5-1995

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Veronica Lynne Broussard

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Veronica Broussard

Louisiana State University and Pennington Biomedical Research Center

Honors Thesis

Submitted to the Honors College and the Department of Psychology

May 1995

Running head: MENSTRUAL CYCLE, MOOD, OVEREATING

Abstract

It is well documented across a number of mammalian species that progesterone produces overeating and an increase in body weight. Our recent research has found that a high-fat, sweetened preload can provoke overeating in women. The present study was conducted to determine whether the magnitude of the overeating effect was related to phase of the menstrual cycle.

Female subjects who were menstruating regularly were given the Premenstrual Assessment Forms to complete across one menstrual cycleand participated in a feeding test during either the follicular phase (when estrogen is elevated and levels of progesterone are low) or the luteal phase (when progesterone is elevated and estrogen titres are lower) of the menstrual cycle. Women were also administered the Three-Factor Eating Questionnaire to determine their history of dieting (Restraint) and their tendency to binge (Disinhibition). Subjects were randomly assigned to the Preload or No Preload condition. In the Preload condition, subjects ingested a high fat, sweetened chocolate pudding, then were presented with a pasta meal and told they could eat as much as they wished. Subjects in the No Preload condition were given only the pasta.

In the Preload condition, subjects ingested more calories than in the control condition, in both the follicular and luteal phases of the menstrual cycle. Thus, the present data show that there are conditions under which overeating can be provoked in both high and low restraint women across the menstrual cycle.In follow-up studies we will further define those conditions by systematically varying fat content, sweetness, and chocolate flavor in test stimuli presented to women across the menstrual cycle.

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Background

Appetite and Macronutrients

Studies conducted with both animals and humans have shown an increase in caloric intake and body weight in females when progesterone levels are at their peak and estrogen levels are lower. Dalvit-McPhillips (1983) has reported a 500 kcal per day increase during the luteal phase. Females have also shown a reduction in caloric intake and body weight when estrogen levels are high. Studies with rats maintained on high-complex carbohydrate diets have shown a relationship between increased caloric intake and elevated progesterone levels and between decreased caloric intake and elevated estradiol levels (Wade, 1976). However, most human studies have failed to report the macronutrient changes in caloric intake. (Dalvit, 1981; Pliner & Fleming, 1983)

Specific response to sweet tastants has been reported to change in relation to sex hormones. Zucker (19690 has shown a significant reduction in sugar preference in ovariectomized female rats, which was reversed by daily injections of estradiol and progesterone. Rats (Geiselman, Martin, Vanderweele, & Novin, 1981) and monkeys (Kemnitz, Gibber, Eisele, & Lindsey, 1986) have shown increased preference for sweets when estradiol levels are elevated. Human studies

have shown women to exhibit high sucrose preference during the follicular phase when estrogen levels are high but lower sucrose preference during the luteal, or premenstrual, phase when progesterone levels are high (Aaron, 1975; Pliner & Fleming, 1983; Wright & Crow, 1073).

While many studies have specifically looked at sweet taste responsivity across the menstrual cycle, they have failed to study the subsequent effects on intake of other macronutrients, especially fat. Geiselman et al. (1981) found rats to increase sugar intake but also to decrease fat intake in relation to elevated levels of estradiol. This is consistent with clinical evidence which indicates that women prefer sweet foods during the follicular phase but fatty or fatty/sweet foods during the luteal phase (P.J. Geiselman, personal communication, May 10, 1993). Tarasuk and Beaton (1991) found a significant increase in fat intake during the luteal phase, which may specifically influence the change in caloric intake mentioned previously.

While there have also been reports that women have specific cravings for sweets during the luteal phase, a closer inspection of those reports leads one to conclude that alternative explanations are possible. For example, Bowen and Grunberg (1990) reported increased preference and ingestion of sweet food over salty and bland foods, in both phases of the menstrual cycle. However, the foods

they analyzed together as *sweet* were chocolate, coffee cake, and gum drops. These foods contain high levels of both fat and sugar; thus, it is not clear which macronutrients motivated the women's preferences. Also, Smith and Sauder (1969) stated that, in their data, answers to questions "regarding sweets and chocolate were not exclusive, and in fact 85% of those who craved chocolates also included themselves in the group who craved sweets" (p.283). It is unclear if cravings for chocolate indicate a specific preference for sugar and/or fat content independent of, or interacting with, chocolate or a unique effect of chocolate itself.

Mood and Appetite

It has been suggested by Smith and Sauder (1969) that a common physiological factor influences cravings for food during the premenstrual phase or times of depressed mood. Their results showed an association of food cravings with premenstrual feelings of tension and depression. Cohen, Sherwin, and Fleming (1987, cited in Rogers, Edwards, Green & Jas, 1992) found women to exhibit more negative mood combined with greater food intake and cravings premenstrually. However, Chaturvedi and Chandra (1989) reported a direct relationship between an increase in appetite and positive emotions, as well as between a decrease in appetite and negative emotions.

