EFFECTS OF MENSTRUAL CYCLE PHASES AND DIETARY BEHAVIOR ON THRESHOLD AND PREFERENCE FOR SUCROSE

by

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(ABSTRACT)

The effects of menstrual cycle (MC) phases (post-menses, premenses, and menses) and dietary behavior (Normal (N), Restrainer (R), and Restrainer/Disinhibitor (RD)) on women's thresholds and preferences for sucrose solutions was investigated. MC phase was determined using both daily temperature readings and days of menses. Dietary group was assigned on the basis of women's responses to the Three Factor Eating Questionnaire (Stunkard and Messick, 1985). Women reported for sensory testing every third day for five weeks following a two-week training phase. Each evening subjects filled out a questionnaire to assess their overall daily fluctuations in total consumption; cravings for sweets; mood (feeling good, happy, and tired); pain (menstrual and other discomfort); metabolic need for energy (hunger, and fatigue); and stress. The results indicated that threshold did not vary due to MC phase ($p = 0.9118$),

Abstract
dietary behavior \((p = 0.4037)\), or the interaction of these two variables \((p = 0.2940)\). Preference for sucrose fluctuated as a result of MC phase only \((p = 0.0441)\). Of the variables assessed daily, only "other discomfort" \((p = 0.0486)\), "feeling good" \((p = 0.0091)\), and "feeling hungry" \((p = 0.0944)\) correlated with preference for sucrose. However, these correlations did not relate with MC phase clearly, indicating preference is not the manifestation of these theorized causes of MC distress. In general this study does not support the negative mood, or increased metabolic need for energy theory of MC distress. The theory of a decreased pain threshold found some support. The theory implicating dietary behavior in the development of MC distress symptoms was significantly supported. The fact MC phases have been implicated in the perpetuation of eating disorders implies the need for a counseling approach for the women most significantly affected, i.e. the R/D group.
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SUPRA-THRESHOLD TESTING---------------------65

AQUEOUS SOLUTIONS VERSUS SOLID FOODS IN SENSORY TESTING-------------------66

IMPORTANCE OF BASAL TEMPERATURE IN MENSTRUAL CYCLE-PHASE DETERMINATION-----67

METHODS

THE PRESENT STUDY

BACKGROUND---------------------------------------------69

PURPOSE-----------------------------------------------71

HYPOTHESIS--------------------------------------------72

INSTRUMENTS

INITIAL SCREENING QUESTIONNAIRE (ISQ)----------------73

EATING DISORDERS INVENTORY (EDI)------------------------74

THREE FACTOR EATING QUESTIONNAIRE (TFEQ)--------------76

DAILY MINI-QUESTIONNAIRE (DMQ)-------------------------77

SUBJECTS-----------------------------------------------78

RECRUITMENT-------------------------------------------79

SELECTION---------------------------------------------81

INITIAL SCREENING QUESTIONNAIRE-----------------------81

EATING DISORDERS INVENTORY---------------------------82

THREE FACTOR EATING QUESTIONNAIRE---------------------83

TRAINING---------------------------------------------84

SOLUTION PREPARATION---------------------------------85

TESTING----------------------------------------------86

SWEET-TASTE PERCEPTION-------------------------------87

Table of Contents vii
RESULTS AND DISCUSSION

THRESHOLD ----------------------------------------93
PREFERENCE----------------------------------------101
THEORIES OF MENSTRUAL CYCLE DISTRESS---------115

INCREASED NEGATIVE MOOD

FEELING GOOD-------------------------------------116
FEELING PRETTY-----------------------------------119
FEELING HAPPY-----------------------------------119

ELEVATED SENSITIVITY TO PAIN

MENSTRUAL DISCOMFORT------------------------122
OTHER DISCOMFORT-------------------------122

ELEVATED METABOLIC NEED FOR ENERGY

FEELING HUNGRY-------------------------127
FEELING TIRED-------------------------127

DIETARY BEHAVIOR

FEELING STRESSED--------------------------132

SERENDIPITOUS FINDINGS-------------------------140

CONCLUSION---------------------------------------------144
SUMMARY------------------------------------------------151
REFERENCES---------------------------------------------156
APPENDIX A: THE MENSTRUAL CYCLE------------------------176
APPENDIX B: SCHEMATIC OF THE MENSTRUAL CYCLE---------178
APPENDIX C: THREE FACTOR EATING QUESTIONNAIRE--------179
APPENDIX D: EATING DISORDERS INVENTORY----------------184
APPENDIX E: DAILY MINI-QUESTIONNAIRE------------------189
APPENDIX F: INITIAL SCREENING QUESTIONNAIRE----------191
APPENDIX G: EATING DISORDER INVENTORY:
MEAN SCALE SCORES FOR ANOREXIA AND
FEMALE COMPARISON GROUPS ------------------194
APPENDIX H: SUBJECT SCORES ON THE EATING
DISORDER INVENTORY--------------------------195
APPENDIX I: PRELIMINARY NORMATIVE GUIDELINES FOR
INTERPRETING RAW SCORES ON THE THE
THREE FACTOR EATING QUESTIONNAIRE--------196
APPENDIX J: SUBJECT SCORES FOR THE THREE FACTORE
EATING QUESTIONNAIRE----------------------197
APPENDIX K: CONSENT FOR PARTICIPATION------------198
APPENDIX L: DATA RECORDING FORMAT---------------199
LIST OF TABLES

TABLE 1: Effect of menstrual cycle phase on women's threshold to sucrose-----------------------------------94

TABLE 2: Effect of dietary behavior on women's threshold to sucrose-----------------------------------95

TABLE 3: Effect of the menstrual cycle-phase/dietary behavior interaction on women's thresholds to sucrose-----------------------------------96

TABLE 4: Effect of menstrual phase and dietary behavior on women's threshold to sucrose: a profile analysis-----------------------------------97

TABLE 5: Relationship of threshold to sucrose and the variables measured to study theories of menstrual cycle distress: a regression analysis---------98

TABLE 6: Effect of menstrual cycle phase on women's preference for sucrose-----------------------------------102

TABLE 7: Effect of dietary behavior on women's preference for sucrose-----------------------------------103

TABLE 8: Effect of the menstrual cycle-phase/dietary behavior interaction on women's preference for sucrose-----------------------------------104

TABLE 9: Effect of menstrual phase and dietary behavior on women's preference for sucrose: a profile analysis-----------------------------------105

TABLE 10: Relationship of preference for sucrose and the variables measured to study theories of menstrual cycle distress: a regression analysis---------107
TABLE 11: Effect of menstrual cycle phase and dietary behavior on women's daily ratings of "feeling good," "feeling pretty," and "feeling happy": a profile analysis-----------------------------117

TABLE 12: Effect of dietary behavior on women's daily ratings of "feeling good," "feeling pretty," and "feeling happy"-----------------------------118

TABLE 13: Effect of menstrual phase and dietary behavior on women's daily ratings of "menstrual discomfort" and "other discomfort": a profile analysis-----------------------------------------------123

TABLE 14: Effect of dietary behavior on women's daily ratings of "menstrual discomfort," and "other discomfort"--------------------------------------------124

TABLE 15: Effect of menstrual cycle phase on women's daily ratings of "menstrual discomfort," and "other discomfort"-------------------------------------125

TABLE 16: Effect of dietary behavior on women's daily ratings of "feeling hungry," and "feeling tired"-------------------------------------------------128

TABLE 17: Effect of menstrual cycle phase and dietary behavior on women's daily ratings of "feeling hungry" and "feeling tired": a profile analysis-----------------------------------------------129

TABLE 18: Effect of dietary behavior on women's daily ratings of "feeling stressed"--------------------------------------------134

TABLE 19: Effect of menstrual phase and dietary behavior on women's daily ratings of "feeling stressed": a profile analysis-----------------------------------------------135

TABLE 20: Effect of the menstrual cycle phase/dietary behavior interaction on women's daily
ratings of "feeling stressed"-----------------------------136

TABLE 21: Means of women’s daily ratings of stress as average total consumption increased------------------137
INTRODUCTION AND JUSTIFICATION

Human feeding is a very complex heterogeneous behavioral pattern (Hill and Blundell, 1982). Clark (1969) has noted that food habits are a result of education, sociocultural background, and one's present environment. The influence of the environment and present circumstances is so strong that mere signaling, either cognitively or physically, of a particular food will cause an increased intake of that food (Flatt and Bailey, 1983; Lovibond, 1983; Zamble, 1973). A particular situation may then be considered a conditioned stimulus associated with a particular food, and when presented, may elicit a craving for that food (Weingarten, 1985). Since food cravings are one of the most frequent and severe of reported menstrual distress symptoms (Siegal, 1986), it seems logical that the menstrual cycle (MC) itself or some physical or cognitive function of MC fluctuations may present such a conditioned stimulus and elaborate this behavior. Changes in taste perception seem to be a logical explanation of MC cravings, since some authors believe taste is of particular importance because of its close association with eating habits and food choice (Krondle, Coleman, Wade and Milner, 1983).

The cravings and increased appetite experienced by
women at various phases of their MC has been well documented (Abraham, Beumont, Argall and Haywood, 1981; Cohen, Sherwin and Fleming, 1987; Dalvit, 1981; Giannini, Price, Loiselle and Giannini, 1985; Gladis and Walsh, 1987; Leon, Phelan, Kelly and Patten, 1986; Manocha, Choudhuri and Tandon, 1986; Morton, Additon, Addison, Hunt and Sullivan, 1958; Siegal, 1986; Smith and Sauder, 1969; Sophos, Worthington-Roberts and Childs, 1987; Tomerelli and Grunewald, 1987). (For an overview of the MC see Appendix A and Appendix B.) The precise mechanism of these cyclic fluctuations has not been elucidated, although many theories have been proposed. Some of these theories include: the degree of one's dietary restraint (Herman and Polivy, 1975; Herman and Polivy, 1980; Herman and Polivy, 1983; Leon et al. 1986; Ruderman, 1986; Striegal-Moore, Silberstein and Rodin, 1986); the fluctuations in ovarian hormones by either an increase, a decrease, a change in their ratio, or a change in their rate of change (Andersch and Hahn, 1985; Backstrom and Carstensen, 1974; Blaustein and Wade, 1976; Clare, 1985; Cullberg, 1972; Czaja, 1978; Dalton, 1964; Dennerstein, Spencer-Gardner and Brown, Smith and Burrows, 1984a; Dennerstein, Spencer-Gardner and Burrows, 1984b; Halbreich, Endicott, Goldstein and Nee, 1986; Hamburg, 1966; Janowsky, 1985; Klaiber, Broverman, Vogel and

Introduction and Justification 2
and Keiser, 1983; Halbreich et al. 1986; Herren, 1933; Ladisich, 1977; Patkai, Johansson and Post, 1974; Peck, 1982; Reid, 1981; Strauss, Schultheiss and Cohen, 1983; Vila and Beech, 1977; Vila and Beech, 1978; Weiner and Elmadjian, 1962; Zuspan and Zuspan, 1973); altered taste sensory perceptions (Aaron, 1975, Glanville and Kaplan 1965; Weizenbaum, Benson, Solomon and Brehony, 1980; Wright and Crow, 1973); and mood changes (Cohen et al. 1987). Many of these proposed mechanisms seem to overlap -- i.e., perhaps it is diet behavior which causes the change in neurotransmitter metabolism, or the increased metabolic need for energy may be due to an increase in progesterone levels which is thought to increase metabolic rate, or an increased pain sensitivity may be due to fluctuating estrogen levels. Obviously this subject is quite complex, and the possible interactions among these mechanisms are myriad.

In addition, one difficulty inherent to the study of the MC is the vast variation in cycles among women and within each woman. The variations are the length of phases and the associated symptoms (Brooks-Gunn, 1986; Glanville and Kaplan 1965; Green, 1982; Halbreich and Endicott, 1985; Hart, Coleman and Russell, 1987; Moghissi, Syner and Evans, 1972; Moos et al. 1969; Siegal, 1986; Taylor, 1979; Van Den Akker and Steptoe, 1985).
Several authors have noted alterations in sensory functions which correlate to certain phases of the MC (Aaron, 1975; Glanville and Kaplan, 1965; Weizenbaum et al. 1980; Wright and Crow, 1973). Most studies have dealt with changes in hedonic preference rather than absolute detection thresholds, however. No generalizations from these studies have developed. However, individual variation has not often been considered in the assigning of phases. So, given the high degree of mechanism interaction and the inherent variability of the MC phenomenon, it is no wonder no conclusive answer to the question of the etiology of MC cravings and increased appetite has been found. It may be that there is not just one answer. It may be that there are many answers or many interactions.

In 1965, Glanville and Kaplan studied the fluctuations of taste sensitivity to bitter compounds as a function of MC phases. It was found that women experience greater taste sensitivity (lower threshold) during menses days than during their post-menses days. The one drawback to this study is the method of phase assignment. Glanville and Kaplan (1965) arbitrarily assigned phases by assessing a general number of days for each phase and placed these phases by using days of menstrual bleeding as the only marker. Given the vast variation between women
in the cyclic phenomenon and the overlap of MC symptoms, this method of phase assignment seems inadequate.

In the 1970s both Wright and Crow (1973) and Aaron (1975) tested the effect of MC phasing on sweet-taste preference by asking women in various phases of their cycle to pick their preference out of a series of sucrose solutions of varying concentrations. Subjects were tested one morning and their phase of that morning was assessed by the date of their last menses. A value of phase preference was obtained by averaging the responses of all the women who were in that particular phase on the day of testing. It was observed that women in menses and ovulation phases found sugar solutions more pleasant than women in pre-menses and pre-ovulation phases and significantly more pleasant than women in the post-ovulatory phase. It is felt that the women's normal sugar preference was not controlled for and that, to study the effects of MC phases on sweet taste preference, one would need to see how the MC phases altered the women's normal sugar preference. Therefore, an average of the women's preferences cannot provide a true value of how the MC phases affect sugar preference. A short-term "longitudinal" study of women at different phases of their cycle would be a more appropriate approach to assess the effect of MC phases on sweet taste preference. In

Introduction and Justification
addition, noting the vast variability in the MC, the assigning of MC phases by the subject's recall of the date of her last menses does not seem very accurate.

In 1980 Weizenbaum et al. conducted a more controlled study. MC phase was determined by monitoring daily basal body temperature as well as days of menstrual bleeding. Food intake and pleasantness of sucrose solutions of various concentrations were measured in women and men who served as controls several times over a seven-week span. Female test intervals were scheduled to include the menses, post-ovulatory, and luteal phases (LP) of the MC. Pleasantness ratings of sucrose were affected by gender and menses length but not by phase of the MC. Short-menses women found sucrose significantly more pleasant than men and long-menses women. There was a MC effect on food intake by short menses women, who increased food intake during the LP relative to their menstrual phase intake. The authors concluded that phase of the MC does not alter pleasantness response patterns to sucrose, and that reproductive variables must participate in control of human regulatory behaviors.

The inherent problems associated with studies of the MC may be the inhibiting factor in the valid analysis of these studies. Hopefully a study which addresses these difficulties and the profound MC phase variability will be
able to provide more definitive answers. In addition, by recording daily fluctuations in pain, hunger, fatigue, mood, and stress, it may be possible to correlate these fluctuations with fluctuations in sucrose preference or threshold and to identify one or more underlying mechanism of these sensory fluctuations.

Consistent low levels of general stress are more important to the degree and severity of MC symptoms than is any one episode of stress during any particular MC phase (Woods, Most and Longenecker, 1985). The association between greater general stress and MC distress is of growing concern in today's society, as more women join the workforce, become single parents, and try to strike a balance between their ingrained traditional view of the woman's role and their need to survive as a modern woman (Burden, 1986). With this increase in everyday stress, it seems logical that MC distress symptoms would become more prevalent and more exacerbated. Especially with the current emphasis on dieting, weight, and fitness, these cyclic eating pathologies are of great concern.

Although increased consumption manifested by cravings may be a natural requirement for some women during their MC, for many, this behavior represents an unwelcome break in their regular routine. It has been highly documented that mere perceptions of overeating can trigger a binge.

Introduction and Justification
episode in normal dieting women (Hibsher and Herman, 1977; Polivy, 1976; Ruderman, 1986; Spencer and Fremouw, 1979; Woody, Costanzo, Liefer and Conger, 1981). This phenomenon can be especially important in certain phases of the MC. Since it has been suggested that women become hungrier at certain phases of their cycle (Manocha et al. 1986; Morton et al. 1953), the dieter may perceive any increased intake to accommodate this hunger as overeating and thus trigger a binge. Normal eating in North American women is now characterized by dieting, and, as dieters, these normal eaters display characteristics of eating disorders (Polivy and Herman, 1987). If the relationship between dietary behavior and MC fluctuations can trigger full-fledged eating disorders, providing an understanding, or even just a clue, to the mystery of these cyclic fluctuations seems to be in high demand.

The present study uniquely focuses on the effects of MC phases and dietary behavior on women's detection thresholds and preferences for sucrose solutions. The "longitudinal" nature of the experimental design makes this study ideal to observe fluctuations in the MC phenomenon. The purpose was to observe the subject's threshold and preference fluctuations to sucrose over the different MC phases and how dietary behavior influences
these fluctuations. These cyclic sensory fluctuations in preference and threshold may be the mechanism responsible for inducing MC cravings in women with certain dietary behaviors. Furthermore, in an effort to investigate the various theories of MC distress, this study focuses on correlating daily fluctuations in mood (feeling good, happy, and pretty), metabolic need for energy (hunger, fatigue), stress, and pain (menstrual and other discomfort) with fluctuations in sucrose preference and threshold. These eight variables influence diet behavior, and thus may affect women's reactions to MC phases and distress. Thus, these sensory fluctuations may be the body's way of manifesting the increased intake which is concomitant to the pain, or the increased metabolic rate, or the change in neurotransmitters, or the change in hormone ratios, or one's dietary restraint, or stress, or mood, or any combination of the above, or even something entirely different. The above variables were tested for both MC phase and dietary group effects as well. It is suggested the assessment of all these correlations will permit an identification of the interaction between diet behavior and MC distress and provide a focus for a counseling approach to the elimination of the MC-eating pathology cycle.

