's < 2.0).
Reliable within effects were detected for the systolic and heart rate physiological indices, $F'(4, 296) = 4.14, 4.37, p's<.01$ for heart rate and systolic values respectively, and for both the positive and negative PANAS dimensions, $F'(1,72) = 20.56, 55.81, p's<.001$ for the positive and negative PANAS scores. The diastolic index did not show significant recovery, $F(2, 74$ due to sphericity corrections) = 1.2, $p>.2$. Significant between condition effects were present only for the heart rate variable, $F(2, 74) = 4.67, p=.01$. A post hoc analysis indicated that the recovery readings of the expression group were significantly lower than those of the other two conditions. The inhibition and low-stress groups did not differ from one another for any of the five variables.

The partial support observed for the expectation that differential recovery rates would be present between the conditions factor provided grounds to assess if the separate recovery groups differed in overall eating behavior. Means for the groups were highly similar (17.31, 19.4, & 17.88, for low-stress, inhibition, and expression conditions respectively). A one way ANOVA on these data proved nonsignificant, $F(2, 74) = .1, p=.90$, suggesting there was no relationship between recovery as a manipulated variable and food consumption.

For our second question, we investigated the notion that food consumption could be associated with the recovery process of high-restraint vs. low-restraint subjects. For the purpose of this exercise, subjects were categorized by their restraint component score and amount of food consumed according to a median split.
Restrained eating

procedure. This step created four groups: low restraint-low eating, low restraint-high eating, high restraint-low eating, and high restraint-high eating. The resulting categories were not equal in size, but they were also not overly disparate (each cell contained between 15 and 24 participants).

Within each of these groups, the relationship between food consumption, restraint, and recovery was explored by performing separate 2x2x4 (food consumption x restraint level x final four recovery points) between-within ANOVA’s with the three physiological indices, and separate 2x2x2 between-within ANOVA’s (food consumption x restraint level x PANAS score at the post-task and post-recovery time points) for the positive and negative PANAS dimensions. Results from all interaction and between effects terms were nonsignificant (F’s 0.01-1.99, all >.05), indicating that reliable differences in recovery data due to restraint status, food consumption, or their interaction, were not present within either physiological or self-report domains.

Following our observation that restraint was most strongly correlated with cracker consumption rather than total food intake, we repeated the above series of steps using low and high cracker consumption categories. This again generated nonsignificant results across the physiological and self-report indices.

DISCUSSION

The present study was designed to explore four primary hypotheses. Initially, we assessed how measures of physiological and self-reported stress could predict stress-induced eating. Measures of physiology have proven to be a very useful complement to self-report instruments in the study of stress (Diamond, 1982), and their absence in the stress-eating literature has been among the most frequently cited
shortcomings of this field (Greeno & Wing, 1994; Grunberg & Straub, 1992). In our results, blood pressure and heart rate increases proved to be consistent negative predictors of post-task eating behavior, whereas both the negative and positive dimensions of our self-report measure failed to correlate with either food consumption or changes in physiology.

The weak correlation we observed between the physiological and subjective dimensions of stress fits a pattern observed in many cardiovascular studies (Gerin, Pieper, Marchese, & Pickering, 1992; Sapira, 1971). Among the physiological variables, heart rate levels showed the strongest correlation with food consumption. Judging that heart rate is the most accessible physiological measure, these results should encourage further use of this variable.

For our second hypothesis, we attempted to replicate the finding that dietary restraint would be an effective predictor of post-task eating behavior. In particular, we were interested in the incremental contribution and potentially moderating effect of the restraint construct after controlling for stress indices. We used two popular measures of dietary restraint in order to create a more stable predictor variable, and to provide a means for directly comparing the questionnaires. The Restraint Scale and disinhibition factor of the Three Factor Eating Questionnaire each showed statistically reliable positive associations with eating behavior, even after controlling for stress variables. Furthermore, the questionnaires produced a nearly identical pattern of correlations with the separate and composite food categories in our sample. Of more telling value, the dietary restraint dimension evidenced only a minimal correlation with physiological stress markers, supporting the use of the two constructs as functionally independent predictors of laboratory eating behavior.
Our expectation that restraint would moderate the stress-eating relationship was not substantiated. Instead, higher levels of physiological stress consistently decreased food consumption across all measured categories of food and levels of restraint. In spite of this effect however, we did find meaningful differences in the eating behavior of low vs. high-restraint participants. Specifically, high-restraint participants with low or high levels of cardiovascular arousal consumed more crackers and total food than those participants with lower levels of restraint and high levels of cardiovascular arousal.