The particular manner in which the menstrual cycle, food preferences, and

mood interact is unclear. Wurtman and Wurtman (1989, cited in Rogers et al., 1992) suggest that changes in nutrient intake, especially carbohydrates, may facilitate the shift toward negative mood experienced by some women premenstrually. As chocolate is a food often craved during the luteal phase (Tomelleri & Grunewald, 1987; Rozin, Levine &Stoess, 1991; cited in Rogers et al., 1992), it is significant to note that chocolate is sometimes eaten for its positive effect on mood (Hill, Weaver & Blundell, 1991; Rogers, 1992; cited in Rogers et al., 1992). The reverse is also possible as depressed or negative mood could relax dietary restraint and increase food cravings and intake (Rogers et al., 1992). Negative mood has reportedly induced dieters and restrained eaters to overeat (Herman & Polivy, 1975). The author has already hypothesized that female sex hormones can affect food preferences, but evidence of the effects of the menstrual cycle on mood are varied and inconclusive.

Premenstrual Changes

Changes in mood, as well as appetite, play a major role in Premenstrual Changes (PMC; Halbreich & Endicott, 1985). Whether these symptoms occur in a very select portion of the population, diagnosed with Premenstrual Syndrome (PMS) or are an intrinsic part of the menstrual cycle which are exacerbated in PMS has not yet been conclusively determined. A modest effect of high dysphoric

moods and depression and low well-being during the premenstrual phase was found in healthy women who were not selected on the basis of premenstrual complaints (Gallant, Hamilton, Popiel, Morokoff & Chakraborty, 1991). Metcalf, Livesey, Wells, and Braiden (1989) found asymptomatic women to experience mood swings throughout the menstrual cycle, while women with PMS experienced mood swings that were more frequent and severe and occurred specifically during the premenstrual phase. Both-Orman, Rubinow, Hoban, Malley, and Grover (1988) compared Premenstrual Assessment Form (PAF) Daily Ratings of appetite with items of negative mood in subjects with and without PMS. They reported an increase in appetite during the luteal phase in all subjects, but they reported a much greater increase in PMS patients as compared to controls. PMS patients showed a significant correlation between increased appetite and negative mood during the premenstrual phase, but controls did not.

Halbreich and Endicott (1985) hypothesized that Premenstrual Changes (PMC) should be seen as various subtypes, which may be explained by partially overlapping, but different, physiological bases. There are a large variety of theories explaining PMC, including changes in levels of estrogen and progesterone, but the fluctuation of numerous physiological substances throughout the menstrual cycle has made it difficult to conclusively single out these sex hormones. In one of

few studies to measure daily blood levels of luteinizing hormone (LH), follicle stimulating hormone (FSH), estradiol, and progesterone, Hammerback, Damber, and Backstrom (1989, cited in Dinan & O'Keane, 1991) reported a greater occurrence of negative premenstrual symptoms in cycles with elevated levels of hormones.

Methodology

Insert Figure 1 about here

Experimenters have generally identified the 10 (Dalvit, 1981) or 14 (Lissner, Stevens, Levitsky, Rasmussen & Strupp, 1988; Tarasuk & Beaton, 1991) days before and following menstruation as the luteal and follicular phases, respectively. Studies have used changes in basal body temperature to confirm this designation of the phases; however, these changes have not been consistently significant (Fong & Kretsch, 1993). Except for a study which tested urinary LH to determine ovulation (Lyons. Truswell, Mira, Vizzard, & Abraham, 1983), most studies have not included mid-cycle days in their analyses (Dalvit-McPhillips, 1983). This has been done, largely, to account for variation in women's cycles and expected differences in lengths of the follicular phase. Lissner et al. (1988) have assumed

standard cyclicity of sex hormone levels across the menstrual cycle and have used these values to make conclusions of correlation with their food intake data. Tarasuk and Beaton (1991) have acknowledged that retrospective reporting of menses by subjects contributes to error variance. In future research, investigators should measure levels of sex hormones at the time of behavioral testing for variations in taste preferences, macronutrient intake, and mood (Wright & Crow, 1973). However, this can be very expensive, and further preliminary studies will be needed to justify such expense.

Dietary Restraint and Overeating

Obesity and eating disorder researchers have investigated why women who report that they are trying to restrict caloric intake frequently overeat. The intention to control body weight by restrictive eating is referred to as dietary restraint (Herman & Polivy, 1975). Researchers have found that dietary restraint can be disrupted by environmental and emotional variables such as dietary preloads, film-induced negative affect, and alcohol (Herman & Mack, 1975; Ruderman, 1986; Schotte, Cools, & McNally, 1990). These studies indicate that when dietary self-control is disturbed, overeating is more likely to occur in restrained eaters than in unrestrained eaters.

Recent studies have begun using the Restraint and Disinhibition scales of

the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) to separate the behaviors associated with dietary restraint and overeating. Westenhoefer, Pudel, and Maus (1990) found that subjects that scored low on the Restraint scale and high on the Disinhibition scale were obese, and those scoring high on both factors were moderately obese. This interaction between restraint and overeating suggests that obesity may be controlled by dieting and that overeating may not result from dietary restraint. A recent study found that dieting behavior moderates the effects of overeating on obesity (Lawson et al., 1993). It is possible that a feeding disturbance exists in subjects who score high on Disinhibition, and this disturbance may be masked by dieting unless this restraint is disturbed by stress or other disinhibitory stimuli, such as a dietary preload (Lawson, et al., 1993).

Our recent research has found that a high-fat, sweetened preload can provoke overeating in women (Geiselman, Smith, Williamson, Broussard,Plum, Kitchen et al., in press; Smith et al., in press; Geiselman,Smith, Williamson, Broussard, Plum, Womble et al., in press). The present study was conducted to determine whether the magnitude of the overeating effect was related to phase of the menstrual cycle.