Introduction and Justification
THEORIES OF MENSTRUAL CYCLE EVENTS WHICH AFFECT FOOD CONSUMPTION

HORMONAL EFFECTS ON INTAKE: Quite a few studies to elucidate the effects of hormonal fluctuations on taste perception have been conducted using animal models. Zucker (1969) found that female rats had a greater preference for sugar than male rats. This difference was attributed to ovarian hormones, since females treated with androgens and intact males evidenced a diminished sugar preference. Ovariectomized females required treatment with both estrogen and progesterone to restore sugar preference to its prior level (Blaustein and Wade, 1976; Zucker, 1969).

A study using intact rats showed that progesterone alone could increase food intake (Czaja, 1978). Ovariectomy in Mongolian gerbils also caused a decrease in intake, which estradiol could restore (Raible and Gorzalka, 1985). In this case, rather than working alone or with estradiol to restore food intake, progesterone attenuated the estradiol increase in food intake. Primates have also exhibited a change in intake associated with a change in ovarian hormones (Czaja, 1978). Intake
was found to decrease due to estrogen and to increase due to progesterone. This obvious inter-species variation makes extrapolation from animal models to humans virtually impossible. In addition, this large variation evidenced between and within these animal models also occurs in human females. Almost every conceivable variation or interaction of estrogen and progesterone has been investigated in hopes of explaining the cyclic phenomenon of human MC symptoms. However, though each study has made some contribution to explaining MC distress symptoms, not one of these has been able to stand the test of time and double-blind studies (Green, 1982). The variation seems simply too broad for one theory to explain.

Absolute levels of progesterone have been implicated in the etiology of MC intake. Progesterone has been proclaimed to be a metabolic stimulant (Landau, 1974). Webb (1986) found women to have an average increased energy expenditure of nine percent in the 14 post-ovulatory days of the LP. Webb attributed this increase to the high levels of progesterone which occur at this time because one subject, who had taken oral contraceptives for one month of the study, did not evidence an increased expenditure for that month, though she had demonstrated a 14 percent increase the previous month. However, in the same study, Webb was unable to
correlate the amount of progesterone levels with the degree of increased expenditure (Webb, 1986). Other authors contend that it is a progesterone deficiency, not excess, which causes MC distress symptoms (Backstrom and Carstensen, 1974; Dennerstein et al. 1984a; Munday et al. 1977; Munday et al. 1981). Clare (1985) showed that MC symptoms increased during the LP as progesterone levels decreased to low premenstrual values. In addition, Hamburg (1966) was able to induce depression by the withdrawal of exogenous progesterone treatments. To study this hypothesis, Andersch and Hahn (1985) administered either progesterone or a placebo to women complaining of premenstrual symptoms. Both treatments were found to be equally effective, implying a role of psychological factors in the etiology of MC symptoms. Other authors have shown progesterone to have a variable effect on MC symptoms (Backstrom and Carstensen, 1974; Munday, 1977; O'Brien et al. 1980).

Estrogen deficiency has been considered a possible cause of increased MC intake and cravings. Although estrogen levels are high during the LP, levels fall when MC symptoms are the most severe (Clare, 1985). This correlation implies a type of estrogen withdrawal in the etiology of MC symptoms. Klaiber et al. (1979), however, question this estrogen withdrawal theory, since estrogen
levels are also low at mid-cycle just after ovulation, when women report positive feelings and few MC symptoms. Perhaps the difference can be attributed to the absolute level of estrogen, since at mid-cycle estrogen is not at absolute bottom levels as it is during the premenstrual phase.

To explain these controversies, some authors contend that the ratio of ovarian hormones is more important in the etiology of MC distress symptoms than absolute levels of the individual hormones (Backstrom and Carstensen, 1974; Clare, 1985; Halbreich et al. 1986; Janowsky, 1985). To analyze this relationship, Cullberg (1972) gave women with a history of MC distress a dose of estrogen or a dose of progesterone. The women receiving progesterone experienced fewer symptoms, while the women receiving estrogen experienced more. In addition, women without any history of MC distress developed distress symptoms when given progesterone. Cullberg (1972) concluded that women who experience MC distress symptoms have an unbalanced ovarian hormone ratio, and since these women got better upon progesterone administration, the symptoms must be caused by an excess of endogenous estrogen or an increased susceptibility to estrogen. This estrogen effect cannot be the only solution however. Since administering progesterone to non-sufferers induced MC symptoms,
progesterone levels higher than the appropriate balance or
estrogen levels lower than this balance could be a
solution to the ratio differences.

In light of the inconsistencies in these hormone
levels and ratios, recent efforts have investigated the
effects of a differential rate of change in hormone levels
and the possibility of a time lag between these hormonal
changes and clinical symptoms. Halbreich et al. (1986)
conducted a study to investigate both these phenomena
simultaneously. Values of estradiol and progesterone and
their relationship to intake were analyzed by peak hormone
levels, absolute daily hormone levels, ratio at peak days
and every day, and rate of hormone decrease. A
significant positive correlation between increased
consumption and rate of progesterone decrease was found.
As rate of progesterone decrease increased, so did the
severity of MC symptoms. There was a weaker correlation
between MC symptoms and the rate of estrogen decline. In
addition, a time lag of four to seven days seemed
necessary for hormonal changes and clinical changes to be
significantly correlated. Dennerstein et al. (1984b) also
noted that a time lag of up to seven days may be necessary
for hormonally induced changes in mood to be obvious.
Evidence of a delayed influence of gonadal hormones on
some MC-related processings in the brain also supports
this time-lag notion (McEwen, Bigon, Fischette, Luine, Parson and Rainbow, 1984). Studies with animal models further indicate that a time lag may be important for feedback to the brain (Dallman and Yates, 1969). If indeed this time lag is crucial to the relationship between intake and hormones, the results of previous studies which did not take this lag into consideration may not be representative of the true phenomenon.

Among all the controversy about which hormone is the more crucial and how it exerts its effect are those beliefs that hormonal fluctuations have nothing to do with MC symptoms. Several authors (Backstrom and Carstensen, 1974; Leon et al. 1986; Rubinow et al. 1988; Taylor, 1977) contend that since estrogen and progesterone levels are not different in distressed and normal women, their clinical differences cannot be due to any type of hormonal fluctuation. Thus, if levels are indeed the same for distressed women, then perhaps their problems are a result of a differential rate of change or just an abnormal response to normal endocrine levels. Dalton (1964) refutes the idea that estrogen or progesterone could be involved in the etiology of MC distress, since ovariectomized and post-menopausal women also experience MC distress symptoms.

None of the theories postulated can be considered
conclusive because they have not withstood further testing. No matter how emphatically one study seems to prove a point, another study is available to refute the results. Part of this difficulty stems from the differences in experimental techniques. The results depend on how the phases have been defined, when the women are tested during these phases, and what specifically was investigated. In addition, the framework within which the experimenters are working must change the conclusions they draw as well as the way they conduct the experiment. It is believed that general MC distress is composed of different distinct clusters of problems and could therefore be caused by different variations in hormonal levels (Steiner and Carroll, 1977). So, just as no medicine can be effective against all symptoms of an ailment, it is likely that no one biological cause could explain the entire spectrum of MC distress symptoms. The increase in consumption and cravings, just like any other symptom, probably has more than one cause. Indeed, the problems of MC distress may not even be related to MC fluctuations. The fluctuations in hormones, catecholamines, endorphines, and other somatic parameters may only seem to coincide with fluctuations in MC symptoms when the true cause may lie elsewhere.
DIETARY BEHAVIOR: Since eating is such an integral part of human existence, any attempt to alter natural intake behaviors could produce profound changes, both physiological and psychological. Normal eating behaviors in North American women are now characterized by dieting. As dieters, these normal eaters display characteristics of eating disorders (Polivy and Herman, 1987). Many young women are preoccupied with their weight and experience the forms of behavior associated with anorexia without being emaciated (Button and Whitehouse, 1981). Button and Whitehouse (1981) found that seven percent of normal women exhibit eating behaviors characteristic of anorexics. Polivy and Herman (1985) found that 13 to 67 percent of normal non-clinical case women indulge in binge behavior. It seems eating disorders without a significant increase or decrease in weight (subclinical eating disorders) are highly prevalent (Garner and Garfinkel, 1979; Palmer, 1979; Russell, 1979; Wardle, 1980). Polivy and Herman (1985) believe these disorders are usually preceded by dieting, which introduces a cognitively regulated eating style to overcome the physiological defenses of the body (hunger). Many studies -- both observational (noting trends in clinical and non-clinical samples) and experimental (inducing an anorexic state and observing the results) -- have shown that anorexia, or dieting behavior,
precedes binge behavior (Boskind-Lodahl, 1976; Boskind-Lodahl and Sirlin, 1977; Clarke and Palmer, 1983; Cosina and Dixon, 1983; Franklin, Schiele, Brozek and Keys, 1948; Garfinkel, Moldofsky and Garner, 1980; Keys, Brozek, Henschel, Mickelsen and Taylor, 1950; Pyle, Mitchell and Eckert, 1981; Russell, 1979). Additional studies indicate that the severity of disinhibited behavior is proportional to the degree one is restrained (Herman and Mack, 1975; Marcus, Wing and Lamparski, 1985; Russell, 1979; Wardle, 1980). At the same time, Polivy and Herman (1986) are careful to point out that, while dieting may increase binge behavior, it does not cause binges -- i.e., there are successful dieters who are not prone to such disinhibitions.

The standard theory of diet behavior has been associated with a set-point, which is determined by one's own body fat stores (Booth, Fuller, and Lewis, 1981; Nisbett, 1968). The theory contends that dieters strive for a weight that is below their biologically determined set-point. This set-point is in dynamic equilibrium as the body tries to defend itself from fluctuations in weight. Sometimes influences can overcome the set-point, and the body will adapt to a new equilibrium. (Dent and Teasdale, 1988; Lowe, 1986). However, in the dieter, the reaction to caloric manipulation is primarily under
cognitive control (Polivy, 1976) -- if it were under physiological control, dieters would eat because they are hungry.

This cognitive inhibition is very prone to disruption (Polivy and Herman, 1987), and many dieters are never able to reach a new and lower set-point equilibrium. In addition, there are physiological mechanisms which strive to maintain this set-point. Nisbett (1968) and Cabanac (1971) found that, after a fast, dieters rated sweeter sucrose solutions as more pleasant. The authors attributed this increased desire for sweets to the body's attempt to compensate for a negative energy balance. Still another theory offers an alternative explanation of this increased palatability of sweet foods.

Sensory specific satiety is a term used to explain satiety after eating a particular type of food. The theory implies that not only do we fulfill our biological need for energy when we eat, but we also satisfy specific sensory sensations. In other words, after we eat enough of a sweet food, we will not want anything else sweet (Booth et al. 1981; Rolls and DeWaal, 1985; Rolls, Rolls and Rowe, 1983; Rolls, Rowe and Rolls, 1982). Several authors (Rolls, 1981; Booth, Mather and Fuller, 1982; Rolls and Rolls, 1982) have demonstrated that sensory specific satiety does occur at the neuronal level. Rolls
and DeWaal (1985) demonstrated that this sensory specific satiety is a long-term phenomenon. In other words, if a person's normal diet is high in sugar, he/she will have a smaller sugar preference than one who diets and denies himself/herself sweets. It follows then that dieters would have a greater sweet preference. Herman and Mack (1975) and Rodin, Moskowitz and Bray (1976) also found that weight loss increased pleasantness ratings of palatable foods. Since ratings were determined after a normal lunch, the authors felt that the subjects could not be hungry, and this additional intake must be due to a cognitive mechanism.

Polivy and Herman (1985) and Ruderman and Wilson (1975) state that dieting causes binging, and the degree of binging is determined cognitively. Polivy and Herman (1986) contend that the extent of a binge may be physiological, but, indeed, the trigger is cognitive. Thus, that the initiation of a binge is primarily cognitive has been highly evidenced. Many studies (Herman and Polivy, 1975; Hibsher and Herman, 1977; Polivy, 1976; Polivy and Herman, 1986; Spencer and Fremouw, 1979; Woody et al. 1981) show that dieters indulged in a greater binge when they thought a "forced preload" was highly caloric. The term, forced preload, comes from experimental designs whereby the experiment begins with dieting subjects being
forced to break their diets and subsequent food intake is measured.

Thus, mere perceptions of overeating can trigger a binge episode in normal dieting women. This phenomenon can be especially important in certain phases of the MC. Since it has been suggested that women become hungrier at certain phases of their cycle, a dieter may perceive an increased intake to accommodate this hunger as overeating, and such a perception may trigger a binge. Indeed, Leon et al. (1986) believe that the normal food consumption fluctuations over the MC may elicit binge episodes, which, in the typical diet-binge cycle, may develop into a clinical eating disorder. Cohen et al. (1987) agree that the cause of MC binges is perceived overeating. They found that, during the LP, dieters craved, and ate, less than nondieters. This finding would imply that the cravings and increased consumption found in the MC are not due to dieting (restraining) behavior alone, but perhaps to some taste-perception change or some other change innate to the MC, or merely the reaction of some dieters to these innate MC changes.

Some authors contend that dieters, being below their set-point, are continually hungry (Bennett, 1984), and this may be the reason for the high rate of disinhibition. Wardle and Beales (1987) and Legoff and Spigelman (1987)
have shown that salivary response to food and food cues is elevated in dieters. In general, however, the set-point theory has received little support. Heatherton, Herman, Polivy, King and McGree (1988) have shown that women who score high on dietary restraint scales do not have depleted fat stores, and thus cannot be starving or below their set-point. Hibsher and Herman (1977) did find increased free fatty acid levels (an index of energy depletion) in dieters, but could not identify their exact cause. In addition, simple hunger ratings have proven a poor instrument in the identification of dieters and non-dieters and in the estimation of food intakes (Hill, Magson and Blundell, 1984). The concept of a set-point is hard to study systematically, since there is no method available to assess an individual's set-point. If there were, we could measure it and compare it to one's current weight to determine causality. If these dieters have no increased metabolic need for food, could this mean these women are psychologically starving since they are continually denying themselves food?

Many studies show that dieters do not respond to normal internal regulatory cues (Herman and Polivy, 1975; Herman and Polivy, 1980; Herman, Polivy, Pliner, Threlkeld and Munic, 1978; Klajner, Herman, Polivy and Chabra, 1982; Polivy, Herman and Warsh, 1978). An example of this
externally oriented behavior is the dieters' reactions to negative moods. The normal physiological effects of stress include inhibited gastric contractions and an elevation of blood-sugar levels (Herman, Polivy, Lank and Heatherton, 1987). These responses in the normal non-dieting individual serve to decrease hunger. Stressed restrainers, however, do not respond to these internal cues, and eat instead. Herman and Polivy (1975) questioned whether this eating shouldn't decrease anxiety if it were induced by anxiety. They felt that, if the eating did not decrease anxiety, it could not be induced by anxiety, but rather by the set-point demand. The fact that no decrease in induced anxiety was found upon eating seems to support Herman and Polivy's suggestion (1975). However, one may wonder if the subjects' induced anxiety was not merely replaced by the anxiety about having eaten.

Indeed, many studies have shown that dieters forced to eat a preload — i.e., go off their diet — will be quite stressed by their actions and keep eating. It must be pointed out that it is not necessarily the preload which causes the subsequent binge; rather it could be just the stress of having eaten the preload that is the disinhibitor. As previously noted, mere perceptions of overeating can trigger a binge episode in normal dieting women (Ruderman, 1986; Spencer and Fremouw, 1979; Woody et
al. 1981). This disinhibition caused by the preload is called counter-regulation. Lowe (1982) has provided another explanation for this counter-regulation. She studied the relationship between counter-regulation and anticipated deprivation and contends it is the anticipated deprivation of starting over on one's diet which causes the dieters to binge. In other words, she believes the dieters feel that, since the preload has forced them off their diet, they might as well make the most of it (binge), and begin dieting again tomorrow (Lowe, 1982).

Still, after all these theories and studies, it is hard to say if dietary control is physiological or cognitive. Hibsher and Herman (1977) note that dieters are both hungrier and more emotionally volatile than non-dieters. Which came first, dieting or an elevated emotional state? Increased free fatty acids levels occur during both hunger and stress (Hibsher and Herman, 1977), so is hunger to be considered a stressor? Really, it is not known if this binge behavior is due to dietary habits, or set-point demand, or if something entirely different predisposes one to have elevated free fatty acid levels, or a reduced stress tolerance, and therefore diet (Hibsher and Herman, 1977). Does dietary restraint increase hunger, and thus induce a binge, or could restraining change taste sensitivity, and thus induce binge behavior?
Since the basis of the restraint-disinhibition relationship is not known, the cause of this phenomenon cannot be accounted for by just one cognitive or one physiological explanation.

Other unrelated studies have linked irregular eating patterns with alterations in brain neurotransmitters and the release of hypothalmic hormones (Goodwin, Fairburn and Cowen, 1987; Kaplan and Woodside, 1987). Diets low in protein cause a decrease in the plasma concentration of monoamine neurotransmitter precursors, thus inhibiting the synthesis of these neurotransmitters in the brain (Ashgar, 1986). Some of these neurotransmitters affect food intake (Kaplan and Woodside, 1987). However, despite a low protein intake, dieters have elevated levels of peptide neurotransmitters, since these endorphins tell the body to eat (Kaplan and Woodside, 1987). Women with MC distress also have increased endorphins (Kaplan and Woodside, 1987). This concurrent increase in endorphins in dieters and in women with MC distress supports the relationship between diet behavior and MC symptoms.

Another dietary effect is on hormone levels and the influence of diet patterns on plasma estrogen levels. Diets high in fat are correlated positively with plasma estrogen, while diets high in fiber are negatively correlated (Gorbach and Goldin, 1987). Gorbach and Goldin
(1987) observed the structural similarity of estrogen to bile acid and proposed that the diet can alter the route of estrogen excretion by influencing enterohepatic circulation. Golden, Adlecreutz, Gorbach, Warrem, Dwyer, Swenson and Woods (1982) note that vegetarian diets decrease plasma estrogen. It has been postulated that, since high-vegetable diets are also high in fiber, it is the fiber which shields estrogen from bacterial deconjugases and prevents its subsequent re-absorption (Gorbach and Goldin, 1987). If it is not the bulk effect, perhaps there is something else in fiber which can prevent B-glucuronidase activity (Gorbach and Goldin, 1987). Also, there could be some characteristic of fat, which increases B-glucuronidase activity, and thus increases estrogen re-absorption (Gorbach and Goldin, 1987). Indeed, activity of B-glucuronidase increases with the intake of a high fat, or a high beef diet, and decreases with antibiotics or a diet rich in whole grains (Goldin and Gorbach, 1976; Goldin, Swenson, Dwyer, Sexton and Gorbach, 1980; Reddy, Weisburger and Wynder, 1974). Whatever the precise mechanism, low levels of plasma estrogen have been correlated with an increased food consumption. Thus, this dietary influence on plasma estrogen may be an important factor in increasing consumption -- especially during phases of the MC when

Review of Literature 27
estrogen levels are already low.