Many of these results therefore concur with established findings in the stress-eating literature. Stress, in at least the physiological dimension, predicted decreased food consumption (Blair, Wing, & Wald, 1991), whereas restraint was associated with greater food intake (Polivy & Herman, 1985). Furthermore, the differences in eating behavior we observed between low and high-restraint participants on the basis of degree of physiological stress level can be readily reconciled with Stone and Brownell's (1994) results, where the prevalence of overeating among females was found to be higher at lower stress levels and lowest under high-stress circumstances.

Our third and fourth hypotheses dealt with the recovery data collected from physiological and self-report sources. By manipulating the opportunity to express negative emotions, we first sought to assess whether such expression could positively influence physiological recovery, and if observed recovery differences were related to individual eating behavior. Partial support for this prediction was obtained with the finding that expression subjects evidenced an increased heart rate recovery relative to the inhibition and low-stress groups. No relationship was found however between the opportunity to express negative emotion and food consumption following the stress
As a final step, we attempted to explore the notion that food consumption could operate as a stress reducing agent for high-restraint individuals. Specifically, we classified individuals according to restraint level and high or low post-task food consumption to test the prediction that increased food consumption by high-restraint subjects would lead to an improved recovery rate relative to non-eaters. We failed to find support for this hypothesis using either overall food intake or cracker consumption as a predictor. Instead, recovery means and slopes showed close correspondence for both physiological and self-report variables.

Our failure to find a meaningful relationship between restraint, food consumption, emotional expression, and recovery must be accepted with caution however. To date, the factors contributing to physiological recovery remain poorly understood (Linden et al., 1996). Nor are standard procedures for measuring, analyzing, and explaining recovery data yet available. Experimental designs differing from our own, or employing alternative methods of analysis, may shed additional insight on this relationship.

A number of questions and issues for laboratory based eating research arose from our efforts to design and interpret the results of the present study. Among other potential questions we asked the following: (a) how is stress optimally induced and defined in the stress-eating relationship?; (b) how can we better understand the process(es) underlying the connection between stress and eating behavior?; and (c) can we generalize our findings to nonlaboratory settings?

Stress has been identified in this and a number of previous studies as a negative predictor of eating (Stone & Brownell, 1994). Our results demonstrate that
defining stress in terms of objective physiological measures and relatively brief active coping tasks can provide a significantly improved predictive potential relative to less reliable stress-induction methods and self-report scales. A number of variations on this methodology are available however. For example, cortisol and other biochemical markers remain untapped as potential contributors to the stress-eating puzzle. Similarly, a lack of more potent and longer term stress tasks in the laboratory make it difficult to compare our findings to many types of real world stressors.

Connected to the problem of optimally inducing and defining stress is the difficulty inherent in understanding how stress affects eating behavior. The low correlations we observed between objective and self-report stress variables, and the absence of a relationship between the self-report measures and food consumption creates vexing interpretive obstacles. If perceived stress in the form of questionnaire results is unable to account for eating variability in the laboratory, how do we reconcile this finding with the clear connection between self-reported stress and eating in clinical research? As a corollary of this, we may also ask if the self-reported stress dimension is more or less salient than physiology in the stress-eating relationship. A reply to either question would appear to require research designed to assess cognitive process variables.