Method

Subjects were women recruited from undergraduate psychology courses at Louisiana State University and received extra credit for their participation. A structured interview was conducted to eliminate potential subjects who met the DSM-IV (Diagnostic and Statistical Manual of Mental Disorders-fourth version; American Psychiatric Association, 1994) criteria for eating disorders (IDED-III; Interview for Diagnosis of Eating Disorder-IV; Williamson et al., 1990), and a food preference questionnaire was used to exclude anyone who did not like the foods that would be used in this study.

Subjects were women who were menstruating regularly. Subjects were interviewed to obtain information about their menstrual cycles and were given the Premenstrual Assessment Forms (PAF; Hallbreich et al., 1982) to complete twice during the experiment, once during their follicular phase (FP Version of PAF) and once during their luteal phase (LP Version). Day One of the menstrual cycle was designated as the day menstrual bleeding began. Subjects were instructed to complete the FP Version of the PAF during days 7-10 of their menstrual cycle. Subjects were instructed to complete the LP Version when they experienced their most severe premenstrual changes. Both versions of the 95-item PAF consisted of the same statements of possible symptoms experienced by the subjects. Subjects rated the items in terms of severity of symptoms (FP Version) and severity of

change in symptoms (LP Version) on scales of 1-6. Subjects participated in the feeding test during either the follicular phase or the luteal phase of the menstrual cycle. Phase of the menstrual cycle was determined by counting forward and back 14 days from the beginning of menstruation.

Women were also administered the Three-Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) to determine their history of dieting (Restraint) and their tendency to binge (Disinhibition). Subjects scored either >67th %ile or <33rd %ile on the Restraint and Disinhibition scales. The cutoff scores were <8 (low) or >13 (high) on the Restraint scale and <6 (low) or >10 (high) on the Disinhibition scale. Four groups were formed according to these cutoff scores on the TFEQ: Low Restraint/Low Disinhibition (LR/LD; n=20), Low Restraint/High Disinhibition (LR/HD; n=5), High Restraint/Low Disinhibition (HR/LD; n=10), and High Restraint/High Disinhibition (HR/HD; n=17). Subjects in each of these four groups were randomly assigned to the Preload or No Preload condition.

Feeding tests were conducted at lunch time, and all subjects had fasted for four hours prior to testing. In the Preload condition, subjects were presented with four small dishes of chocolate pudding, which were prepared according to a 2 (high or low fat) x 2 (high or low sugar) design. Subjects tasted and rated each of

the puddings on 14 different 100mm visual analog scales regarding the taste, texture, creaminess, sweetness, etc. of the puddings (See Appendix A). Subjects then ingested a 350 kcal preload of the high fat, high sweet chocolate pudding (140 g). Next, subjects were presented with a pasta meal (600g, 570kcal) and told they could eat as much as they wished. Subjects in the No Preload condition were given only the pasta; they were not given any of the four puddings. Subjects in the No Preload condition were given magazines without food advertisements and asked to sit quietly and read for approximately 20 minutes, while the other subjects participated in the taste test and ingested the preload.

Results

The feeding test paradigm was a 2 (High or Low Restraint) X 2 (High or Low Disinhibition) X 2 (No Preload or Preload) X 2 (Follicular or Luteal phase) between subjects factorial design. Data were analyzed using four-way analyses of variance (ANOVAs), with the dependent measure as the total calories consumed by subjects during the feeding test. A significant three-way interaction was found between restraint, preload condition, and menstrual cycle phase.

Insert Figure 2 about here

Scheffe's post-hoc analyses were performed on the means of caloric intake. In the No Preload condition, Low Restraint subjects ingested more calories in the Luteal phase (321 kcal) than in the Follicular phase (204 kcal), and this was marginally significant [$F(1,13) = 4.26$, $p = .06$].

Insert Figure 3 about here

Results showed that both High and Low Restraint subjects in both phases of the menstrual cycle had greater caloric intake in the Preload condition than in the No Preload control condition. High Restraint subjects ingested significantly more calories in the Preload condition than in the control condition in both the Follicular [452 kcal vs. 200 kcal; $F(1,14) = 14.79$, $p<.01$] and the Luteal phase [542 kcal vs. 243 kcal; $F(1,11) = 11.47$, $p<.01$]. During both menstrual cycle phases, the caloric intake of High Restraint subjects in the Preload condition was approximately 125% greater than caloric intake in the control condition.

Insert Figure 4 about here

Low Restraint subjects in the Follicular phase ingested significantly more

calories in the Preload condition (612 kcal) than in the control condition [204 kcal; $F(1,8) = 15.93, p<.01$]. Caloric intake for these subjects in the Preload condition was 200 % greater than caloric intake in the control condition. Low Restraint subjects in the Luteal phase also ingested significantly more calories in Preload condition than in the control condition [455 kcal vs.321 kcal; $F(1,15) = 7.54, p<.05$]. For these subjects, caloric intake was only 42% greater than in the control condition.

A 2 (High or Low Restraint) X 2 (High or Low Disinhibition) X 2 (FP Version and LP Version) mixed design (two-between, one-within) was used for the PAF. The dependent measures were 18 unipolar summary scale scores from each version of the PAF. Scores were converted to a percentage of the total possible for each summary scale. 18 three-way ANOVAs were performed on the data. Three-way interactions between restraint, disihibition, and PAF version were found for 15 of the summary scales. Summary scale two showed a two-way interaction between restraint and disinhibition. Tukkey's post-hoc analyses were performed on the summary scale scores to identify the nature of the interactions.