In summary, due to the high degree of disinhibition prevalent in many dieters as a result of some stressor, the MC, with all its inherent stressors, may, for some women, be a disinhibitor, and trigger the cravings and increased consumption associated with typical binge behavior. Indeed, several theories have been postulated concerning the co-occurrence of MC symptoms and subclinical eating disorders. Both, it seems, are parallel symptoms of the same psychological process (Clarke and Palmer, 1983; Kaplan and Woodside, 1987; Kreipe, Strauss, Hodgman and Ryan, 1988). In addition, the effects of dietary restraint, or at least dietary irregularities, have been associated with changes in hormone, catecholamine, and endorphine levels, which may ultimately be the basis for the increased consumption.

INCREASED METABOLIC NEED FOR ENERGY: It has been postulated that the cravings and increased consumption experienced by women during certain phases of the MC is concomitant to an increased metabolic need for energy. Webb (1986) measured the 24-hour energy expenditure changes during different phases of the MC. He found that eight of ten premenstrual women had an increased expenditure ranging from eight to 16 percent (average nine
percent), which corresponds to about 142 kcals. In a similar study, Solomon et al. (1982) found basal metabolic rate to vary significantly within the MC and women to increase their energy expenditure by 395 kcal in the premenstrual versus the post-ovulation phase. The authors believe this increased energy expenditure could instill an increased biological need, and therefore could stimulate one's appetite via cravings. Brown and Toma (1986) and Bruera, Carraro, Roca, Cedaro and Chacon (1984) note that, at least for pregnant women and malnourished cancer patients, there are increases in preference and sugar thresholds, which are related to an increased biological need for energy. However, one may wonder whether the small LP increases in expenditure found by Webb (1986) and Solomon et al. (1982) would be significant enough to stimulate appetite.

Several studies have evidenced a type of hypoglycemia primarily in the LP. This hypoglycemia is characterized by an increased appetite, sugar cravings, depression, and an increased sugar tolerance, which would imply an increased carbohydrate metabolism (Bonora et al. 1987; Cohen et al. 1987; Dalvit, 1981; Hamburg, 1966; Hill and Blundell, 1982). These authors feel this increased tolerance to sugar signifies an increased need for carbohydrates in the LP, which causes a subsequent increase in consumption to
Many authors think the increased basal metabolic rate during the LP, as evidenced by an increase in heart rate, temperature, respiratory rate, and blood pressure, is a primary reason for the increased energy expenditure found in the LP (Hastrup and Light, 1984; Rosenberg, 1980; Sommers, 1982). More specifically, Wurtman (1985) and Fernstrom and Wurtman (1971) believe these craved carbohydrates are demanded to accommodate the synthesis of brain neurotransmitters. Other authors (Janowsky, Fann and Davis, 1971; Klaiber et al. 1979) agree, and contend that the low levels of premenstrual estrogen allow for increased monoamine oxidase activity, which decreases levels of endogenous catecholamines. However, in other studies (Sommers, 1982; Spellacy et al. 1967; Reid et al. 1986), no difference in glucose tolerance, insulin secretion, or carbohydrate metabolism due to MC phases was found. Wade (1972) also questions the validity of the hypoglycemic theory -- although women were hungrier and had changed their intake, they had not craved sweets. Indeed, Horowitz et al. (1985) found no difference in gastrointestinal emptying in ten women which were tested during two days of each the LP and the follicular (FP). However, it is believed the results would be more valid if more subjects been used and had a greater number of
observations per phase been made. Brala and Hagan (1983) performed one study to observe whether food intake is determined by the caloric value of the food or the taste of the food. The post-preload intake of three normal-weight, fasted groups of subjects was recorded. The three preloads were as follows: control (not sweet or caloric); aspartate (sweet, not caloric); and sugar (sweet and caloric). It was found that sweet taste was much more important than caloric value in the determination of short-term food intake (Brala and Hagan, 1983). Indeed, Polivy and Herman (1987) state that feelings of hunger play a small role in controlling consumption once eating has begun. These studies imply that, if there are consumption changes during the MC, they could be due more to a changes in sensory perception than to a need for more energy.

To further complicate matters, Rolls, Rolls and Rowe (1981) found a decrease in ratings of sweet pleasantness, which was apparent as soon as two minutes after eating sweets. The authors contend that this sensory specific satiety must be due to a sensory or cognitive change, and not to a post-absorptive or physiological change. In addition, Moskowitz, Kumraiah, Sharma, Jacobs and Sharma (1976) found that satiety influences sweet pleasantness ratings, but in a manner contrary to that predicted by
sensory specific satiety mechanisms. Moskowitz et al. (1976) found that after a sweet preload, there was no expected break point in the hedonic preference for sweets. Drewnowski and Greenwood (1983) also studied the breakpoint for hedonic preference, and found their to be no difference between the fed and fasted state. Although these three studies are seemingly different, they all imply the importance of cognitive mechanisms, as opposed to physiological mechanisms, in the determination of satiety. The fact that hunger is not correlated well with intake (Blundell and Hill, 1985; Hill and Blundell, 1982; Hill et al. 1984) also indicates a cognitive role is the assessment and satiety of metabolic need for energy.

The question of whether there is an increased metabolic need for energy concomitant to certain phases of the HC -- primarily the LP -- remains. Also, if there is an increased need, is the underlying mechanism physiological or cognitive in nature? Blundell and Hill (1985) contend the mechanism is both, and neither cognitive or physiological alone. Hunger is affected by total energy intake, palatability of the food, and the macronutrient composition of the food (Blundell and Hill, 1985).

PAIN EFFECTS ON INTAKE: Pain has been reported as one of
the most severe of all the MC-related distresses (Siegal, 1986). The body of evidence is both large and diverse and this diversity breeds a lack of consistency. One reason for the lack of consistency is the diverse nature of the MC. MC cycles vary unpredictably from month to month in the same woman and from one woman to the next. In addition to this variation, data analysis and making comparisons between studies has proven difficult due to the differences in methodology -- i.e., different pain inducers and different means to assess pain.

A high proportion of pain studies have found that women in the premenstrual phase have a greater sensitivity to pain and a lower pain threshold. Moos et al. (1969) found premenstrual-phase women were especially sensitive to pain. Collins et al. (1985) found pain to be greater in premenstrual women, but lower in ovulating women. Herren (1933) found that, although there were no differences in pain sensitivity in intermenstrual and postmenstrual women, pain sensitivity was elevated in premenstrual women.

In direct refute of these studies, Tedford et al. (1977) found no decrease in pain threshold in women during their premenstrual phase. To further exacerbate this controversy, Aberger et al. (1983) found premenstrual women to have a greater threshold and tolerance to pain.
(i.e., decreased sensitivity) than intermenstrual and menstrual woman. Veith et al. (1984) however, found no cyclic variations in pain thresholds associated with any phase of the MC.

Kuczmierczyk and Adams (1986) offer a possible explanation for Veith et al.'s results: they found that, for all the phases of the MC, women who professed to suffer from menstrual discomfort rated pain at a higher intensity than did the control-group women, who experienced no menstrual discomfort. Kuczmierczyk et al. (1986) again investigated the difference in pain tolerance and threshold between women who did and did not experience menstrual distress. In this second study, no difference between sufferers and non-sufferers was found. However, since obtained values had a very large standard deviation -- some even greater than the mean itself -- applicability of this study is questionable.

The mere suggestion of menstrually related variations in pain threshold and sensitivity is very important to the issue of menstrually related increases in consumption and cravings, especially of sweets. If pain can be considered a stressor, then perhaps cyclic cravings are the body's attempt to diminish this stress. It is known that sweet foods are preferred under stress (Bertiere, Baigts, Mandenoff and Apfelbaum, 1978). Blass, Fitzgerald and...
Kehoe (1987) have shown that infused sugar can decrease stress and lengthen the time of pain tolerance. These effects of infused sugar are reversible by an opioid receptor antagonist, naltrexone (Blass et al. 1987). This ability of sugar and sugar's reversibility by naltrexone imply that ingested sugar can act via an opioid mechanism to ease pain and stress.

Ashgar (1986) contends that a high-sugar diet increases opioid binding in the brain. Blass et al. (1987) note that ingesting sugar can stimulate opioid release, and the greater the sugar concentration, the greater the opioid release. Bodnar, Kelly, Spiaggia and Glusman (1978) observed that fasting can decrease pain thresholds. So, perhaps the increased consumption and cravings of women in various phases of the MC are a function of their relative pain level. In other words, when women feel MC pain, they may crave sugar to increase opioid binding, or release; consequently, they consume sugar to decrease their pain. Indeed, opioids are known to mediate the biological response to stress (Blass et al. 1987; Herman et al. 1987). Opioids not only decrease pain, they also cause an increase in sugar intake which is reversible by naltrexone (Blass et al. 1987; Reid, 1985). So, perhaps the increased pain causes a secretion of brain opioids which induce cravings for sugar to enhance opioid-
receptor binding. Another theory is that sufferers from MC distress -- the ones that crave sweets and increase their consumption -- merely have a greater-than-normal level of opioids (Blass et al. 1987; Reid, 1985).

A new theory of pain induction has recently been introduced by Bar, Amelink, Oldenburg and Blankenstein (1988). Noting that, traditionally, men are more susceptible to pain and muscle damage upon exercise than are women, Bar et al. (1988) investigated the possibility that estrogen may be the cause of this difference. To study this role of estrogens, they studied the efflux of a muscle-specific protein, creatine kinase (CK), in the intact rat. They found female rats had lower resting CK, as well as lower CK release upon exercise. This sex difference was extinguished upon ovariectomy and upon estrogen administration to male rats. So it seems estrogen has the ability to decrease muscular pain via protection of muscular membranes. Thus, perhaps, when estrogen levels decrease during the MC, women lose this estrogen-mediated protection and feel an increased pain intensity or sensitivity. This pain then could mediate increased sugar intake via the opioid mechanism discussed above.

An alternate theory (Bonen, Ling, MacIntyre, Neil, McGrail and Baleastro, 1979) is that high levels of
estrogen may result in greater fat metabolism which would delay the onset of fatigue and muscle damage due to energy depletion. When estrogen levels decrease during certain MC phases, fat metabolism would be replaced by carbohydrate metabolism and women would experience greater pain and fatigue. The increased pain, being considered a stressor, could itself increase cravings and consumption via the opioid mechanism. Or perhaps the increase in carbohydrate metabolism concomitant with the decrease in fat metabolism is the cause of the change in intake behavior.

In addition to MC variability and differences in experimental design, the mere complexity of these issues hinders the study of pain as an influence on MC behavior.

MOOD EFFECTS ON INTAKE: The validity of reported negative mood swings (anxiety, depression, and tension) as a result of MC phases has been a point of great controversy (Lahmeyer, Williams and Deleon-Jones, 1982; Silbergeld, Brast and Noble, 1971). Women self-report greater negative moods during the LP and menses, and more positive feelings during the FP and ovulation (Collins et al. 1985; Stout and Steege, 1985; Van Den Akker and Steptoe, 1985). Collins et al. (1985) measured psychoneuroendocrine responses to induced stress at different phases of the MC.
and found stress to vary across the MC and to peak in the LP. Chen and Filsinger (1987) however, found no main effect of MC phase on mood. Unfortunately, MC phase was determined only by the women recalling when their next menses would be, and mood ratings were assessed sporadically via an interview in which the women reported only their current mood. Yet, in support of these findings, Brooks, Ruble and Clark (1977) and Ruble (1977) observed that independently of real MC phase, women reported greater negative mood when they were in, or believed they were in, the LP than when they were in, or believed they were in the FP. Thus, it seems moods are largely subject to a psychological factor. So, if mood can or does change appetite, it must also exert this effect via a cognitive mechanism.

Contradicting this psychological-effect theory, other studies have associated these cyclic mood variations with some very real physiological changes -- primarily focusing on the hormonal fluctuations during the MC. Many depressed people have abnormal hormone secretions (Halbreich, Endicott and Nee, 1983; Sachar, 1986). A potent example of this is the post-partem depression experienced by many women when their ovarian hormones decrease to normal levels after delivery (Golub, 1976; Smith, Barish, Correa and Williams, 1972). Estrogen has
been shown to have anti-depressant properties (Klaiber et al. 1979; Oppenheim, 1984). Estrogen, or a combination of estrogen and anti-depressants, has been used clinically when anti-depressants alone have failed (Maggi and Perez, 1985). The effectiveness of estrogen in relieving depression is seen by some as a result of its relationship with endogenous catecholamines. Estrogen induces the release of endogenous catecholamines within the hypothalamus (Paul, Axelrod, Saavedra and Skolnick, 1979). Indeed, Stout and Steege (1985) contend that depression is due to an impaired adrenergic and serotonogenic transmission. Kaplan and Woodside (1987) agree, since discovering that norepinephrine metabolism is decreased in depressed individuals. Whether estrogen exerts its effect via catecholamines or some other mechanism, the relationship of estrogen levels to depression seems to be a very real physiological phenomenon. Since estrogen levels are much lower in the LP than in the FP, this phase difference in estrogen levels may confer some validity upon the self reports of a greater negative mood in the LP as opposed to the FP.

The question of the validity of MC mood swings has been assessed. Now the relationship between mood and consumption must be addressed. Khan (1981) notes that both appetite and mood change due to illness, but it is
not known which comes first, or even if they are interdependent. Clare (1985) contends that cravings for sweets are a reaction to a negative mood. Booth (1981) believes that eating can help distract a person in emotional distress. Therefore, an anxious, sad, or stressed state may become the incentive to eat. Foote, Aston-Jones and Bloom (1989) and Smith and Sauder (1969) observed a positive association between cravings, tension, and stress.

However, in a study of mood and cravings during the MC, Cohen et al. (1987) found both mood and craving to vary as a function of MC phase, but independently of each other. These results imply that cravings are not solely a reaction to mood. Indeed, for many years, lack of appetite has been a well-documented symptom of negative mood and depression (American Psychiatric Association, 1983). Only recently has this relationship been reassessed. It seems dysphoric mood can trigger a reversal of one's normal intake regulator (Baucon and Aiken, 1981; Fritjers, 1984; Herman and Polivy, 1975; Polivy and Herman, 1976a-c; Ruderman, 1985a; Ruderman, 1986; Zielinski, 1978). Negative mood can cause dietary restrainers to go off their diet -- lose control of their normal intake regulation mechanism (the positive reinforcement of health and image). Non-dieters in
negative moods also lose their normal intake regulation mechanism -- they lose their physiological desire to eat, and without this reinforcement, stop eating. One unexpected phenomenon of this relationship between loss of reinforcement and negative mood is the effect of alcohol. Alcohol, without its disinhibitory label, "alcohol," will decrease anxiety and cause restrainers to decrease food intake and non-restrainers to increase consumption (Polivy, 1976; Polivy and Herman, 1976b). So, dysphoric mood can induce a reversal of one's normal intake pattern and ultimately cause an increase or decrease in consumption. Thus, it seems the effect of negative mood experienced during the MC, whether real or imagined, can induce increased consumption and cravings in dietary restrainers, at the very least. The importance of this phenomenon is tremendous when one considers the vast proportion of female restrainers. Button and Whitehouse (1981) found that seven percent of normal women have eating behaviors characteristic of anorexics. Polivy and Herman (1985) found that 13 to 67 percent of normal non-clinical case women indulge in binge behavior.

BRAIN NEUROTRANSMITTER'S EFFECT ON INTAKE: The brain is considered the final common pathway regulating nutritional behavior (Steller, Hennin, Rodin, Rozin and Wilson, 1985).
Indeed, the interactions between the brain and peripheral structures seem endless. The hypothalamus is considered important with respect to eating behavior. Damage to the hypothalamus results in an altered set-point, the direction depends on where in the hypothalamus the damage has occurred (Bennett, 1984). Several neurotransmitters are thought to be involved in the neural pathways mediating eating behavior. Some of these which have been found to vary in association with MC fluctuations are: endorphins (polypeptides); serotonin (an amine); and epinephrine and norepinephrine (catecholamines). The effects of each of these neurotransmitters will be considered individually.

Endorphins: The relationship between endorphin levels and the MC is quite complex. Some authors go so far as to implicate endorphins in the etiology of MC distress (Giannini et al. 1984; Giannini et al. 1985; Peck, 1982; Reid and Yen, 1982). Kumar, Chen and Muther (1979) note that, in rats, B-endorphins vary with MC phase and covary with estrogen levels. Giannini et al. (1984) agree that B-endorphin levels fluctuate with the MC, but found levels to be highest just prior to menses rather than just prior to ovulation, as would be expected if B-endorphins fluctuated with estrogen levels. In addition, Giannini et al. (1984) found that the greater this premenstrual
increase in B-endorphins, the greater the premenstrual distress. Thus, it seems endorphins may cause, or somehow correlated with the cause, of MC distress. Yet, surprisingly, this relationship is inversely correlated. Peck (1982) assessed the effect of naltrexone, an opioid antagonist, on MC distress severity. He found that naltrexone caused an increase in premenstrual distress severity. So, if endorphins are implicated in the etiology of premenstrual distress, it must mean that premenstrual distress is a result of opioid withdrawal. The high premenstrual levels of endorphins, which increase with increasing severity of MC symptoms, could then be said to correlate with the increased demand of these opioids to combat distress. The fact that endorphins serve to block the release of luteinizing hormone seems to add further substance to the theory that opioids increase premenstrually. In other words, since luteinizing hormone is quite low during the LP, perhaps endorphins, which block their release, are elevated (Reid and Yen, 1982). Contending that human endorphin levels do not fluctuate at all during the LP, Hamilton, Aloi, Mucciardi and Murphy (1982) refute this opioid-withdrawl theory.

The bulk of the evidence seems to imply that endorphin levels are elevated during the premenstrual phase. Discrepancies may be accounted for by differences
in methodology. Since endorphins have consistently proven to increase sweet intake (Asghar, 1986; Blass et al. 1987; Giannini et al. 1984; Giannini et al. 1985; Margules, Moisset and Lewis, 1978; Peck, 1982; Reid, 1985), and opioid antagonists have consistently been associated with a decrease in sweet intake (Asghar, 1986; Blass et al. 1987; Margules, Moisset and Lewis, 1978), it seems accurate to deduce an association between MC cravings and MC endorphin fluctuations.