Arguably the most important issue facing this and all other laboratory studies of stress-induced eating concerns the validity of extending our results to clinical samples. Practitioners working with eating disorder victims are acutely aware for instance that binge eating almost always occurs under isolated conditions, and that discrete episodes of binge eating may take place over periods as long as several hours (American Psychiatric Association, 1994). Laboratory research, confined typically to
the use of mild stressors, a limited range of food options, and relatively short durations, can at best hope to capture an experimental analogue for these idiosyncratic behaviors. The burden of proof for demonstrating that increased eating by high-restraint female participants represents such an analogue rests firmly on the shoulders of the laboratory scientist. Research bridging the gap between the overcontrolled lab environment and the uncontrolled field study is clearly necessary in order to reach a verdict on this issue.
REFERENCES


Winer, B. J. (1971). *Statistical principles in experimental design* (2nd ed.).
Table 1.

Condition means at baseline and task time points for the diastolic, systolic, and heart rate indices.

<table>
<thead>
<tr>
<th>Index</th>
<th>Condition</th>
<th>Baseline</th>
<th>Task1-1</th>
<th>Task1-2</th>
<th>Task2-1</th>
<th>Task2-2</th>
<th>Task3-1</th>
<th>Task3-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diastolic</td>
<td>Low stress</td>
<td>66.08</td>
<td>75.23</td>
<td>72.96</td>
<td>76.04</td>
<td>72.85</td>
<td>76.65</td>
<td>74.46</td>
</tr>
<tr>
<td></td>
<td>Inhibition</td>
<td>65.90</td>
<td>73.80</td>
<td>73.48</td>
<td>78.08</td>
<td>74.76</td>
<td>76.44</td>
<td>72.16</td>
</tr>
<tr>
<td></td>
<td>Expression</td>
<td>63.27</td>
<td>72.85</td>
<td>72.23</td>
<td>73.77</td>
<td>71.19</td>
<td>72.81</td>
<td>72.38</td>
</tr>
<tr>
<td>Systolic</td>
<td>Low stress</td>
<td>107.75</td>
<td>118.73</td>
<td>118.04</td>
<td>119.54</td>
<td>116.35</td>
<td>119.96</td>
<td>118.69</td>
</tr>
<tr>
<td></td>
<td>Inhibition</td>
<td>107.58</td>
<td>116.16</td>
<td>115.80</td>
<td>119.16</td>
<td>118.16</td>
<td>116.80</td>
<td>117.32</td>
</tr>
<tr>
<td></td>
<td>Expression</td>
<td>106.31</td>
<td>116.85</td>
<td>116.58</td>
<td>117.08</td>
<td>115.58</td>
<td>116.58</td>
<td>115.38</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>Low stress</td>
<td>68.98</td>
<td>81.04</td>
<td>81.54</td>
<td>77.85</td>
<td>77.88</td>
<td>79.58</td>
<td>79.38</td>
</tr>
<tr>
<td></td>
<td>Inhibition</td>
<td>70.38</td>
<td>79.32</td>
<td>82.00</td>
<td>81.72</td>
<td>84.24</td>
<td>81.24</td>
<td>81.12</td>
</tr>
<tr>
<td></td>
<td>Expression</td>
<td>72.35</td>
<td>80.69</td>
<td>84.15</td>
<td>79.58</td>
<td>82.50</td>
<td>80.73</td>
<td>81.58</td>
</tr>
</tbody>
</table>
Table 2.