Insert Figure 5 about here

Summary scale one, "Low Mood/Loss of Pleasure," showed a significant three-way interaction [$F(1, 20) = 6.90$, $p < .05$]. Low Restraint/Low Disinhibition (LR/LD) subjects scored significantly higher on the LP Version than on the FP Version ($p < .05$), while Low Restraint/High Disinhibition (LR/HD) subjects scored significantly higher on the FP Version than on the LP Version ($p < .05$). On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and High Restraint/High Disinhibition (HR/HD) subjects ($p < .01$). Also on the FP Version, High Restraint/Low Disinhibition (HR/LD) subjects scored higher than LR/LD subjects, and this was marginally significant ($p = .06$).

Summary scale two, "Endogenous Depressive Features," showed a significant two-way interaction between restraint and disinhibition [$F(1,20) = 10.14$, $p < .01$]. LR/HD subjects scored significantly higher than HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$).

Summary scale three, "Lability (Mood Shifting)," showed a significant three-way interaction [$F(1, 20) = 9.86$, $p < .01$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while LR/HD subjects ($p < .05$) scored significantly higher on the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .01$). Also on the FP Version,

HR/LD subjects scored higher than LR/LD subjects, and this was marginally significant ($p = .05$).

Summary scale four, "Atypical Depressive Features," showed a significant three-way interaction [$F(1, 20) = 10.74$, $p < .01$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while LR/HD subjects ($p < .05$) scored significantly higher on the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .01$).

Summary scale five, "Hysteroid Features," showed a significant three-way interaction [$F(1, 20) = 12.83$, $p < .01$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while LR/HD subjects ($p < .05$) scored significantly higher on the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .01$). Also on the FP Version, HR/LD subjects scored significantly higher than LR/LD subjects ($p < .05$).

Summary scale six, "Hostility/Anger," showed a significant three-way interaction [$F(1, 20) = 7.49$, $p < .05$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while LR/HD subjects ($p < .05$) scored significantly higher on the FP

Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .01$).

Summary scale eight, "Anxiety," showed a significant three-way interaction [$F(1, 20) = 8.85$, $p < .01$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while HR/LD subjects ($p < .05$) and LR/HD subjects ($p < .05$) scored higher on the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .05$).

Summary scale ten, "Impulsivity," showed a marginally significant three-way interaction [$F(1, 20) = 3.99$, $p = .06$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .05$). Also on the FP Version, HR/LD subjects scored significantly higher than LR/LD subjects ($p < .05$).

Summary scale eleven, "Organic Mental Features," showed a significant three-way interaction [$F(1, 20) = 4.65$, $p < .05$]. LR/HD subjects ($p < .05$) scored higher on the FP Version than on the LP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .05$).

Summary scale twelve, "Signs of Water Retention," showed a significant

three-way interaction [$F(1, 20) = 6.33$, $p < .05$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .05$). Also on the FP Version, HR/LD subjects scored significantly higher than LR/LD subjects ($p < .01$).

Summary scale thirteen, "General Physical Discomfort," showed a marginally significant three-way interaction [$F(1, 20) = 4.21$, $p = .05$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .01$). Also on the FP Version, HR/LD subjects scored significantly higher than LR/LD subjects ($p < .01$) and, with marginal significance, higher than HR/HD subjects ($p = .06$).

Summary scale fourteen, "Autonomic Physical Changes," showed a significant three-way interaction [$F(1, 20) = 11.15$, $p < .01$]. HR/HD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while LR/HD subjects ($p < .05$) scored higher on the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .05$) and with marginal significance, higher than HR/HD subjects ($p = .07$). Also on the FP

Version, HR/LD subjects scored significantly higher than LR/LD subjects ($p < .05$).

Summary scale fifteen, "Fatigue," showed a significant three-way interaction [$F(1, 20) = 8.75$, $p < .01$]. HR/HD subjects ($p < .05$) and LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while LR/HD subjects ($p < .05$) scored significantly higher on the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .01$).

Summary scale sixteen, "Impaired Social Functioning," showed a significant three-way interaction [$F(1, 20) = 7.08$, $p < .05$]. LR/LD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while LR/HD subjects ($p < .05$) scored significantly higher on the FP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects ($p < .01$) and HR/HD subjects ($p < .05$). Also on the FP Version, HR/LD subjects scored significantly higher than LR/LD subjects ($p < .05$).

Summary scale seventeen, "Miscellaneous Mood/Behavior Changes," showed a significant three-way interaction [$F(1, 20) = 5.13$, $p < .05$]. LR/HD subjects ($p < .05$) scored higher on the FP Version than on the LP Version. On the FP Version, LR/HD subjects scored significantly higher than LR/LD subjects

($p < .01$) and with marginal significance, higher than HR/HD subjects ($p = .07$).

Summary scale eighteen, "Miscellaneous Physical Changes," showed a significant three-way interaction [$F(1, 20) = 6.72$, $p < .05$]. HR/HD subjects ($p < .05$) scored significantly higher on the LP Version than the FP Version, while HR/LD subjects ($p < .05$) scored significantly higher on the FP Version. On the FP Version, HR/LD subjects scored significantly higher than LR/LD subjects ($p < .05$). Also on the FP Version with marginal significance, LR/HD subjects scored higher than LR/LD subjects ($p = .07$) and HR/LD subjects scored higher than HR/HD subjects ($p = .08$).