It is believed that this opioid-sugar relationship is a biological response to the presence of stress and pain, since stress has been shown to cause an increased sweet intake, which naltrexone decreases (Blass et al. 1987; Kaye, Pickar, Naber and Ebert, 1982; Weiner, 1985). Similarly, opioids can increase pain thresholds which naltrexone can decrease (Blass et al. 1987). It has been shown that sugar can decrease stress due to an opioid action. Using three concentrations of sugar, Blass et al. (1987) found rats have a greater pain tolerance and send out less distress calls when administered greater concentrations of sugar. These effects were inhibited by naltrexone. Asghar (1986) contends that a high-sugar diet increases opioid binding in the brain. Similarly, Blass et al. (1987) claim that sugar serves to increase opioid release proportionally to the sugar concentration.

Review of Literature
Therefore, eating sweets is like getting a reward and may initiate an addiction to sugar. This addiction may be the foundation of sugar cravings experienced during the MC. Indeed, it has been suggested that since opioids mediate sweet taste, cravers of sugar during the MC may just have an elevated level of opioids (Blass et al. 1987).

The MC can be considered a source of both stress and pain. So perhaps opioids and sugar act in this synergistic manner to mediate the biological response to the stress of the MC. Could it be that taste responsiveness -- i.e., alterations in sweet-taste perceptions -- mediates this link between opioids and increased sweet preference.

Serotonin: Estrogen and progesterone have been found to increase the uptake and turnover of brain serotonin (Ladisich, 1977). Since serotonin is known to decrease food intake, it seems that intake would decrease during phases of the MC when these ovarian hormones are high. The fact that serotonin turnover decreases in the premenstrual phase when estrogen and progesterone are low (Janowsky, 1985) supports these findings. In addition, this cyclic fluctuation of serotonin could have larger implications with respect to intake disruption during the MC than its effect on appetite alone.
Brown, Goodwin and Bunney (1983) have shown a decrease in serotonin to be associated with impaired impulse control. It seems that, if dieting behavior has any relationship to intake abnormalities during the MC, and if decreased serotonin can increase impulse behavior, then, the premenstrual decrease in serotonin could only serve to exacerbate, or initiate, disinhibitions in dieters. Wurtman, Wurtman, Growdon, Henry, Lipscomb and Zeisel (1981) have shown that serotonin decreases total food intake by decreasing the portion of carbohydrate intake. One could infer then that when levels of serotonin are low, the demand for carbohydrate might increase. Could this then imply that premenstrual sugar cravings are due to a decrease in serotonin which is concomitant to the premenstrual decrease in ovarian hormones?

In addition, since decreased serotonin uptake is observed in depressed patients (Perry, Marshall and Blessed, 1983), as well as in women in premenses, it seems that serotonin levels could have a causal association with premenstrual depression. Also, since depression serves as a disinhibitor for dieters, serotonin may also exert an effect on MC intake via depression.

Epinephrine and norepinephrine: Both self reports and

Review of Literature
objective tests, which have correlated quite accurately with one another, have evidenced a relationship between the MC and changes in nervous system activity. Several studies (Aberger et al. 1983; Armour and Asso, 1986; Asso, 1978) have shown cortical and autonomic nervous system activity to vary independently at two hormonally distinct phases of the MC. Cortical arousal -- "associated with aspects of cognitive functioning and with gross motor activity" (Armour and Asso, 1986, p. 139) -- is greater at ovulation than at the premenstrual phase. Autonomic arousal -- "associated with emotion" (Armour and Asso, 1986, p. 139) -- on the other hand, is greater during the premenstrual phase. There has been evidence which disputes this relationship (Patkai et al. 1974; Strauss et al. 1983; Weiner and Elmadjian, 1962; Zuspan and Zuspan, 1973). However, the overwhelming majority of studies have indicated a definite increase in autonomic nervous system (ANS) activity during the premenstrual days of the MC cycle (Asso, 1978; Goldstein et al. 1983; Vila and Beech 1977; Vila and Beech, 1978). Perhaps these differences in conclusions are due to differences in experimental design, including differential labeling and assessment of MC phases. Collins et al. (1985) assessed MC phase by daily monitoring of blood hormone levels -- the most accurate method available -- and found, indeed, there is an
increased autonomic arousal at premenses. The ANS controls involuntary movements; it seems logical that such involuntary activity would increase during phases of the MC, when basal metabolic rate and energy expenditure increase (Dalvit, 1981; Webb, 1986).

The ANS is composed of two separate systems: the parasympathetic and the sympathetic nervous system. The sympathetic nervous system is responsible for the "fight or flight" responses to stimuli and is responsive to norepinephrine (Fox, 1987). "Noradrenergic" is the term given to functions related to epinephrine and norepinephrine.

Since norepinephrine is one mediator of the ANS response, norepinephrine levels should covary with ANS activity. As stated above, this has not been illustrated conclusively. However, to further evidence the theory that ANS activity increases premenstrually is the relationship between norepinephrine and estrogen. Estrogen has been found to inhibit the neuronal response to norepinephrine in hypothalamic glucose responsive neurons (Kow and Pfaff, 1985). Norepinephrine in the hypothalamic ventromedial nucleus induces feeding by inhibiting neurons which signify satiety (Kow and Pfaff, 1985). Estrogen serves to inhibit this inhibition and thus signal satiety. Since estrogen is low during the
premenses days, it is unavailable to inhibit the norepineprine response. This disinhibition of norepineprine may explain why some women experience increased hunger and cravings during the premenstrual phase of the MC. Asghar (1986) contends there is a relationship between noradrenergic functions and cravings.

In addition to the estrogen withdrawal effect, the relationship between noradrenergic function and MC cravings could be stress-related. Stress has been shown to increase cravings and central adrenergic activity via the fight-or-flight response (Korf, Aghajanian and Roth, 1973). The fight-or-flight stress response is mediated through norepineprine, which alone could stimulate consumption. Since stress and thus ANS and norepineprine have been shown to increase premenstrually, it could be that premenstrual stress causes an increase in consumption via its stimulation of catecholamine release. If this eating behavior could decrease tension and noradrenergic activity, eating premenstrually could be habituating due to a learned craving for the eating behavior (Foote et al. 1980).

CONSUMPTION CHANGES: Mills (1977) states that, with respect to eating, "We are creatures of habit," and that in general we have very stable eating patterns across
time, which are immune to changes in season, outdoor temperature, and the day of the week. However, it must be pointed out that Mills observed only a very general, averaged consumption pattern in one company cafeteria and not fluctuations in individual choices. Also, despite this professed stability, women do experience consumption changes during the MC. Indeed, food cravings are among the most frequent and severe of reported MC symptoms (Siegal, 1986).

Morton et al. (1953) studied changes in food patterns and cravings during the MC, and found 37 percent of women studied craved sugar and 23 percent had an increased appetite. Dalvit (1981) took daily interviews for sixty days to evaluate intake in women over the course of the MC, and found LP women to have a greater intake than FP women by 500 kcals. Manocha et al. (1986) found this same cyclic pattern of food intake, but a difference of only 300 kcals. The difference between 300 and 500 kilocalories seems insignificant in the practical sense. Indeed, this difference probably can be attributed to a difference in instrument sensitivity. Cohen et al. (1987) observed changes in cravings and consumption over the MC. They found that both cravings and consumption correlated positively with one another and were greater in the LP than in the FP. Abraham et al. (1981) found that
not only do women eat more in the LP, they eat more carbohydrates during that phase. Tomerelli and Grunewald (1987) studied food cravings in women at various stages of the MC, and found no significant phase effect on their preference of sweet, starchy, or low-carbohydrate foods. However, these results are uncertain since the test instrument, a questionnaire, was administered only one morning a week, and subjects were to indicate a preference to food categories. It is believed that test subjects responded to the questionnaire with their preferences of the time of testing, not attempting to provide a retrospective weekly preference. Perhaps, the tests should have been conducted more frequently, to avoid the chance of missing a MC phase entirely during each seven-day span. Sophos et al. (1987) found no support for a cyclic pattern of eating in a study of intake, nutrient intake, and weight fluctuations over the MC. However, since women who had experienced a weight fluctuation of at least five pounds in the previous six months were not invited to participate in the study, those individuals most significantly affected by MC distress could have been excluded. Leon et al. (1986) did not find any relationship between MC phase and intake in normal-weight women with bulimia who were on medication for their problem, but Gladis and Walsh (1987) found bulemics who
were not on any medication experienced moderate, but significant, increases in binge behavior during the LP. Studies with bulimic subjects must be noted carefully. In both studies, subjects self-reported their number of binges per day on a weekly basis. In Leon's study responses were mailed in, however. In any self-report, subjects are free to respond as they wish, and with the answer they want people to believe. Perhaps in Leon's study, the medication was effective and thus the cause of the discrepancy in results, or perhaps the subjects did not want to admit that the medicine was not helping them. Asking the subjects to mail their responses could have made it easier for them to misrepresent their results. In addition, one may wonder if it is possible to detect any additional binge behavior in bulimic women.

Overall, the evidence seems to support a slight increased intake by women in the LP of the MC. In addition, Khan (1981) observed that a patient's appetite and mood can change due to illness, and that food preferences and selection are highly affected by short-term crisis situations. Given that the MC can be a short-term crisis situation, and can in some women approximate an illness, it seems feasible that changes in intake would no doubt accompany changes in the degree of MC stress. Whether the basis of this increased intake is
physiological or psychological has yet to be determined.

SENSORY CHANGES IN TASTE: O'Connor, Shelley and Stern (1974) note that some changes in sensory and motor measures of performance are MC-related. In a review of these changes, Parlee (1983) indicates visual, auditory, and tactile changes are quite prevalent. However, given that volumes of research have been devoted to the study of the MC and its related symptomologies, it is surprising that relatively little work has been done on the changes in taste perception. In addition, the stimuli, test conditions, and psychophysical procedures have varied across experiments making it difficult to draw general conclusions. Detection thresholds for bitter compounds -- propythiouracil and quinine -- have been found to decrease in women in their menstrual phase (Glanville and Kaplan, 1965). This increased sensitivity to bitterness during menstruation was so pronounced in one "non-tasting" subject that she could actually detect the bitter compounds (Glanville and Kaplan, 1965). This profound change in at least this one woman would indicate that changes in taste sensory perceptions can occur during the MC.

The evidence for sweet perception changes has not been as conclusive. Most studies have dealt with changes
in hedonic preference rather than absolute detection thresholds. Aaron (1975) evaluated sensory changes in threshold during the MC by having woman express their preference for three sugar solutions. It was found that sugar was rated significantly more pleasant by women in menses and ovulatory phases than by women in the post-ovulatory phase, and insignificantly more pleasant than by women in the pre- and post-menses phases. Tomerelli and Grunewald (1987) also found a decreased preference for sugar in women in the mid-luteal phase. In a similar but more detailed study, Wright and Crow (1973) assessed sugar preference fluctuations as a function of both MC-phase and sensory-specific satiety. Subjects were asked to rate their preferences for sugar solutions of different concentrations before, ten minutes after, and one hour after consuming 200 mls of a 25 percent glucose load. In baseline ratings (before load), women in post-ovulatory and early premenses phases were found to have a decreased preference for sugar. These findings are in agreement with the previous study. Ten minutes after the glucose load, women in all but ovulation phases evidenced a decreased preference for sugar. The authors inferred from this result that during ovulation women have a less-effective satiety mechanism. Indeed, Russell (1972) confirmed this assumption by showing that food intake
increased during ovulation. One hour after the glucose load, women in all phases had decreased preferences for sweet taste (Wright and Crow, 1973). The authors speculate that these preference changes are influenced by hormonal changes.

The reports of women craving sugar and sweets during premenses (Abraham et al. 1981; Cohen et al. 1987; Morton et al. 1953) seems to be in sharp contrast to these studies. Studies of sugar tolerance indicate that women in premenses experience a type of hypoglycemic effect (Bonora et al. 1987; Clare, 1985; Cohen et al. 1987; Dalvit, 1981; Hill and Blundell, 1982; Jarret and Graven, 1968). Authors of these studies contend that women crave the sugar due to an alteration in taste sensory perception and to accommodate their altered carbohydrate metabolism.

Although the studies are contradictory and thus inconclusive, there are many believers of the construct that there is indeed a change in taste sensory perception which will cause subsequent cravings and an increased consumption (Hook, 1978; Parlee, 1983; Woody et al. 1981). Mattes-Kulig and Henkin (1985) demonstrated that those individuals who have lost the sense of taste or smell will gain weight because they have a continued unsatisfied interest in finding food and taste. Perhaps these discrepancies can be accounted for by the vast individual
variation of symptoms and cycles experienced among all women and by individual women across time (Brooks-Gunn, 1986; Glanville and Kaplan, 1965; Green, 1982; Halbreich and Endicott, 1985; Hart et al. 1987; Moghissi et al. 1972; Siegal, 1986; Steiner and Carroll, 1977; Taylor, 1979; Van Den Akker and Steptoe, 1985). Still, it seems that if the variation were so extreme, no study would ever be able to make definitive conclusions about the results of even one study. It would appear that no generalizations are possible since every woman has her own unique cycle. Thus, differences in experimental methods are likely the cause of these conflicts.

BACKGROUND FOR EXPERIMENTAL DESIGN

INSTRUMENTS TO MEASURE DIETARY RESTRAINT: The first instrument to measure "dietary restraint" was Herman and Polivy's (1975) Restraint Scale. The Restraint Scale was developed to investigate the concept of restrained eating, i.e., the tendency for a person to restrict food intake to control body weight. This 1975 scale has been the choice in many successful studies on dietary restraint, or, more specifically, disinhibition. The results of these studies have been quite enlightening (Baucom and Aiken, 1981; Peck, 1982; Polivy, 1976; Polivy and Herman, 1976a–
c; Polivy, Herman, and Warsh, 1978; Ruderman, 1985a; Spencer and Fremouw, 1979; Woody et al. 1981; Zielinski, 1978). This research has shown that restrainers are distinct from non-restrainers in their eating responses following consumption of a highly caloric foods or alcohol, and during periods of stress or depression. A restrainer will eat more than a non-restrainer after consuming a high-calorie food and during times of stress and depression, but will eat less than a non-restrainer after consuming alcohol. Although this 1975 Restraint Scale has proven quite successful in identifying different dietary patterns, problems in the scale's construct have become apparent. Recently two subscales have evolved (Blanchard and Frost, 1983; Drewnowski, Riskey and Desor, 1982; Heatherton et al. 1988; Love, 1984), and the choice of subscales and knowing what actually is being measured has proven troublesome (Blanchard and Frost, 1983; Drewnowski et al. 1982; Frost, Gookasian, Ely and Blanchard, 1982; Herman and Polivy, 1975; Johnson, Lake, and Mahan, 1983; Lowe, 1984; Lowe, 1986; Ruderman 1985a; Ruderman, 1985b; Ruderman, 1986; Stunkard and Messick, 1985; van Strein, Fritjers, Bergers and Defares, 1986; Wardle, 1987, Wardle, 1986). In addition, subjects have shown confusion with regard to how to answer certain questions (Wardle, 1986). Due to the
problems associated with this 1975 scale (Herman and Polivy, 1975), it was determined a newer scale should be used.

The two newer restraint instruments are Stunkard and Messick's 1985 Three Factor Eating Questionnaire (TFEQ) and van Strein et al.'s 1986 Dutch Eating Behaviors Questionnaire (DEBQ). Both these tests have been able to identify the same disinhibitors of dietary restraint as the 1975 scale (Herman and Polivy, 1975; Stunkard and Messick, 1985; van Strein et al. 1986; Wardle, 1986). The TFEQ, however, was chosen over the DEBQ because of its greater appropriateness and preference of word choice and questions.

The TFEQ was designed to assess three dimensions of eating behavior: cognitive restraint, disinhibition, and hunger. Of these three scales, the disinhibition scale correlates the highest with the total score on Herman and Polivy's 1975 Restraint Scale (Stunkard and Messick, 1985, Wardle, 1986). (See Appendix C for a copy of the TFEQ.)

INSTRUMENTS TO MEASURE ANOREXIA NERVOSA AND BULEMIA NERVOSA: The Eating Disorder Inventory (EDI) by Garner, Olmsted, and Polivy (1983), was chosen as the instrument to identify clinical cases of anorexia nervosa and bulimia nervosa because it more clearly distinguishes between
these patient groups and subclinical cases (i.e. normal dieters). The EDI consists of eight subscales: interoceptive awareness; body dissatisfaction; ineffectiveness; bulimia; maturity fears; interpersonal distrust; perfectionism; and drive for thinness. The scores of these subscales can be used to assess the degree of a subject's eating pathology. Clinical anorexics and bulimics score high on all eight subscales. Normal dieters score high on the drive for thinness, body dissatisfaction, and perfectionism scales only (Garner, Olmstead, Polivy and Garfinkel, 1984). The difference between patients and dieters evidenced by the subscale scores is a psychological ego deficit found in patients, but not in sub-clinical dieters (Button and Whitehouse, 1981). Thus, weight-preoccupied dieters express attitudes similar to clinical anorexics and bulimics, but are free of the psychological disturbances found in the clinical cases (Garner et al. 1984). The ability of the EDI to measure these psychological differences is the primary reason for its choice in this study. The Eating Attitudes Test (EAT) by Garner and Garfinkel (1979) is another popular instrument used to measure symptoms of anorexia and bulimia. The EAT, however, does not completely distinguish between clinical and subclinical eating pathologies (Clarke and Palmer, 1983; Garner and
Garfinkel, 1979; Garner, Olmstead, Bohr, and Garfinkel, 1982). Rather, it is more beneficial for detecting subclinical eating pathologies. Button and Whitehouse (1981) contend "the EAT is more accurately viewed as a measure of the concern about weight and food intake, rather than exclusively a measure of the symptoms of anorexia nervosa". Clearly, for the purposes of this study, the EDI is the better choice since it can actually identify clinical cases of eating pathologies. (See Appendix D for a copy of the EDI.)