Zero order correlations between the Restraint Scale (RS), Eating Inventory (EI), restraint component (R), composite stress index (Stress) and separate cardiovascular indices (diastolic, systolic, and heart rate), stress x restraint interaction term (SxR), Cookie (Cook), Cracker (Crack) and overall food consumption (Food), time since previous meal (Time) and positive and negative PANAS dimensions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>RS</th>
<th>EI</th>
<th>R</th>
<th>Stress</th>
<th>SxR</th>
<th>Cook</th>
<th>Crack</th>
<th>Food</th>
<th>Diast</th>
<th>Systol</th>
<th>Heart</th>
<th>Time</th>
<th>PanPos</th>
<th>PanNeg</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS</td>
<td>1.0</td>
<td>.65***</td>
<td>.91***</td>
<td>-.02</td>
<td>.63***</td>
<td>.09</td>
<td>.35</td>
<td>.24*</td>
<td>-.07</td>
<td>.00</td>
<td>-.06</td>
<td>.02</td>
<td>.03</td>
<td>.07</td>
</tr>
<tr>
<td>EI</td>
<td>1.0</td>
<td>.91***</td>
<td>-.06</td>
<td>.58***</td>
<td>.01</td>
<td>.35</td>
<td>.24*</td>
<td>-.07</td>
<td>.08</td>
<td>-.12</td>
<td>-.06</td>
<td>.06</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>1.0</td>
<td></td>
<td>-.09</td>
<td>.71***</td>
<td>.04</td>
<td>.39</td>
<td>.26*</td>
<td>-.08</td>
<td>-.04</td>
<td>-.10</td>
<td>.04</td>
<td>.08</td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>1.0</td>
<td>.25*</td>
<td>-.37</td>
<td>-.16</td>
<td>-.33**</td>
<td>.81***</td>
<td>.82***</td>
<td>.78***</td>
<td>.03</td>
<td>-.10</td>
<td>-.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SxR</td>
<td>1.0</td>
<td>.18</td>
<td>-.19</td>
<td>.16</td>
<td>.18</td>
<td>.27*</td>
<td>.17</td>
<td>.08</td>
<td>-.11</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cook</td>
<td>1.0</td>
<td>.23</td>
<td>.79</td>
<td>-.34</td>
<td>-.28</td>
<td>-.29</td>
<td>.09</td>
<td>.18</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crack</td>
<td>1.0</td>
<td>.72</td>
<td>-.07</td>
<td>-.12</td>
<td>-.22</td>
<td>-.17</td>
<td>.12</td>
<td>.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>1.0</td>
<td>-.25*</td>
<td>-.23*</td>
<td>-.32</td>
<td>-.07</td>
<td>.06</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diast</td>
<td>1.0</td>
<td>.77***</td>
<td>.37**</td>
<td>-.03</td>
<td>-.03</td>
<td>-.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systol</td>
<td>1.0</td>
<td>.33**</td>
<td>.08</td>
<td>-.17</td>
<td>.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1.0</td>
<td>-.07</td>
<td>-.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PanPos</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PanNeg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

*p<.05  **p<.01  ***p<.001
Table 3.
Multiple regression results: Use of the composite stress, restraint component, and stress x restraint interaction terms in the prediction of post-stress food consumption.

<table>
<thead>
<tr>
<th>Variable/step</th>
<th>Mult R/R²</th>
<th>R² change</th>
<th>Beta</th>
<th>F</th>
<th>p. of F</th>
<th>F change</th>
<th>p. F change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stress</td>
<td>.33/.11</td>
<td>.11</td>
<td>-.33</td>
<td>9.01</td>
<td>.004</td>
<td>9.01</td>
<td>.004</td>
</tr>
<tr>
<td>2. Restraint</td>
<td>.43/.18</td>
<td>.07</td>
<td>.27</td>
<td>8.22</td>
<td>.000</td>
<td>6.74</td>
<td>.01</td>
</tr>
<tr>
<td>3. Interaction</td>
<td>.43/.18</td>
<td>.00</td>
<td>-.03</td>
<td>5.42</td>
<td>.002</td>
<td>.04</td>
<td>.85</td>
</tr>
</tbody>
</table>
Figure Caption

Figure 1. Mean food consumption for groups classified by restraint level and degree of cardiovascular arousal.

Figure 2. Diastolic recovery curves, measured in change scores relative to baseline, for the experimental-inhibition, experimental-expression, and control conditions.

Figure 3. Systolic recovery curves, measured in change scores relative to baseline, for the experimental-inhibition, experimental-expression, and control conditions.

Figure 4. Heart rate recovery curves, measured in change scores relative to baseline, for the experimental-inhibition, experimental-expression, and control conditions.