Summary and Conclusions

Data for the No Preload condition support the literature that suggests that subjects would ingest more calories in the luteal phase than the follicular phase. While there is no difference in caloric intake between High and Low Restraint subjects in the follicular phase, there is a discrimination based on habitual eating behavior during the luteal phase. Responding to physiological motivation to ingest more calories in the luteal phase, High Restraint subjects begin restraining. Thus, only Low Restraint subjects had a significantly greater caloric intake in the luteal phase.

In the Preload condition, subjects ingested more calories than in the control

condition, in both the follicular and luteal phases of the menstrual cycle. Thus, the present data show that there are conditions under which overeating can be provoked in both high and low restraint women across the menstrual cycle.

In this study, we have used a high sugar/high fat chocolate pudding as a preload, and in future research we will want to determine to which component of the preload women are responding. In follow-up studies we will further define those conditions by systematically varying fat content, sweetness, and chocolate flavor in test stimuli presented to women across the menstrual cycle. Phase of the menstrual cycle will be determined by measuring basal body temperature to track ovulation. As stated earlier, it will eventually be our goal to directly measure blood levels of sex hormones at the time of behavioral testing to verify this factor of our studies.

The literature has suggested that sex hormones, mood, and eating preferences work together to affect changes in women's behavior across the menstrual cycle. The data from the summary scales of the PAF suggest that habitual eating patterns are related to changes in mood and physical symptoms across the menstrual cycle.The data show consistency among scores of the four groups in the luteal phase, while in the follicular phase, restraint and disinhibition have strongly affected PAF scores. The instances of significant differences

between scores in the follicular and luteal phases seem to be directly affected by the variability among scores in the follicular phase.

To further identify the relationships among sex hormones, eating behavior and mood, future studies should systematically measure mood symptomology at the time of behavioral testing, in addition to methodical determination of menstrual cycle phase.

While obesity is a problem of epidemic proportions in our society, dietary restraint is very common among women also. Out of hundreds of women screened for this study, very few subjects qualified for the Low Restraint/High Disinhibition group. The author recognizes that the data could be affected by this low number of subjects for this group, and this problem will be addressed as the study continues. The difficulty in finding subjects to fit this group also suggests that it is a group within the population which could well use further investigation.

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Figure Captions

Figure 1. Standard, cyclic levels of estrogens and progesterone across the menstrual cycle.

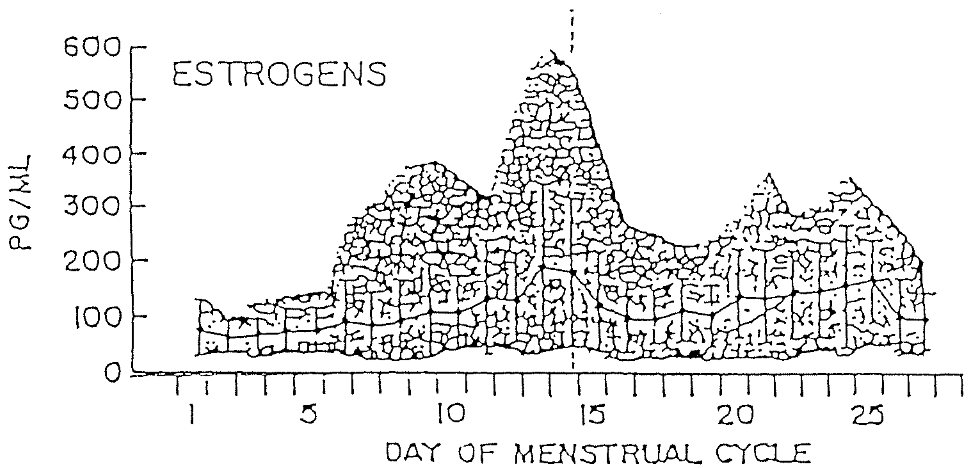
Figure 2. Total calories ingested in the control condition by High and Low Restraint subjects in their follicular and luteal phases.

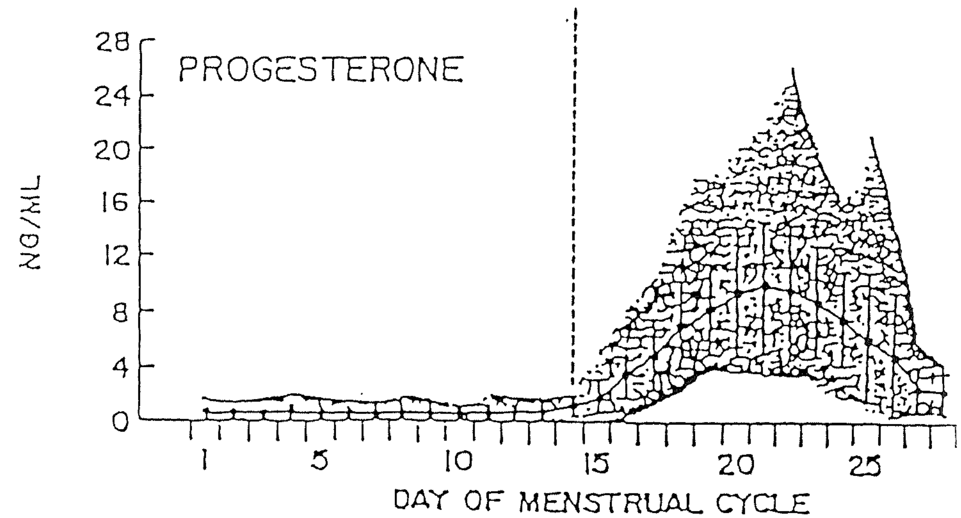
Figure 3. Total calories ingested in the Preload condition by High Restraint subjects in their follicular and luteal phases.