THEORY ON TASTE PREFERENCE: Taste perception (identification thresholds) and taste preference to sweets follow different power functions (Drewnowski and Greenwood, 1983; Hill and Blundell, 1982; Moskowitz, 1971; Moskowitz, Kluter, Westerling and Jacobs, 1974). Usually individuals are able to identify solutions of increasing sucrose concentration as being increasingly sweeter without reaching an upper limit at which they can no longer distinguish a more concentrated solution. However, individuals given the same series of solutions and asked to specify a preference will express a greater preference with increasing concentration, but will find an upper limit after which their preference declines with increasing sweetness. This break point for individuals
falls at a constant sweetness level, not at a constant sweetness concentration (Moskowitz et al. 1974). This difference between sweetness level and concentration becomes important when solutions of different sweeteners are tested. Small changes in sweet concentration can greatly affect hedonic preference (Drewnowski and Greenwood, 1981). Moskowitz (1971) found this preference break point for sucrose to be within eight to ten percent sucrose concentration. An assessment of changes in sweet preference is felt important since food preferences are a useful indication of consumption (Mattes, 1988; Pilgrim, 1961).

An additional point is that, though all women can equally detect sweet intensity, women with any level eating disorder have a greater preference for sweet foods (13 to 15 percent sucrose wt/wt) than do women with normal dietary habits (nine percent sucrose wt/wt) (Bellisle, Drewnowski, Aimez and Remy, 1987; Drewnowski, Halmi, Pierce, Gibbs and Smith, 1987a; Drewnowski and Schteingart, 1987; Hill and Blundell, 1982). This difference in preference was not associated with any difference in weight (Drewnowski et al. 1987a; Drewnowski, Wittala and Schteingart, 1987b). Thus, if dietary restraint is associated with MC-related changes in taste sensitivity, noting changes in sweet preference is quite
THRESHOLD TECHNIQUES:

Stairwise Technique: The "stairwise" method by Cornsweet (1962) is thought to be the best, most-efficient threshold technique (Bartoshuk, 1979). Stairwise experiments are conducted with only one subject at a time. This one-to-one relationship enables the experimenter to maintain constant control and ensures the identification of the subject's correct threshold. Samples are presented from the lowest to the highest level of the desired characteristic. The experimenter provides the subject with one sample (the lowest concentration), and asks if the sample has the desired characteristic. If the subject responds negatively, the experimenter continues presenting samples of increasing concentration until the subject responds affirmatively (i.e., that he/she can detect the desired characteristic). At this point, the experimenter presents a sample of the next-lower concentration and continues decreasing the concentration until the subject can no longer detect the characteristic. Then, the experimenter, once again, presents samples of increasing concentration until the subject can respond affirmatively. This up-and-down procedure usually continues for many
reversals. The subject's threshold is determined by averaging the peak points (the lowest concentration which the subject could detect the characteristic for each trip up the "stairs"), or by determining the concentration above which 50 percent of the responses are affirmative (Cornsweet, 1962).

While this method is extremely efficient and reliable, problems with "sensory fatigue" arise when the samples require tasting or smelling. Sensory fatigue is a term used to describe the exhaustion of sensory receptors (i.e., taste buds) which occurs when too many samples are tested. Since the basis of the stairwise test's reliability requires many trips up and down the continuum of concentrations, testing many samples is inevitable. Such a vast number of samples would quickly result in sensory fatigue and ultimately decrease the test's validity (Stone and Sidel, 1985).

In addition, one must wonder how accurate the assigned threshold could be, since subject's guessing can largely affect the test's validity. Stone and Sidel (1985) and Drewnowski and Moskowitz (1985) point out that the frequency of subjects' guessing is quite high because subjects try to provide the correct response.

Paired-comparisons: The benefits of using paired-
comparisons have also been highly acclaimed (Bartoshuk, 1979; Kelty and Mayer, 1971; Stone and Sidel, 1985). A paired-comparison test is a two-sample test in which the subject is asked to identify which sample has more of a designated characteristic, such as sweetness. By presenting the subjects with an array of pairs of varying concentrations, subject thresholds can be determined by the lowest concentration at which he/she can correctly identify the correct sample. Forcing the subject to make a choice reduces the likelihood of arbitrary guessing and provides a built-in control to prevent arbitrary guessing from interfering with threshold assignment. However, in order to obtain the precision of the stairwise method, many pairs of samples would be required. Thus, as with the stairwise test, there can be problems with sensory fatigue.

Combination of paired-comparisons and the stairwise technique: Introducing paired comparisons into the stairwise method seems to be the solution to the problems incurred when either method is used alone. Subjects would not only have to make a choice of which solution is sweeter, they would have to make the correct choice consistently. Thus, performing the stairwise technique with paired samples prevents the acceptance of arbitrary
affirmative responses and eliminates the guessing problem. In addition, since the experimenter controls which pairs the subject is given according to the subject's own responses, the number of samples required is significantly decreased. Decreasing the number of pairs decreases the likelihood of taste fatigue, and thus increases test validity, reliability, and efficiency.

Supra-threshold testing: There has been some debate over the effectiveness of threshold testing as opposed to supra-threshold testing (Bartoshuk, 1979). Both threshold and supra-threshold techniques are used to indicate taste sensitivity. Solutions of very low solute concentration (i.e., sub-threshold concentrations) are used in threshold testing. The threshold found by this method is the lowest concentration which the subject can detect 50 percent of the time (Cornsweet, 1962). In supra-threshold testing, solutions of much greater solute concentrations are used. More concentrated solutions are used in an effort to better approximate real-life experiences. Determining thresholds using supra-threshold concentrations requires a technique called magnitude estimation. "In a magnitude estimation experiment, the respondent assigns a numerical value (neither less than zero nor a fraction) to each sample. This numerical value should represent the
perceived intensity [of the specified attribute] for that sample" (p.73) (Stone and Sidel, 1985). Both threshold and supra-threshold detection have merits and specific applications where one or the other is more useful. It was felt, for the present study, threshold testing would be more appropriate. The extent to which subjects require training before any sensory responses can be considered stable is still not known (Mattes, 1988), and the techniques used in supra-threshold testing are difficult for the panelist and require extensive training (Stone and Sidel, 1985).

AQUEOUS SOLUTIONS VERSUS SOLID FOODS IN SENSORY TESTING: It is well-known that aqueous solutions do not resemble real foods (Mattes, 1988; Witherly, Pangborn and Stern, 1980). However, in preference testing, the preferred concentration has proven to be proportional between foods and water (Mattes, 1988). In other words, the preferred solution and the preferred food will have the same sweetness, but not the same sweet concentration -- i.e., foods can have greater sweetness concentrations (Moskowitz et al. 1974). In addition, in threshold testing, the reliability of thresholds determined by aqueous solutions has proven to be greater than that for foods (Mattes, 1988). The difficulty in equating the responses of
threshold and preference testing by aqueous and food systems may be caused by this difference in reliability.

IMPORTANCE OF BASAL TEMPERATURE IN MENSTRUAL CYCLE PHASE DETERMINATION: It has been well-documented that women vary within and among themselves with respect to MC phases and distress symptoms (Brooks-Gunn, 1986; Glanville and Kaplan, 1965; Halbreich and Endicott, 1985; Hart et al. 1987; Moghissi et al. 1972; Siegal, 1986; Steiner and Carroll, 1977; Taylor, 1979; Van Den Akker and Steptoe, 1985). Because of this variability, it is important that adequate, scientific, and precise methods are used to assure proper MC-phase identification. Assigning phases by counting backward and forward a pre-determined number of days from menses cannot be accurate for all women in a given study. Using basal body temperature to determine day of ovulation seems to be important to ensure a more accurate identification of MC phases. According to Moghissi et al. (1972), on the day of the luteinizing hormone peak there is a slight decrease in basal body temperature, followed the next day by a sharp increase in temperature (ie, 97.46 to 98.00 °C), which will stay elevated throughout the LP. In other words, a sharp rise in basal body temperature implies that ovulation has occurred 24 hours prior to the temperature increase, and
marks the onset of the premenstrual phase.
METHODS

THE PRESENT STUDY

BACKGROUND: The present study was concerned with the effects of MC phases and dietary behavior on women's thresholds and preferences for sucrose solutions. Thirty-six college-age, normal-weight women were tested for taste threshold and preference to sucrose solutions. The solution concentrations used to determine detection thresholds were 3, 5, 10, 15, 20, 25, and 30 mmol/l. The concentrations used to determine sweet preference were 315.32, 360.36, 405.41, 450.45, and 495.50 mmol/l, corresponding to 7, 8, 9, 10, and 11 percent sucrose respectively. Subjects attended four training sessions prior to data collection. Sensory tests were conducted every third day for five weeks in order to evaluate variations in sensory function across the MC. To investigate various MC-distress theories, degree of dietary restraint and daily fluctuations in mood (feeling good, happy, and pretty), metabolic need for energy (appetite, fatigue), stress, and pain (menstrual and other discomfort) were assessed via initial screening questionnaires and a daily mini-questionnaire (DMQ) (see Appendix E for a copy of the DMQ). Since phases of MCs
are very individualized, two methods to pinpoint the subject's MC phases (recording days of menses and basal body temperature) were used. Both methods were used simultaneously to divide each subject's MC into three phases. These three phases were: post-menses (from menses to ovulation); premenses (from ovulation to menses); and menses (days of bleeding). The great variation which prevents the arbitrary assigning of days to phases is also a primary reason for the frequency of testing (i.e. every third day). Each subject was placed into one of three dietary behavior groups according to her score on Stunkard and Messick's (1985) Three Factor Eating Questionnaire (TFEQ). These dietary groups were Normals (N) i.e., non-restrainers/non-disinhibitors; Restrainers (R); and Restrainers/Disinhibitors (RD). The Eating Disorder Inventory (EDI) by Garner et al. (1983) was used to identify and eliminate anorexics from the subject population.

Fluctuations in sucrose threshold and preference were analyzed by both MC phase and dietary group for all subjects as one unit, and also by phase for each of the three dietary groups (i.e., MC phase by dietary group interaction). In an effort to investigate the various theories of MC distress, daily fluctuations in mood (feeling good, happy, and pretty); metabolic need for

Methods
energy (appetite, fatigue); stress; and pain (menstrual and other discomfort) were correlated with fluctuations in sucrose preference and threshold. The effect of MC phase, dietary behavior, and the interaction of these two variables was also determined. The variables used to study MC distress theories also influence diet behavior, and thus may affect reactions to MC phases and distress. Thus, fluctuations in threshold and preference may be the body's way of manifesting the increased intake, which is concomitant with the pain, or the increased metabolic rate, or dietary restraint, or stress, or mood, or any combination of the above, or even something entirely different.

These correlations should permit an identification of the interaction between diet behavior and MC distress and provide a focus for a counseling approach to the elimination of the MC-eating pathology cycle.

PURPOSE: The main purpose of the present study was to assess the effects of MC phases (post-menses, premenses, and menses) and dietary behavior (Normal (N), Restrainer (R), and Restrainer/Disinhibitor (RD)) on women's threshold and preference for sucrose solutions.

There were several secondary objectives:

1. to correlate the variables measuring mood
(feeling good, happy, and pretty), metabolic need for energy (appetite, fatigue), stress, and pain (menstrual and other discomfort) with threshold and preference fluctuations in an effort to investigate possible underlying causes of these taste perception fluctuations;

2. to use the relationship between MC phase and the variables measuring mood (feeling good, happy, and pretty), metabolic need for energy (appetite, fatigue), stress, and pain (menstrual and other discomfort) to investigate various current theories of MC distress: the degree of one's dietary restraint, an altered pain threshold, an increased metabolic need for energy, and mood changes.

HYPOTHESES:

1. Young women who exhibit normal dietary behavior (N) will not evidence any significant MC-phase fluctuations in threshold or preference for sucrose, whereas young women identified as dietary Restrainers (R) or dietary

Methods
Restrainer/Disinhibitors (RD) will exhibit significant threshold and preference fluctuations during their MC.

2. These R and R/D group women will experience the greatest increase in threshold and preference during their premenstrual phase as opposed to their post-menses and menses phases.

3. Considering the variables measuring mood (feeling good, happy, and pretty), metabolic need for energy (appetite, fatigue), stress, and pain (menstrual and other discomfort) as signs of MC distress, the N group will not exhibit any significant phase fluctuations in MC distress or any subsequent eating behavior. Both the R and R/D group women will experience significant premenstrual increases in these MC distress symptoms. However, only the R/D group women will evidence any subsequent elevated eating behavior.

INSTRUMENTS

INITIAL SCREENING QUESTIONNAIRE (ISQ): This questionnaire
was given to all women interested in participating in the study. The purpose was to obtain some background information on each candidate and from this information invite for further screening only those candidates that met all the requirements. Important criteria were outlined to all interested women during the recruitment sessions, and this ISQ served as a double check of participant qualification. Subjects were asked to provide the following information: date of birth, height, and approximate weight. This information ensured each chosen subject fell within the pre-determined age and weight range. Questions of general health; medications; regularity of menstruation; smoking habits; sleep patterns; exercise habits; special diet; and alcohol consumption were also included. Of these questions, those pertaining to regularity of menstruation, alcohol consumption, medications (specifically oral contraceptives) and smoking habits were considered most valuable for subsequent subject selection. (See Appendix F for a copy of the ISQ.)

EATING DISORDERS INVENTORY (EDI): The EDI is a "64-item, self-report, multi-scale measure designed for the assessment of psychological and behavior traits common in anorexia nervosa and bulimia" (Garner, et al. 1983, p.15).
It was chosen as the instrument to identify clinical cases of anorexia and bulimia because it more clearly distinguishes between these patient groups and subclinical cases (i.e., normal dieters). The EDI consists of eight subscales: interoceptive awareness; body dissatisfaction; ineffectiveness; bulimia; maturity fears; interpersonal distrust; perfectionism; and drive for thinness. The scores of these subscales can be used to assess the degree of a subject's eating pathology. Clinical anorexics and bulimics score high on all eight subscales. Normal dieters score high on drive for thinness, body dissatisfaction, and perfectionism scales only (Garner et al. 1984). Questions pertaining to each subscales are mixed within the 64 statements. Subjects respond to each of the 64 items by rating each item on a six-point scale from "always" to "never." In scoring the EDI, "the most extreme 'anorexic' response (‘always' or 'never' depending on the specified item direction) [earns] a score of 3; the immediately adjacent response 2, the next response 1 and the three choices opposite to the most 'anorexic' response receive no score (0)" (Garner et al. 1983, p.19). (See Appendix D for item-direction and item-scale identification.). For example, though both items 14 and 22 evaluate the maturity fears of the subject, the response of "never" would earn a different score on the
two items. Item 14 is positively directed, thus the most extreme anorexic response which would earn a score of 3 is "always," a response of "usually" earns a 2, and a response of "often" earns a 1. Any other response to item 14 (including "never") would earn a score of 0. Item 22, on the other hand, is negatively directed, thus the most anorexic response which would earn a score of 3 is "never." In this case a response of "rarely" would earn a 2, and a "sometimes" would earn a 1, and any other response would earn a score of 0. The score for each of the eight scales is the sum of all item scores for that particular scale.

THREE FACTOR EATING QUESTIONNAIRE (TFEQ): The TFEQ (Stunkard and Messick, 1985) is a 51-item self-report, multiscale measure designed to assess three dimensions of eating behavior: cognitive restraint, disinhibition, and hunger. The TFEQ consists of two parts. Part one is composed of 36 true-false items; part two consists of 15 rating-scale items. Questions from all three scales are mixed within each of the two parts. In Part one, the subject is asked to respond to the statements by answering "true" if she feels the statement is true. If she gives the "correct" answer (either "true" or "false" depending on the item's direction), she is given one point toward
the subscale to which the item pertains. Positively directed items get one point for "true" responses and negatively directed items get one point for "false" responses. In Part two, subjects are asked to rate their feelings of behaviors on the scale provided for each item. Once again, items are positively and negatively directed. Positively directed items get one point for an answer of 3 or 4, and no point for an answer of 1 or 2. On the other hand, negatively directed items get one point for an answer of 1 or 2, and no point for an answer of 3 or 4. Each item can score at most one point for the scale to which it pertains. Thus, the maximum score for each scale is equal to the number of items provided to measure the scale. There are 21 items which pertain to cognitive restraint. Disinhibition and hunger scales have 16 and 14 items respectively. (See Appendix C for item-direction and item-scale identification.)

DAILY MINI-QUESTIONNAIRE (DMQ): The DMQ (see Appendix E) was designed to assess the daily status of each subject. Subjects were given a large enough supply of questionnaires to last them the duration of the study. Subjects were to record their basal body temperature each morning before getting out of bed and then were to fill in the remainder of the questionnaire each night before they
went to bed. The DMQ contains eight end-anchored scale questions concerning how they felt -- i.e., whether they felt good, hungry, pretty, any menstrual discomfort, any other discomfort, happy, tired, or stressed. Each scale was end-anchored with qualifiers indicating the extremes of the variables (i.e., not good to very good). Subjects were to slash the point on the scale which indicated how they felt that day. The length of the scale to their slash was measured from left to right in centimeters to quantitate their responses. In addition to these eight variables, there were three yes-no questions. One determined presence of menstrual bleeding. The other two assessed the presence of cravings (or lack of cravings) for sweets. Finally, subjects had to rate their daily consumption on a five-point scale from much more to much less than normal. This mini-questionnaire was important because it permitted a correlation of dietary behavior, MC phases, and taste sensitivity fluctuations with daily fluctuations in consumption; desire for sweets; mood (feeling good, happy, and pretty); metabolic need for energy (appetite, fatigue); stress; and pain (menstrual and other discomfort).

SUBJECTS
The subjects of this study were normal-weight, American, caucasian, college students (graduates and undergraduates) between the ages of 18 and 30. All subjects had a normal MC, which had a duration of approximately 30 days. None of the women smoked, abused alcohol (drank greater than one to two drinks on any given day), used any type of oral contraceptive, or were diagnosed as anorexic or bulimic on the basis of their responses on the EDI. The TFEQ identified three patterns of dietary behavior. These dietary groups were Normals (N) i.e., non-restrainers/non-disinhibitors; Restrainers (R); and Restrainers/Disinhibitors (RD). Subjects were selected to provide an equal number (i.e., twelve) in each dietary group. However, by the end of the study one of the R-group subjects had dropped out, leaving only eleven subjects in that group. Normal weight was defined as being neither ten percent above or below their ideal body weight. All calculations were based upon self-reported height and weight.