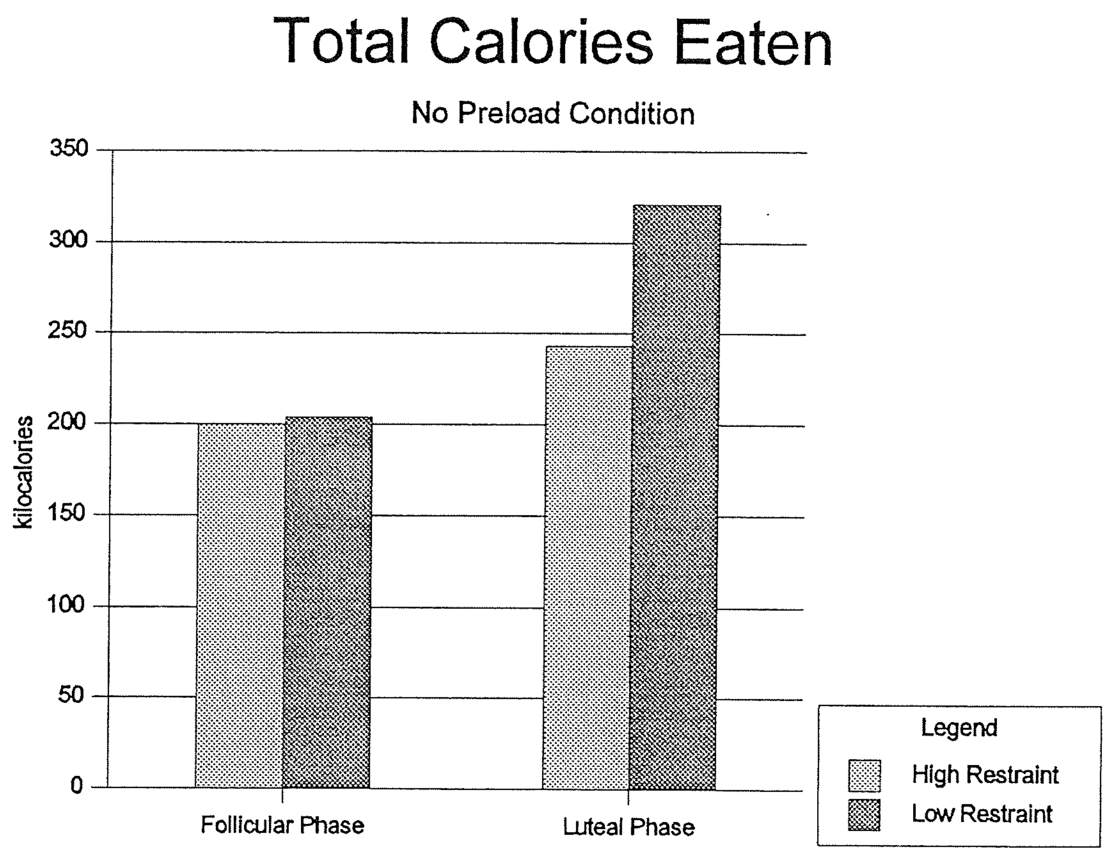
Figure 4. Total calories ingested in the Preload condition by Low Restraint subjects in their follicular and luteal phases.

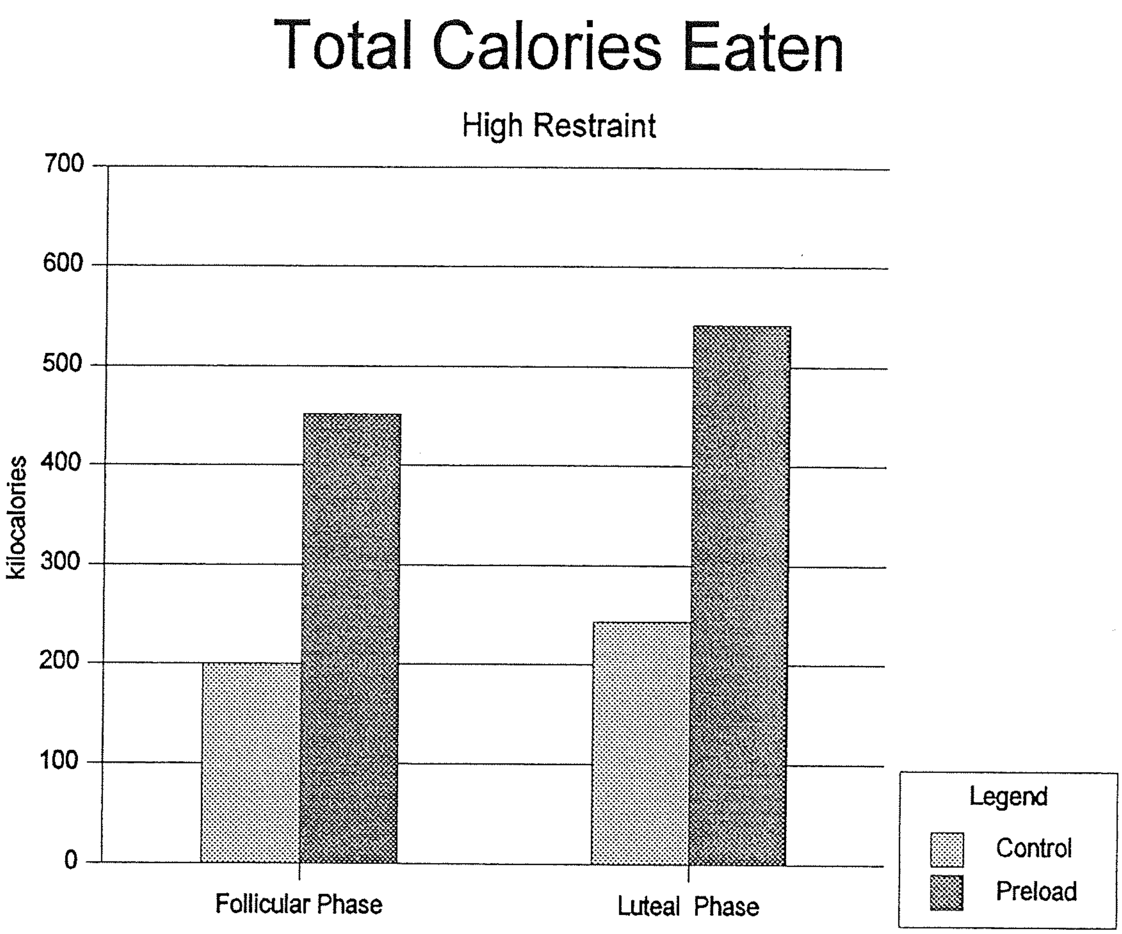
Figure 5. Mean scores on the Premenstrual Assessment Form (PAF) summary scales for the Follicular Phase and Luteal Phase Versions by Restraint and Disinhibition. Note. For each summary scale, cells with corresponding lower case letters indicate significant differences between means.

Estrogen and Progesterone Across the Menstrual Cycle

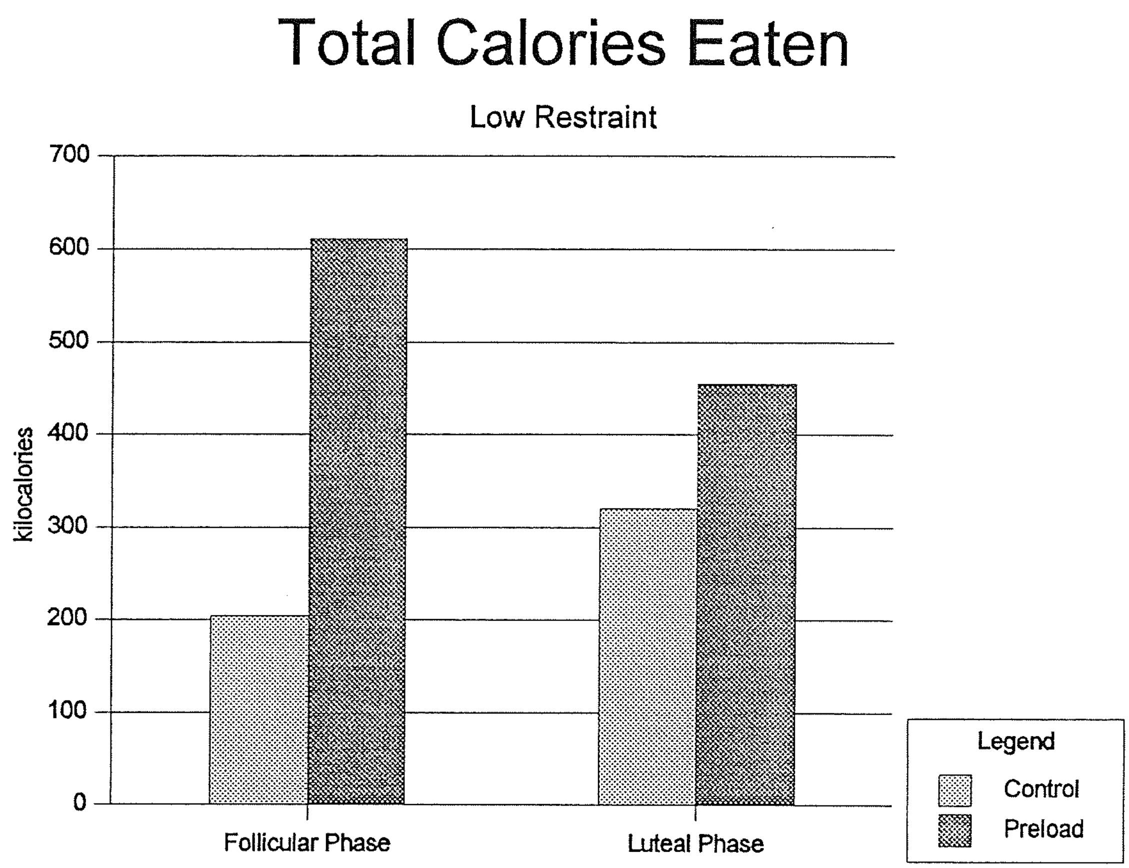





Total Calories Eaten
No Preload Condition
kilocalories
350
300
250
200
150
100
50
0
Follicular Phase
Luteal Phase
Legend
High Restraint
Low Restraint