RECRUITEMENT: Subjects were recruited from various university classes by way of a speaker who explained the need of subjects to study fluctuations in taste sensitivity to sweet solutions as a function of the menstrual cycle. Class members were told the time
commitment would be from January 23 to March 10; that during this time they would be required to take their basal temperature each morning, fill out a short questionnaire each evening, and come to Wallace Hall for about twenty minutes every third day to taste sucrose solutions; and that in return, subjects would receive a monetary reward of $50.00, the satisfaction of learning something about themselves, and a basal thermometer. In addition, it was pointed out that subjects would be selected on the basis of their responses to three questionnaires, and that smokers, users of oral contraceptives, and women who drank alcohol excessively would not be invited to participate. No mention of dietary behavior was made. At the end of the talk, all interested persons received a copy of the ISQ, the EDI, and the TFEQ. They were instructed to fill out all three questionnaires and return them to a box in Wallace Hall within one week. In addition, all interested women were asked to write down their name and phone number so they could be notified if they were chosen for the study.

After analyzing all applicants' questionnaires, selected women were invited to participate in the study via a phone call. During this conversation, women were reminded of the requirements and selection criteria which they had been told in class and were asked if they were
still interested. A time which they could meet any day of the week and a schedule of days was also determined. Since thirty-six subjects were to be tested every third day, subjects were placed into three testing groups of twelve women each. Thus, testing was conducted every day, but each day only one testing group (twelve subjects) participated. This division provided three cycles of test-days. Subjects were able to choose which cycle of days they preferred. Thus, women from each dietary group were mixed within each testing group.

SELECTION: Subjects were chosen to participate in this study on the basis of their responses to three questionnaires: the ISQ, the EDI, and the TFEQ. In addition, women who met all these criteria but did not think they could stick to their schedule of days were not selected.

Initial Screening Questionnaire: In the ISQ, subjects were asked to provide the following information: date of birth, height, and approximate weight. Questions of general health; medications; regularity of menstruation; smoking habits; sleep patterns; exercise habits; special diet; and alcohol consumption were also included. Respondents who smoked, drank greater than one to two
drinks on any given day, took oral contraceptives, followed a therapeutic diet, experienced irregular menstrual cycles, were not within ten percent of their ideal weight for their height, or were not of age (18 to 30) were not invited to participate.

Eating Disorder Inventory: The EDI was designed to identify clinical cases of anorexia nervosa and bulimia nervosa, and to distinguish between these patient groups and subclinical cases (normal dieters). Clinical anorexics and bulimics score high on each of the EDI's eight subscales: interoceptive awareness; body dissatisfaction; ineffectiveness; bulimia; maturity fears; interpersonal distrust; perfectionism; and drive for thinness (Garner et al. 1984). Normal dieters express attitudes similar to clinical anorexics and bulimics, but are free of the psychological disturbances found in the clinical cases (Garner et al. 1984). Thus, normal dieters score high on drive for thinness, body dissatisfaction, and perfectionism scales only (Garner et al. 1984). All applicants filled out the EDI. Anyone scoring above the female-comparison range set by Garner et al. (1983) (see Appendix G) for any of the "anorexic/bulemic" scales (interoceptive awareness; ineffectiveness; bulimia; maturity fears; and interpersonal distrust) were not
Three Factor Eating Questionnaire: The TFEQ was designed to assess three dimensions of eating behavior: cognitive restraint, disinhibition, and hunger. The dietary behavior of a person who takes this test can be determined by his/her responses to the questions in each scale. Each applicant took the TFEQ. For the purposes of this study, scales for cognitive restraint and disinhibition were the primary interest. Using Stunkard and Messick's (1988) Normative Guidelines for scoring the TFEQ (see Appendix I), women scoring in the low-to-average range on all three scales were identified as normal (N) -- i.e., non-restrainers and non-disinhibitors. In addition, women who scored above the low-to-average range on the disinhibition and hunger scales only were also included in the N group. It was felt the elevated disinhibition score was due to hunger and eating whenever and whatever the person chose, and not due to true disinhibition, which can only result from a concomitant restraint (Stunkard and Messick, 1988). Women who scored above the low-to-average range for the
restraint scale only were identified as restrainers (R). A score above the low-to-average range for both restraint and disinhibition scales resulted in a label of restrainer/disinhbitor (R/D). (See Appendix J for individual subject's scores on the TFEQ.)

A total of 36 subjects was desired. Using the TFEQ and this method to identify each applicant's dietary behavior, it was possible to select subjects so there were an equal number of women in each dietary behavior group. However, one subject dropped-out, leaving only 11 women in the R group.

TRAINING: Training took place January 23 to February 3. Each subject attended four sessions, one every third day according to the testing schedule she had chosen. Twelve of the thirty-six subjects attended each day. At the start of the initial training meeting, all subjects signed an informed consent form which illuminated the potential risks and benefits of participation and freed the university from liability for any injury incurred on the way to or from the test site (see Appendix K). Subjects were given a supply of DHQs and a basal thermometer on this first meeting. Sessions took approximately twenty minutes. During each session, subjects were taken through a typical test day; both intensity and preference testing
were conducted. In addition, during this training period subjects took their temperatures each morning and filled out the DMQ each evening. This training period was important to familiarize the subjects with the testing procedures and diminish any apprehensions they may have had. In addition, these meetings provided the opportunity for any questions to be addressed and for any misunderstandings to be resolved.

SOLUTION PREPARATION

Fischer's reagant-grade sucrose was weighed on a Mettler Balance. Triton Bottled spring water was used to prepare sucrose solutions. Both plain spring water and sucrose solutions were prepared and stored in volumetric flasks. To prevent any possible bacterial contamination, all solutions, including plain spring water, were disposed of and new solutions were prepared each evening. After pouring out the day's solutions, the volumetric flasks were washed in hot, soapy water and rinsed several times, first with warm tap water, then with deionized water, and finally with the spring water. Solutions were covered with para-film, shaken, and stored in an incubator at 22 °C over night. Each morning all flasks were shaken and the para-film cover was replaced with a plastic medicine
cup, placed upside-down over the flask. The covered preference solutions remained stored in the incubator throughout the day. The threshold solutions remained covered in the testing room most of the day, but were re-incubated during any long gaps between testing.

TESTING

The test facility used was the sensory-testing booths in Wallace Hall at Virginia Tech. The use of the booth minimized subject-experimenter interaction as much as possible. In addition, the booth provided some privacy to both the experimenter and the subject. The room itself was highly accessible and almost free of distractions and noise. Taste testing was conducted from February 6 to March 10. Since thirty-six subjects were to be tested every three days, subjects were placed into three testing groups of twelve women each. Thus, testing was conducted every day, but each day only one testing group (twelve subjects) participated. Testing time was determined individually and was consistent across all days of the week for each subject. Stone and Sidel (1985) note there is a change in acuity of taste sensitivity at different times of the day. The subjects were requested to come feeling satiated -- not hungry and not full. No specific
time lapse between food consumption and test time was requested. It was felt this method would allow for greater control and consistency of hunger levels between subjects since any specific lapse could mean different things to different people. Booth et al. (1982) have shown that different degrees of hunger may lead to preferences for different types of nutrients. The only stipulation then was that subjects had not eaten or drunk anything but water, or chewed gum at least 30 minutes prior to testing.

SWEET-TASTE PERCEPTION: The combination of the "Stairwise" method of threshold testing (Cornsweet, 1962) and a paired comparison was used. Test solution concentrations were 3, 5, 10, 15, 20, 25, and 30 mmol/l. sucrose in bottled spring water. Solutions were held at a constant 22 °C in an incubator and served in plain plastic cups in 15 ml increments. Tests were conducted individually -- one subject at a time. Solutions were presented from the lowest to the highest concentration. The subject was given a pair of solutions -- one test solution and one spring water -- and asked to compare the pairs and identify which, if either, was the sweeter solution. In making each comparison, subjects first rinsed with bottled spring water (sip, swish for 5
seconds, and spit), then tasted the first solution (sip, swish for 5 seconds, and spit), rinsed again, and tasted the second solution. If the subject could not identify the test solution as the sweeter solution, the experimenter continued presenting pairs of one spring water and one test solution of increasing concentration until the subject could consistently make the correct identification.

At this point, the experimenter presented a pair of spring waters to prevent any possibility of carry-over from a more-concentrated solution to a less-concentrated solution. Then the experimenter presented a pair containing the next-lower concentration and continued decreasing the concentration until the subject could no longer identify the test solution as being sweeter -- before each decrease in solution concentration a pair of spring waters was provided. Then, once again the experimenter presented pairs containing increasing solution concentration until the subject could consistently identify the test solution. This up-and-down procedure continued for one or two reversals. The subject's threshold was determined as that concentration at which she could identify sweetness consistently. (See Appendix L for a copy of the Data Recording Form.)
SWEET-TASTE PREFERENCE: Subjects were presented with five cups of varying sucrose concentrations (15 mls) in a randomized order. The same procedure for rinsing between tasting which was used in taste perception testing was used. Subjects were asked to taste each solution, rinsing before each taste, and to identify the solution which they found to be the most preferable. Each subject's preference was recorded by the experimenter. Solutions were held at a constant temperature of 22 °C using an incubator and served in clear, plastic cups marked only with a small colored dot. The dots were positioned away from the subject's field of vision to minimize the effect of dot color on solution choice. The colored dot was a means of coding the identification of the solution concentration. Each day the code changed, so subjects did not have the opportunity to identify the solution by its colored dot. The concentrations for preference testing were 315.32, 360.36, 405.41, 450.45, and 495.50 mmol/l. sucrose in bottle spring water (corresponding to 7, 8, 9, 10, and 11 percent respectively). Thus the concentration ranges chosen for the study included the typical preference breakpoint (8 to 10 percent) proposed by Moskowitz (1971) and room for an increased or decreased preference fluctuation. (See Appendix L for a copy of the Data Recording Form.)
STATISTICAL ANALYSIS

The purpose of this study was to assess the effects of MC phases (post-menses, premenses, and menses) and dietary behavior (Normal (N), Restrainer (R), and Restrainer/Disinhibitor (RD)) on women's thresholds and preferences for sucrose solutions. Also, in an effort to investigate the various theories of MC distress, daily fluctuations in the variables measuring mood (feeling good, happy, and pretty); metabolic need for energy (appetite and fatigue); stress; and pain (menstrual and other discomfort) were correlated with fluctuations in sucrose preference and threshold. For the same reason, the effects of MC phase, dietary behavior, and the MC-phase/dietary group interaction on the above variables were determined. In all statistical analyses the variables, good; hungry; pretty; menstrual discomfort; other discomfort; happy; tired; stress; threshold; and preference were considered continuous. Cravings for sweets, total consumption, and dietary group were considered classification variables. MC phase was considered a repeated-measure variable.

The variables, good; hungry; pretty; menstrual discomfort; other discomfort; happy; tired; stress;
threshold; and preference were analyzed with respect to differences experienced by women in each of the three dietary groups, at different MC phases, and with respect to any MC-phase/dietary group interaction. These tests were done by means of a Greenhouse-Geisser profile analysis (Morrison, 1976). A profile analysis is a type of Anova used when one of the variables is a repeated-measure and there is an interest in the interaction between this repeated-measure variable and another variable. In this study, each subject was assigned to only one dietary-behavior group, but her responses were divided into three MC phases. Thus, MC phase is considered a repeated-measure, and the assessment of the MC-phase/dietary group interaction required the use of a profile analysis. Though the profile analysis is normally considered an effective, reliable test for repeated-measures data (Morrison, 1976), in this particular analysis, the power of the profile test was reduced. This power deficit is concomitant to the experimental design. Frequent data collection (in the form of both sensory testing and the DMQs) was required to permit an accurate appraisal of the MC-phase effect on all the variables. Thus, though the variability in MC phases required frequent data collection, the repeated measure of MC phase for each subject required each subject's data to be truncated to

Methods
include only one averaged value for each MC phase of one cycle only. In using these averages, important data points and trends could have been lost.

Because of the low power of the profile test, a one-way Anova (Hinkle, Wiersma and Jurs, 1988) was also used to correlate the variables good; hungry; pretty; menstrual discomfort; other discomfort; happy; tired; and stress with dietary behavior group. To determine which dietary group was the cause of any significant relationship, all significant relationships were subjected to Tukey's Studentized Range (HSD) Test.

The effect of the variables: good; hungry; pretty; menstrual discomfort; other discomfort; happy; tired; and stress on both threshold and preference was determined using a regression analysis (Hinkle et al. 1988).

The protocol for this study was approved by the Institutional Review Board of Virginia Tech.
RESULTS AND DISCUSSION

THRESHOLD

The means of women's thresholds to sucrose are presented according to MC phase, dietary behavior, and the interaction of MC phase and dietary behavior, in Tables 1, 2, and 3, respectively. According to the profile analysis, there were no significant differences in threshold due to MC phase, dietary group, or the interaction of MC phase and dietary group (Table 4). Although no significant differences were revealed, the R group women had the lowest threshold for sucrose and the N group women had the least sensitivity to sucrose (Table 2). The regression analysis (Table 5) revealed a significant and negative association between threshold and hunger (p = 0.0100); a near significant negative relationship between threshold and being tired (p = 0.0582); and a non-significant positive correlation between other discomfort and threshold (p = 0.0681). The daily fluctuations of the other variables: feeling good; feeling pretty; menstrual discomfort; feeling happy; and feeling stressed evidenced no relationship with threshold in the regression analysis. It was hypothesized that threshold would vary as a function of both MC phase and dietary...
**TABLE 1: Effect of menstrual cycle phase on women's threshold to sucrose**

<table>
<thead>
<tr>
<th>MENSTRUAL PHASE</th>
<th>THRESHOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Menses</td>
<td>3.36⁺ (0.15)</td>
</tr>
<tr>
<td>Premenses</td>
<td>3.44⁺ (0.13)</td>
</tr>
<tr>
<td>Menses</td>
<td>3.31⁺ (0.24)</td>
</tr>
</tbody>
</table>

* means are from a scale of sucrose solution concentration. The scale ranged from 1 to 7, where:

1 = 3 mmol/l
d = 5 mmol/l
c = 10 mmol/l
d = 15 mmol/l
e = 20 mmol/l
f = 25 mmol/l
g = 30 mmol/l

⁺ indicates means which are not statistically different at the 0.05% level according to a Profile Analysis.
<table>
<thead>
<tr>
<th>DIETARY GROUP</th>
<th>THRESHOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normals</td>
<td>3.51 (0.21)</td>
</tr>
<tr>
<td>Restrainers</td>
<td>3.25 (0.16)</td>
</tr>
<tr>
<td>Restrainers/Disinhibitors</td>
<td>3.44 (0.13)</td>
</tr>
</tbody>
</table>

* means are from a scale of sucrose solution concentration. The scale ranged from 1 to 7, where:

1 = 3 mmol/l
2 = 5 mmol/l
3 = 10 mmol/l
4 = 15 mmol/l
5 = 20 mmol/l
6 = 25 mmol/l
7 = 30 mmol/l

* indicates means which are not statistically different at the 0.05% level according to a Profile Analysis.

Results and Discussion
TABLE 3: Effect of the menstrual cycle-phase/dietary behavior interaction on women's thresholds to sucrose

<table>
<thead>
<tr>
<th>MENSTRUAL CYCLE PHASE BY DIETARY GROUP MEANS*</th>
<th>(+/- standard deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIETARY BEHAVIOR GROUP</td>
<td></td>
</tr>
<tr>
<td>MENSTRUAL PHASE</td>
<td>Normals</td>
</tr>
<tr>
<td>Post-Menses</td>
<td>3.52 (0.29)</td>
</tr>
<tr>
<td>Premenses</td>
<td>3.43 (0.26)</td>
</tr>
<tr>
<td>Menses</td>
<td>3.58 (0.55)</td>
</tr>
</tbody>
</table>

* means are from a scale of sucrose solution concentration. The scale ranged from 1 to 7, where:
1 = 3 mmol/l
2 = 5 mmol/l
3 = 10 mmol/l
4 = 15 mmol/l
5 = 20 mmol/l
6 = 25 mmol/l
7 = 30 mmol/l

* indicates means which are not statistically different at the 0.05% level according to a Profile Analysis

Results and Discussion
TABLE 4: Effect of menstrual phase and dietary behavior on women's threshold to sucrose: a profile analysis

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstrual Phase Effect</td>
<td>0.9118</td>
</tr>
<tr>
<td>Dietary Group Effect</td>
<td>0.4037</td>
</tr>
<tr>
<td>Menstrual Phase by Dietary Group Interaction</td>
<td>0.2940</td>
</tr>
<tr>
<td>Dietary Group Effect for Post-menses</td>
<td>0.8229</td>
</tr>
<tr>
<td>Dietary Group Effect for Premenses</td>
<td>0.5245</td>
</tr>
<tr>
<td>Dietary Group Effect for Menses</td>
<td>0.2065</td>
</tr>
<tr>
<td>Comparison of Pre- and Post-menses</td>
<td>0.5986</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of</td>
<td></td>
</tr>
<tr>
<td>Pre- and Post-menses</td>
<td></td>
</tr>
<tr>
<td>Comparison of Premenses and Menses</td>
<td>0.8589</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of</td>
<td></td>
</tr>
<tr>
<td>Premenses and Menses</td>
<td>0.4667</td>
</tr>
</tbody>
</table>
TABLE 5: Relationship of threshold to sucrose and the variables measured to study theories of menstrual cycle distress: a regression analysis*

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>P VALUE</th>
<th>R VALUE+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling Good</td>
<td>0.2344</td>
<td>0.0700</td>
</tr>
<tr>
<td>Feeling Hungry</td>
<td>0.0100</td>
<td>-0.0557</td>
</tr>
<tr>
<td>Feeling Pretty</td>
<td>0.7204</td>
<td>0.0086</td>
</tr>
<tr>
<td>Menstrual Discomfort</td>
<td>0.3904</td>
<td>0.0224</td>
</tr>
<tr>
<td>Other Discomfort</td>
<td>0.0881</td>
<td>0.0352</td>
</tr>
<tr>
<td>Feeling Happy</td>
<td>0.7912</td>
<td>0.0057</td>
</tr>
<tr>
<td>Feeling Tired</td>
<td>0.0582</td>
<td>-0.0373</td>
</tr>
<tr>
<td>Feeling Stressed</td>
<td>0.1258</td>
<td>-0.0170</td>
</tr>
</tbody>
</table>

*probable cause of small R values with or without significant P values is the repeated measurement of these variables

+regression parameter, slope of regression equation
behavior. Increased cravings for sweets and consumption play a significant role in MC-distress syndromes (Siegal, 1986). It was hypothesized that thresholds for sucrose would increase during premenses when these distress symptoms are most pronounced (Abraham et al. 1983; Cohen et al. 1987; Morton et al. 1953). In other words, with an increased threshold for sucrose, women's desires for sweets may not be satisfied as easily as usual; thus, they could crave sweets more, and consequently could consume more food (sweets) (Mattes-Kulig and Henkin, 1985). However, since not all women experience cyclic cravings and increases in consumption of sweets (Sophos et al. 1987), it was suggested that dietary behavior may be the cause of the discrepancy. More specifically, it was hypothesized that women who dieted (R and R/D group women), and thus evidenced a body weight below their biological set-point (Booth et al. 1981; Nisbett, 1968), would be more affected by the premenstrual demand for carbohydrates than women who did not diet (N group women). Being more effected, dieters should then evidence greater increases in threshold during premenses than non-dieters. However, there was no effect on threshold by MC phase, dietary behavior, or the interaction of these two variables. Indeed, if there had been any significant

Results and Discussion
effect on threshold due to dietary behavior, it would have been opposite to the hypothesized effect. Group R women had the lowest threshold, while group N women evidenced the least sensitivity to sucrose. This outcome indicates that threshold is merely a function of exposure. The more exposure a person has to a particular tastant, the more accustomed he/she will be to that tastant. As that person becomes accustomed to the tastant, his/her threshold will increase (Stone and Sidel, 1985). Since R group women continually diet, they should not be as accustomed to sweet tastes. Consequently, they evidenced a greater sensitivity to the sweet solutions. Thus, it seems that the increase in sweet cravings and consumption experienced by women during their premenstrual and menstrual phases (Abraham et al. 1983; Cohen et al. 1987; Dalvit, 1981; Manocha et al. 1986; Siegal, 1986), whatever their underlying cause, were not manifested by alterations in sensitivity to sucrose (i.e. threshold).