Total Calories Eaten
High Restraint
kilocalories
700
600
500
400
300
200
100
0
Follicular Phase
Luteal Phase
Legend
Control
Preload


Total Calories Eaten
Low Restraint
kilocalories
700
600
500
400
300
200
100
0
Follicular Phase
Luteal Phase
Legend
Control
Preload

1	Follicular	Luteal
HR/HD	d 0.31	0.42
HR/LD	e 0.38	0.41
LR/HD	b c d 0.78	b 0.52
LR/LD	a c e 0.25	a 0.40

2	HRestraint	LRestraint
HDisinhib	a 0.24	a b 0.49
LDisinhib	0.24	b 0.24

3	Follicular	Luteal
HR/HD	a e 0.27	a 0.48
HR/LD	f 0.39	0.38
LR/HD	c d e 0.89	c 0.59
LR/LD	b d f 0.25	b 0.45

4	Follicular	Luteal
HR/HD	a e 0.32	a 0.55
HR/LD	0.42	0.43
LR/HD	c d e 0.81	c 0.58
LR/LD	b d 0.31	b 0.48

5	Follicular	Luteal
HR/HD	a e 0.32	a 0.47
HR/LD	f 0.34	0.36
LR/HD	c d e 0.85	c 0.59
LR/LD	b d f 0.24	b 0.37

6	Follicular	Luteal
HR/HD	a e 0.23	a 0.40
HR/LD	0.26	0.28
LR/HD	c d e 0.60	c 0.40
LR/LD	b d 0.20	b 0.31

8	Follicular	Luteal
HR/HD	a 0.31	a 0.45
HR/LD	d 0.41	d 0.31
LR/HD	c e 0.52	c 0.40
LR/LD	b e 0.30	b 0.41

10	Follicular	Luteal
HR/HD	a d 0.27	a 0.43
HR/LD	e 0.27	0.29
LR/HD	c d 0.57	0.50
LR/LD	b c e 0.20	b 0.34

11	Follicular	Luteal
HR/HD	0.32	0.32
HR/LD	0.25	0.27
LR/HD	a b 0.54	a 0.32
LR/LD	b 0.25	0.34

12	Follicular	Luteal
HR/HD	a d 0.28	a 0.39
HR/LD	e 0.40	0.39
LR/HD	c d 0.57	0.49
LR/LD	b c e 0.21	b 0.43

13	Follicular	Luteal
HR/HD	a d f 0.25	a 0.39
HR/LD	e f 0.49	0.47
LR/HD	c d 0.58	0.56
LR/LD	b c e 0.24	b 0.47

14	Follicular	Luteal
HR/HD	a d 0.23	a 0.35
HR/LD	e 0.33	0.27
LR/HD	b c d 0.47	b 0.35
LR/LD	c e 0.22	0.30

15	Follicular	Luteal
HR/HD	a e 0.27	a 0.43
HR/LD	0.36	0.34
LR/HD	c d e 0.63	c 0.48
LR/LD	b d 0.25	b 0.46

16	Follicular	Luteal
HR/HD	d 0.27	0.36
HR/LD	e 0.38	0.36
LR/HD	b c d 0.61	b 0.50
LR/LD	a c e 0.21	a 0.32

17	Follicular	Luteal
HR/HD	c 0.30	0.39
HR/LD	0.34	0.34
LR/HD	a b c 0.54	a 0.41
LR/LD	b 0.26	0.31

18	Follicular	Luteal
HR/HD	a e 0.24	a 0.36
HR/LD	b c e 0.42	b 0.32
LR/HD	d 0.43	0.41
LR/LD	c d 0.26	0.32

APPENDIX A

100 mm Variable Analog Scales to Rate Pudding

"How pleasant is the taste of this food?" ranging from "Not at all pleasant" to "Extremely pleasant"

"How pleasant is the texture of this food?" ranging from "Not at all pleasant" to "Extremely pleasant"

"How flavorful is this food?" ranging from "Very bland" to "Very flavorful"

"How strong is your desire to eat this food?" ranging from "Very weak" to "Very strong"

"How filling is this food?" ranging from "Not at all filling" to "Extremely filling"

"How high in fat does this food taste?" ranging from "Not at all high in fat" to "Extremely high in fat"

"How creamy does this food taste?" ranging from "Not at all creamy" to "Extremely creamy"

"How high in carbohydrates does this food taste?" ranging from "Not at all high in carbohydrates" to "Extremely high in carbohydrates"

"How thick does this food taste?" ranging from "Not at all thick" to "Extremely thick"

"How sweet does this food taste?" ranging from "Not at all sweet" to "Extremely sweet"

"How smooth does this food taste?" ranging from "Not at all smooth" to "Extremely smooth"

"How many calories do you think this food has?" ranging from "Very few calories" to "Very many calories"

"How bitter does this food taste?" ranging from "Not at all bitter" to "Extremely bitter"

"How chocolate does this food taste?" ranging from "Not at all chocolate" to "Extremely chocolate"