Several current theories, speculating the underlying cause of the premenstrual cravings and increased consumption, were evaluated by measuring daily fluctuations in mood (feeling good, pretty, and happy), pain (menstrual and other discomfort), and metabolic need for energy (feeling hungry and tired), and stress. It was believed women who dieted (R and R/D groups) would
experience greater premenstrual increases in negative mood, metabolic need for energy, and pain sensitivity than non-dieters. Dieters are typically considered to be below their biological set-point (Booth et al. 1981; Nisbett, 1968), and thus should be more effected by the premenstrual demand for carbohydrates. Since threshold did not depend on MC phase, dietary behavior, or the interaction of these two variables, the relationship between threshold and the variables "feeling hungry," "feeling tired" and "experiencing other discomfort," which correlated with threshold, is not germane to this discussion. The discussion of these relationships will be presented in the section on serendipitous findings.

PREFERENCE

The means of women's preferences for sucrose are presented according to MC phase, dietary behavior, and the interaction of MC phase and dietary behavior in Tables 6, 7, and 8, respectively. According to the profile analysis, neither dietary behavior group nor the interaction of dietary behavior and MC phase had any effect on preference for sucrose solutions (Table 9). There was an effect on preference by MC phase, however. This effect was apparent only in the comparison of the
### TABLE 6: Effect of menstrual cycle phase on women's preference for sucrose

<table>
<thead>
<tr>
<th>MENSTRUAL PHASE</th>
<th>PREFERENCE</th>
<th>MEANS± (±standard deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Menses</td>
<td>2.58±</td>
<td>(0.23)</td>
</tr>
<tr>
<td>Premenses</td>
<td>2.82+</td>
<td>(0.20)</td>
</tr>
<tr>
<td>Menses</td>
<td>2.80+</td>
<td>(0.26)</td>
</tr>
</tbody>
</table>

* means are from a scale of sucrose solution concentration. The scale ranged from 1 to 5, where:
- 1 = 315.32 mmol/l (7% sucrose)
- 2 = 369.36 mmol/l (8% sucrose)
- 3 = 405.41 mmol/l (9% sucrose)
- 4 = 450.41 mmol/l (10% sucrose)
- 5 = 495.58 mmol/l (11% sucrose)

* indicates means which are not statistically different at the 0.05% level according to a Profile Analysis
TABLE 7: Effect of dietary behavior on women's preference for sucrose

<table>
<thead>
<tr>
<th>DIETARY GROUP</th>
<th>PREFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normals</td>
<td>2.76+ (0.24)</td>
</tr>
<tr>
<td>Restrainers</td>
<td>2.82+ (0.23)</td>
</tr>
<tr>
<td>Restrainers/Disinhibitors</td>
<td>2.71+ (0.22)</td>
</tr>
</tbody>
</table>

* means are from a scale of sucrose solution concentration. The scale ranged from 1 to 5, where:

1 = 315.32 mmol/l (7% sucrose)
2 = 360.36 mmol/l (8% sucrose)
3 = 405.41 mmol/l (9% sucrose)
4 = 450.41 mmol/l (10% sucrose)
5 = 495.50 mmol/l (11% sucrose)

* indicates means which are not statistically different at the 0.05% level according to a Profile Analysis
### TABLE 8: Effect of the menstrual cycle-phase/dietary behavior interaction on women's preference for sucrose

**MENSTRUAL PHASE BY DIETARY GROUP MEAN**

(+/- standard deviation)

<table>
<thead>
<tr>
<th>MENSTRUAL PHASE</th>
<th>DIETARY BEHAVIOR GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normals</td>
</tr>
<tr>
<td>Post-Menses</td>
<td>2.41+ (0.39)</td>
</tr>
<tr>
<td>Premenses</td>
<td>2.75+ (0.39)</td>
</tr>
<tr>
<td>Menses</td>
<td>3.13+ (0.45)</td>
</tr>
</tbody>
</table>

* means are from a scale of sucrose solution concentration.
The scale ranged from 1 to 5, where:
1 = 315.32 mmol/l (7% sucrose)
2 = 360.36 mmol/l (8% sucrose)
3 = 405.41 mmol/l (9% sucrose)
4 = 450.41 mmol/l (10% sucrose)
5 = 495.50 mmol/l (11% sucrose)

* indicates means which are not statistically different at the 0.05% level according to a Profile Analysis
TABLE 9: Effect of menstrual phase and dietary behavior on women's preference for sucrose: a profile analysis

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstrual Phase Effect</td>
<td>0.1455</td>
</tr>
<tr>
<td>Dietary Group Effect</td>
<td>0.7233</td>
</tr>
<tr>
<td>Menstrual Phase by Dietary Group Interaction</td>
<td>0.6760</td>
</tr>
<tr>
<td>Dietary Group Effect for Post-menses</td>
<td>0.6408</td>
</tr>
<tr>
<td>Dietary Group Effect for Premenses</td>
<td>0.7733</td>
</tr>
<tr>
<td>Dietary Group Effect for Menses</td>
<td>0.6680</td>
</tr>
<tr>
<td>Comparison of Pre- and Post-menses</td>
<td>0.0441</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of Pre- and Post-menses</td>
<td>0.8756</td>
</tr>
<tr>
<td>Comparison of Premenses and Menses</td>
<td>0.7563</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of Premenses and Menses</td>
<td>0.5867</td>
</tr>
</tbody>
</table>
pre- and post-menses phases ($p = 0.0441$). The overall phase effect and the comparison of premenses and menses phases was not significant. Preference for sucrose was significantly greater during premenses and menses than during post menses (Table 6). According to the regression analysis (Table 10), preference was significantly affected by daily ratings of both feeling good ($p = 0.0091$, positive relationship) and other discomfort ($p = .0486$, inverse relationship). In addition, hunger had a non-significant ($p = 0.0994$), positive correlation with preference. The other variables assessed using the regression analysis were not significantly related with preference. These unrelated variables were feeling pretty, menstrual discomfort, feeling happy, feeling tired, and feeling stressed.

It was hypothesized that preference, in a mechanism similar to that for threshold, would vary as a function of both MC phase and dietary behavior. The fact many women experience premenstrual increases in cravings for sweets has been well documented (Abraham et al. 1983; Cohen et al. 1987; Dalvit, 1981; Manocha et al. 1986; Siegal, 1986). Thus, it seems logical that, concomitant to these cravings, women's preference for sweets should also demonstrate a premenstrual increase. Indeed, since a MC
TABLE 10: Relationship of preference for sucrose and the variables measured to study theories of menstrual cycle distress: a regression analysis

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>P VALUE</th>
<th>R VALUE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling Good</td>
<td>0.0091</td>
<td>0.0700</td>
</tr>
<tr>
<td>Feeling Hungry</td>
<td>0.0944</td>
<td>0.0438</td>
</tr>
<tr>
<td>Feeling Pretty</td>
<td>0.5191</td>
<td>0.0187</td>
</tr>
<tr>
<td>Menstrual Discomfort</td>
<td>0.3077</td>
<td>0.0321</td>
</tr>
<tr>
<td>Other Discomfort</td>
<td>0.0486</td>
<td>-0.0490</td>
</tr>
<tr>
<td>Feeling Happy</td>
<td>0.1641</td>
<td>0.0360</td>
</tr>
<tr>
<td>Feeling Tired</td>
<td>0.4191</td>
<td>-0.0192</td>
</tr>
<tr>
<td>Feeling Stressed</td>
<td>0.1954</td>
<td>-0.0173</td>
</tr>
</tbody>
</table>

* probable cause of small R values with or without significant P values is the repeated measurement of these variables

* regression parameter, slope of regression equation

Results and Discussion
phase effect on women's preference to sucrose was found, one may speculate that the underlying cause of the MC-distress symptoms of increased cravings and consumption, whether they be physiological or psychological, may be manifested in an altered preference for sucrose. On the average all subject's preference for sucrose during premenses was significantly greater than their preference during post-menses, but not greater than during menses. This phenomenon suggests that the mechanism behind the preference changes occurs around the time of ovulation and does not cease until menstruation is at least well on its way. Because, not all women experience MC related cyclic cravings for sweets (Sophos et al. 1987), it was hypothesized that only women who dieted (R and R/D group women) would experience this premenstrual increase in preference for sucrose. Indeed, Nisbett (1968) and Cabanac (1971) found that, after a fast, dieters rated sweeter sucrose solutions as more pleasant. However, since the expected effect on preference for sucrose by dietary behavior or the interaction of dietary behavior and MC phase was not found, it seems the increased preference for sucrose was not a product of dieters' unique MC experience, either psychologic, or physiologic. Since women in all dietary groups evidenced an elevated

Results and Discussion
preference for sucrose at premenses, perhaps the origin of the premenstrual cravings for sweets found only in some women is due to the reaction of some women to the increased preference, rather than the increased preference itself. Thus, although there was no effect on preference for sucrose by dietary behavior group, dietary behavior may ultimately still be the cause of the increased cravings experienced by some women at premenses.

From this association between MC phase and women's preference for sucrose, one might speculate that the increased preference for sucrose was to offset the increased pain, metabolic need, stress, and/or negative mood which prevail during the menses and premenses phases (Bonora et al. 1987; Cohen et al. 1987; Collins et al. 1985; Dalvit, 1981; Hamburg, 1966; Herren, 1933; Hill and Blundell, 1982; Moos et al. 1969; Siegal, 1986; Solomon et al. 1982; Stout and Steege, Van Den Akker and Steptoe, 1985; Webb, 1986). Of the variables measured to investigate these current theories of MC distress, only subject's daily ratings of feeling good, feeling hungry, and experiencing other discomfort had any relationship with preference.

On days which subjects felt hungrier or better overall, they also preferred sweeter solutions. Daily ratings of hunger were used as an indication of metabolic

Results and Discussion
need. Thus, this preference-hunger relationship was as expected, if this study were to support the theory of an increased metabolic need causing the MC related cyclic cravings for sweets and increased consumption (Bonora et al. 1987; Cohen et al., 1987; Dalvit, 1981; Hamburg, 1966; Hill and Blundell, 1982; Solomon et al. 1982; Webb, 1986).

The fact that this relationship was not truly significant and the fact that hunger was not affected by MC phase indicate a lack of support for the theory of increased metabolic need, however. This lack of effect was expected since hunger does not correlate well with intake (Hill and Blundell, 1982; Hill et al. 1984), and studies measuring increased metabolic rate (Solomon et al. 1982; Webb, 1986) found only a very small increase.

The feeling-good/preference relationship was opposite of what was expected however. The degree to which subjects felt good or not good was used as an indicator of negative mood, in an effort to investigate the theory implicating negative mood as the cause of the premenstrual increases in preference for sweets. Typically, it is a negative mood which increases the desire for sweets (Booth, 1981; Clare, 1985; Foote et al. 1980; Smith and Sauder, 1969). Instead, women preferred the sweeter solutions when they felt in a better mood as indicated by their scores of "feeling good." This incongruency can be

Results and Discussion
explained by the subject's possible confusion over the choice of the word-anchor "good" as opposed to "mood." However, in defense of this word choice, it should be noted that the variables "other discomfort" and "feeling good" were oppositely related to preference and therefore were not likely given the same meaning by subjects. Through its association with preference, it seems that women's ratings of feeling good would also increase at ovulation and continue to increase into menses. However, feeling good or bad was not influenced by MC phase. One would have expected feeling bad to be influenced by MC phase, and that premenses would elicit a greater negative mood. Many studies have shown this to be the case (Collins et al. 1985; Stout and Steege, 1985; Van Den Akker and Steptoe, 1985).

This lack of negative mood and/or the lack of any mood-MC effect could be due to 1) a misunderstanding of the word-anchor "good" as explained above, and/or 2) the subject population. Because the subject population was young college women, this study may, from the start, have had some inherent problems. Since age and marital status change food habits and other behaviors (Khan, 1981), this study may not apply to the average woman, but merely the average college woman. Also, Stout and Steege (1985) contend that those affected significantly by premenstrual
syndrome are women in their mid-thirties. Other authors dismiss the high prevalence of MC symptoms in this age group as being due to their belief in what society expects them to feel rather than actual symptoms (Brooks et al. 1977; Brooks-Gunn, 1986; Hart et al. 1987; Ruble, 1977). At any rate, whether the contribution of mood to MC-distress symptoms is physiological or psychological, there was no evidence of a MC-phase/mood relationship by the variable feeling good. Indeed, in this study none of the measures of mood (feeling good, happy, and pretty) were related to MC phase.

The last variable to evidence a relationship with preference was other discomfort. Other discomfort was inversely related to preference for sucrose. The more discomfort subjects felt, the less they preferred sweets. The variable "other discomfort" was intended to measure pain, i.e. any aches and pains associated with discomforts other than the MC. If this study were to substantiate the theory of an increased pain sensitivity causing the premenstrual cravings for sweets (Aberger et al. 1983; Collins, 1985; Herren, 1933; Kuzmierczyk and Adams, 1986; Kuzmierczyk et al. 1986; Siegal, 1986), "other discomfort" would had to have correlated positively with preference via the opioid mechanism of pain relief. The evidenced negative relationship implies that there is no association

Results and Discussion 112
of pain and preference, or that the subjects experienced discomfort from many sources which did not necessarily have any associated pain or which produced other negative sensations which overrode any associated pain. This latter explanation is more probable. This study was conducted in the winter, and colds and the flu were prevalent among the subjects. It is interesting that of the three variables to correlate with preference, only other discomfort is also affected by MC phases. This association between other discomfort and MC phase progression seems to validate the ability of the variable "other discomfort" to measure pain. There is a conflict in the two-fold investigation of this variable, however. It was previously noted that preference increased from post-menses to premenses to menses, and that other discomfort decreased as preference increased. Associating these two relationships would imply that other discomfort should decrease from post-menses back to menses. However, in the direct analysis of the other discomfort/MC-phase relationship, other discomfort increased from post-menses back to menses. Perhaps this flaw in logic can be explained by the phase-by-phase comparisons of both preference and other discomfort. Preference was significantly lower during post-menses than during premenses and menses, during both of which preference was
relatively the same. Other discomfort had a different phase-by-phase interaction. In this case, post-menses and premenses values were about the same and significantly lower than the menses ratings of other discomfort.

Before drawing this discussion of the factors affecting preference to sucrose to a close, a word of warning is required. Since preference is entirely a subjective response, it is important to be aware that people like to give the answer that they think is right and to tell only what they want people to believe (Drewnowski and Moskowitz, 1985; Stone and Sidel, 1985). Subjects may have picked lower sweetnesses because they were dieting and "should not" want the sweeter solution; or they may have picked the sweeter solution during menses because they knew of the interest in MC. Indeed, many authors contend that subjects knowledge of a MC-related purpose will inevitably alter their responses (AuBuchon and Calhoun, 1985; Brooks et al. 1977; Olasov and Jackson, 1987; Ruble, 1977).

In addition, food is quite multidimensional. It is evaluated on color, appearance, texture, and flavor, which includes both odor and taste. Therefore there may be other things besides "taste" which can influence food preference and cravings. With solutions, the part odor plays in tasting flavor cannot be taken into account.
Yet, odor can play an important part in the whole picture of the cyclic sensory changes during the MC. With all the different influences which integrate in the brain in every normal sensory process, it may seem inappropriate to look at only one aspect of the problem or picture. However the only systematic way to study a phenomenon is to break it down into its component parts. In this study the component "taste" was investigated.

THEORIES OF MENSTRUAL CYCLE DISTRESS

Knowing the relationship of the variables: feeling good; feeling hungry; feeling pretty; menstrual discomfort; other discomfort; feeling happy; feeling tired; and feeling stressed with threshold and preference to sucrose, it was of interest to determine the effect that MC phase, dietary behavior group, and the interaction of MC phase and dietary group had on these variables. All the above comparisons were made with a profile analysis. Using this statistical technique, dietary grouping had no effect on any of the variables. When the same dietary-group-by-variable comparisons were made using a one-way Anova test, quite different results evolved. The results of both tests are included in the appropriate statistical tables. Only the results of the group-by-variable Anova

Results and Discussion
test will be discussed.

Of the variables used to investigate the theories of MC distress, only "menstrual discomfort" and "other discomfort" were significantly affected by MC phase. Both menstrual discomfort and other discomfort were used as indicators of pain. Dietary behavior had a broader influence. All three indicators of mood (feeling good, happy, and pretty) as well as feeling tired (an indicator of increased metabolic need for energy) and stress (an indicator of the effect of dietary behavior) were affected by dietary behavior grouping. The interaction of MC phase and dietary behavior affected only the variable "stress."

In the following sections, each examined theory of MC distress: increased negative mood, increased sensitivity to pain, increased metabolic need, and dietary behavior will be presented separately. Thus, each of the variables chosen to measure that theory will be grouped together.

INCREASED NEGATIVE MOOD: (Feeling good, pretty, and happy)

Feeling Good: According to the profile analysis (Table 11), the daily ratings of "feeling good" were not affected by MC phase or the interaction of MC phase and dietary group. Only the subject's dietary behavior group had any effect on how good they felt (p = 0.0379) (Table 12). A
### Table 11: Effect of menstrual cycle phase and dietary behavior on women's daily ratings of "feeling good," "feeling pretty," and "feeling happy": a profile analysis

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>FEELING GOOD</th>
<th>FEELING PRETTY</th>
<th>FEELING HAPPY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstrual Phase Effect</td>
<td>0.9140</td>
<td>0.8361</td>
<td>0.8007</td>
</tr>
<tr>
<td>Dietary Group Effect</td>
<td>0.5370</td>
<td>0.3298</td>
<td>0.9837</td>
</tr>
<tr>
<td>Menstrual Phase by Dietary Group Interaction</td>
<td>0.3002</td>
<td>0.2355</td>
<td>0.7199</td>
</tr>
<tr>
<td>Dietary Group Effect for Post-menses</td>
<td>0.6010</td>
<td>0.1438</td>
<td>0.8415</td>
</tr>
<tr>
<td>Dietary Group Effect for Premenses</td>
<td>0.5410</td>
<td>0.3987</td>
<td>0.7710</td>
</tr>
<tr>
<td>Dietary Group Effect for Menses</td>
<td>0.2039</td>
<td>0.5479</td>
<td>0.8852</td>
</tr>
<tr>
<td>Comparison of Pre- and Post-menses</td>
<td>0.9110</td>
<td>0.5691</td>
<td>0.4581</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of Pre- and Post-menses</td>
<td>0.9879</td>
<td>0.1843</td>
<td>0.5758</td>
</tr>
<tr>
<td>Comparison of Premenses and Menses</td>
<td>0.6973</td>
<td>0.8055</td>
<td>0.6342</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of Premenses and Menses</td>
<td>0.1744</td>
<td>0.8055</td>
<td>0.5698</td>
</tr>
</tbody>
</table>

Results and Discussion
### TABLE 12: Effect of dietary behavior on women's daily ratings of "feeling good," "feeling pretty," and "feeling happy"

**DIETARY GROUP MEANS* AND ANOVA ANALYSIS**

<table>
<thead>
<tr>
<th>DIETARY GROUP</th>
<th>FEELING GOOD</th>
<th>FEELING PRETTY</th>
<th>FEELING HUNGRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normals</td>
<td>6.7± ~ (3.3)</td>
<td>6.7** (3.1)</td>
<td>6.7~ ~ (3.3)</td>
</tr>
<tr>
<td>Restrainers</td>
<td>7.2± (2.9)</td>
<td>6.2** ~ ++ (2.5)</td>
<td>6.8~ ~ (2.8)</td>
</tr>
<tr>
<td>Restrainer/</td>
<td>6.2~ (2.9)</td>
<td>5.5** (5.1)</td>
<td>6.7~ ~ (5.2)</td>
</tr>
<tr>
<td>Disinhibitors</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* means are in centimeters and were obtained from a rating scale ranging from -2 to +17
+ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
~ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
** indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
++ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
~~ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)

\[ p = 0.0379 \quad p = 0.0021 \quad p = 0.0726 \]
Tukey's analysis of the group scores indicates that the R/D group felt significantly less good than group R. The mean "feeling good" score for group N women fell between these two groups and was not significantly different from either.

Feeling Pretty: As with feeling good, daily ratings of feeling pretty were not affected by MC phase or the interaction of MC phase and dietary behavior group (Table 11). Feeling pretty was affected by dietary behavior group, however (p = 0.0021) (Table 12). Women in group N felt significantly more pretty than women in group R/D. The mean of the R group scores fell in between that of these two groups and was not significantly different from either.

Feeling Happy: Neither MC phase nor the interaction of MC phase and dietary group had any effect on feeling happy (Table 11). Dietary behavior grouping had only a non-significant effect (p = 0.0726) on daily ratings of feeling happy (Table 12). Since this effect is not significant, it cannot be specified which group caused the slight dependance of feeling happy on dietary behavior grouping. Based on their scores, group R women did,
however, claim to be the happiest, followed by group N women, and then by group R/D women.

The degree to which subjects felt good, pretty, and happy were all used as indicators of negative mood. The theory of negative mood relates the premenstrual increases in cravings for sweets and total consumption to a premenstrual increase in negative mood. There was no affect of MC phase on any of the measures of mood. Thus, it seems this study cannot substantiate the theory of negative mood. All three measures of mood were, however, affected by dietary behavior. For all three variables, group R/D women evidenced the most negative mood. The trend of the group R women is not so easy to describe. These women felt better and happier, but not as pretty as group N women. One might speculate that group R women became restrainers because of a dissatisfaction with their appearance, and thus might attribute their feelings of being less pretty to this dissatisfaction. However, unlike R/D group women, the R group women were able to maintain their commitment to restrain and thus feel good and happy about themselves. The N group women did not feel better or happier than the R group women because they did not give themselves the goal to restrain, and thus were not elated at its accomplishment.

It seems that if this study were to support the
theory that negative mood is associated with MC distress, it would have to occur through a dietary group/MC-phase interaction. This interaction was not associated with any of the mood indicators, however. Perhaps this lack of support for the negative-mood theory can be explained. Perhaps the chosen variables did not measure negative mood, or mood does not vary as a function of MC phase, or the fluctuations in negative mood could not be detected in the chosen subject population. The subject population was young college women, thus this study may, from the start, have had some inherent problems. Since age and marital status change food habits and other behaviors (Khan, 1981), this study may not apply to the average woman, but merely the average college woman. Also, Stout and Steege (1985) contend that those affected significantly by premenstrual syndrome are women in their mid-thirties. Other authors dismiss the high prevalence of MC symptoms in this age group as being due to their belief in what society expects them to feel rather than actual symptoms (Brooks et al. 1977; Brooks-Gunn, 1986; Hart et al. 1987; Ruble, 1977). At any rate, whether the contribution of mood to MC-distress symptoms is physiological or psychological, there was no evidence of a MC-phase/mood relationship.
ELEVATED SENSITIVITY TO PAIN: (Menstrual and Other discomfort)

Menstrual Discomfort: Though many subjects claimed to have menstrual discomfort on almost every day of the study, MC phase was the only variable to have any effect on daily ratings of menstrual discomfort (Table 13). Neither dietary group (Table 14) nor the interaction of dietary group and MC phase (Table 13) had any effect on daily ratings of menstrual discomfort. The effect of MC phase was not only significant overall \( (p = 0.0001) \), but also in the comparison between pre- and post-menses \( (p = 0.0363) \) and between premenses and menses \( (p = 0.0001) \). Daily menstrual discomfort ratings were quite low during the post-menses phase and increased on the average almost seven times at premenses, only to increase even more at menstruation (Table 15).

Other Discomfort: As with menstrual discomfort, neither dietary group alone (Table 14) nor the interaction of dietary group and MC phase (Table 13) had any effect on daily ratings of other discomfort. Only MC phase alone had any effect (Table 13). The overall MC-phase effect was near significant \( (p = 0.0593) \). The phase-by-phase comparisons evidenced a significant relationship between

Results and Discussion

122
TABLE 13: Effect of menstrual phase and dietary behavior on women's daily ratings of "menstrual discomfort" and "other discomfort": a profile analysis

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>MENSTRUAL DISCOMFORT</th>
<th>OTHER DISCOMFORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstrual Phase Effect</td>
<td>0.0001</td>
<td>0.0593</td>
</tr>
<tr>
<td>Dietary Group Effect</td>
<td>0.4959</td>
<td>0.8277</td>
</tr>
<tr>
<td>Menstrual Phase by Dietary Group Interaction</td>
<td>0.5505</td>
<td>0.7492</td>
</tr>
<tr>
<td>Dietary Group Effect for Post-menses</td>
<td>0.8070</td>
<td>0.8100</td>
</tr>
<tr>
<td>Dietary Group Effect for Premenses</td>
<td>0.7358</td>
<td>0.8125</td>
</tr>
<tr>
<td>Dietary Group Effect for Menses</td>
<td>0.4698</td>
<td>0.6542</td>
</tr>
<tr>
<td>Comparison of Pre- and Post-menses</td>
<td>0.0363</td>
<td>0.1286</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of Pre- and Post-menses</td>
<td>0.8853</td>
<td>0.9442</td>
</tr>
<tr>
<td>Comparison of Premenses and Menses</td>
<td>0.0001</td>
<td>0.0190</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of Premenses and Menses</td>
<td>0.4762</td>
<td>0.5786</td>
</tr>
</tbody>
</table>
### TABLE 14: Effect of dietary behavior on women's daily ratings of "menstrual discomfort," and "other discomfort"

<table>
<thead>
<tr>
<th>DIETARY GROUP</th>
<th>MENSTRUAL DISCOMFORT</th>
<th>OTHER DISCOMFORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normals</td>
<td>1.3⁺ (2.9)</td>
<td>2.6~ (3.1)</td>
</tr>
<tr>
<td>Restrainers</td>
<td>1.1⁺ (2.6)</td>
<td>2.9~ (3.6)</td>
</tr>
<tr>
<td>Restrainer/Disinhibitors</td>
<td>0.9⁺ (2.4)</td>
<td>2.7~ (3.2)</td>
</tr>
<tr>
<td>P = 0.3824</td>
<td>P = 0.5971</td>
<td></td>
</tr>
</tbody>
</table>

* means are in centimeters and were obtained from a rating scale ranging from -2 to +17
⁺ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
~ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)

Results and Discussion
### TABLE 15: Effect of menstrual cycle phase on women's daily ratings of "menstrual discomfort," and "other discomfort"

<table>
<thead>
<tr>
<th>MENSTRUAL CYCLE PHASE</th>
<th>MENSTRUAL DISCOMFORT</th>
<th>OTHER DISCOMFORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Menses</td>
<td>0.4 (0.07)</td>
<td>2.7+ (0.38)</td>
</tr>
<tr>
<td>Premenses</td>
<td>3.0 (0.11)</td>
<td>2.8+ (0.31)</td>
</tr>
<tr>
<td>Menses</td>
<td>3.5 (0.54)</td>
<td>3.9 (0.45)</td>
</tr>
</tbody>
</table>

* means are in centimeters and were obtained from a rating scale ranging from -2 to +17
+ indicates means which are not statistically different at the 0.05% level according to a Profile Analysis

---

Results and Discussion
premenses and menses ($p = 0.0190$), but not between pre- and post-menses. (See Table 15 for means of daily ratings of "other discomfort" as effected by MC phase.)

The cause of the increased sensitivity to pain which has been implicated in the genesis of premenstrual increases in cravings for sweets has not been confirmed. Both the existence of this increased sensitivity (Collins et al. 1985; Moos et al. 1969; Siegal, 1986) and the association of pain and cravings (Ashgar, 1986; Blass et al. 1987) has been documented, however. Some recent evidence indicates estrogen may protect muscle membranes. Thus when estrogen levels decrease (dip down at ovulation and virtually disappear during menses) women could experience more pain. This study seems to support the estrogen-withdrawal mechanism since both measures of pain were highly affected by MC phase. Both menstrual discomfort and other discomfort increased from post-menses through the MC to menses (as estrogen decreased). In addition, this study supports the endorphin theory of pain relief. The support of this theory stems from the simultaneous increase in preference, menstrual discomfort and other discomfort with MC phase progression.

The literature, however, evidences a variety of responses and trends in pain thresholds over the MC. This
variation indicates that not all women suffer from fluctuating pain sensitivity. One explanation for this variation is, of course, the difference in hormone ratios or rates of change experienced by different women. Hormonal fluctuations were not measured in this study however. Another logical explanation could be that differences in dietary behavior were not previously accounted for. It has long been proven that sugars decrease pain sensations; thus, it seems dieters would experience greater pain, especially upon estrogen withdrawal. There was no effect of dietary behavior alone or an interaction of dietary group and MC phase on either measure of pain, however.

ELEVATED METABOLIC NEED FOR ENERGY: (Feeling hungry and tired)

Feeling Hungry: Daily rating of hunger were not affected by dietary group (Table 16), MC phase, or the interaction of these two variables (Table 17).

Feeling Tired: Only dietary behavior group had any effect on daily ratings of being tired (p = 0.0017) (Table 16). There was no effect by MC phase or the interaction of MC phase and dietary behavior group (Table 17). A Tukey's
TABLE 16: Effect of dietary behavior on women's daily ratings of "feeling hungry," and "feeling tired"

<table>
<thead>
<tr>
<th>DIETARY GROUP</th>
<th>FEELING HUNGRY</th>
<th>FEELING TIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normals</td>
<td>5.3± (3.1)</td>
<td>6.3~ (3.4)</td>
</tr>
<tr>
<td>Restrainers</td>
<td>5.1± (3.1)</td>
<td>6.4~ (3.6)</td>
</tr>
<tr>
<td>Restrainer/Disinhibitors</td>
<td>5.1± (3.0)</td>
<td>7.7 (5.2)</td>
</tr>
</tbody>
</table>

P = 0.1877 P = 0.0017

* means are in centimeters and were obtained from a rating scale ranging from -2 to +17
+ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
~ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
TABLE 17: Effect of menstrual cycle phase and dietary behavior on women’s daily ratings of "feeling hungry" and "feeling tired": a profile analysis

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>FEELING HUNGRY</th>
<th>FEELING TIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstrual Phase Effect</td>
<td>0.5620</td>
<td>0.2539</td>
</tr>
<tr>
<td>Dietary Group Effect</td>
<td>0.9540</td>
<td>0.5888</td>
</tr>
<tr>
<td>Menstrual Phase by Dietary Group Interaction</td>
<td>0.9195</td>
<td>0.7020</td>
</tr>
<tr>
<td>Dietary Group Effect for Post-menses</td>
<td>0.7736</td>
<td>0.7174</td>
</tr>
<tr>
<td>Dietary Group Effect for Premenses</td>
<td>0.9738</td>
<td>0.2850</td>
</tr>
<tr>
<td>Dietary Group Effect for Menses</td>
<td>0.9944</td>
<td>0.6740</td>
</tr>
<tr>
<td>Comparison of Pre- and Post-menses</td>
<td>0.5371</td>
<td>0.4504</td>
</tr>
<tr>
<td>Dietary Group Effect for the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison of Premenses and Menses</td>
<td>0.3207</td>
<td>0.3113</td>
</tr>
<tr>
<td>Dietary Group Effect for the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison of Premenses and Menses</td>
<td>0.9906</td>
<td>0.8587</td>
</tr>
</tbody>
</table>

Results and Discussion

129
analysis of this dietary behavior group effect on feeling
tired indicates that the group R/D women were
significantly different from the women in the other
dietary groups. These R/D group women were significantly
more tired on a daily basis than women in either of the
other two dietary groups.

It has been postulated that the cravings and
increased consumption experienced by women during certain
phases of the MC is concomitant to an increased metabolic
need for energy. Some authors have evidenced an increase
in 24-hour energy expenditure during premenses (Solomon et
al. 1982; Webb, 1986). Others studies have noted a type
of hypoglycemia during premenses (Bonora et al. 1987;
Cohen et al. 1987; Dalvit, 1981; Hamburg, 1966; Hill and
Blundell, 1982). The reason for this apparent increase in
metabolic need for energy is still not known. Indeed, the
existence of a cyclic increase in metabolic need for
sucrose is still controversial (Reid et al. 1986; Sommers,
1982; Spellacy et al. 1967; Wade, 1982). In addition,
this study can offer no support to this theory. The two
variables used to assess metabolic need for energy,
feeling hungry and feeling tired, did not fluctuate as a
function of MC phase.

It was hypothesized that dietary behavior would prove
important in this metabolic need/MC-phase relationship. Since dieters should have a lower energy reserve with respect to their biological set-point (Booth et al. 1981; Nisbett, 1971), they could have been more affected by the increased energy demands of premenses. Also, because some dieters tend to disinhibit after overeating, or even thinking they have overeaten (Hibsher and Herman, 1977; Polivy, 1976; Polivy and Herman, 1975; Polivy and Herman, 1986; Spencer and Fremouw, 1979; Woody et al. 1981), any small increase in intake to accommodate the premenstrual energy demand could cascade into a large-scale binge. Indeed, there was a dietary group effect on daily ratings of being tired. The R/D group was significantly more tired than women in the other two groups. This phenomenon is interesting. If total intake were the predominating factor in feeling tired and without energy, it would seem the R group women (who restrain and do not disinhibit) would be most tired. Perhaps the key factor is biological set-point, instead. The N group's set-point could have been close to each member's present weight, and these women would have felt no need to diet. The R group women may have had a set-point slightly greater than their desired body weight, and thus dieted. Since their set-point was only slightly greater than their desired weight, these R group women may not have felt drained upon dieting.
to the level of their desired weight and, in addition, were able to maintain diets. The R/D group women may have had a set-point much greater than their desired body weight. Thus, as they tried to diet to maintain a weight much lower than their set-point, they could not and subsequently disinhibited. In addition, the energy deficit from trying to maintain this lower body weight may have made the R/D group women tired. Unfortunately, there was no dietary group/MC-phase interaction with respect to daily ratings of being tired which could indicate a cascade of disinhibition. Also, neither dietary behavior alone nor the interaction of dietary behavior and MC phase had any effect on daily ratings of hunger.

In consideration of all these relationships, it is not surprising that the increased metabolic need for energy theory was not validated. As mentioned earlier, hunger does not correlate well with intake (Hill and Blundell, 1982; Hill et al. 1984), and the increases in premenstrual energy expenditure are not of practical significance (Solomon et al. 1982; Webb, 1986).

DIETARY BEHAVIOR: (Feeling Stressed)

Feeling stressed: Daily ratings of feeling stressed were affected by dietary behavior ($p = 0.0072$) (Table 18) and

Results and Discussion 132
the interaction of MC phase and dietary behavior grouping 
(p = 0.0205) (Table 19). MC phase alone had no effect on 
daily ratings of feeling stressed (Table 19). The Tukey's 
analysis indicated the women in group R/D were 
significantly more stressed on a daily basis than women in 
either of the other two dietary groups (Table 18). The 
profile analysis of the MC-phase/dietary group interaction 
indicates that during premenses there is a significant 
group effect (p = 0.0255). A further analysis which 
determines the group effect at a phase-by-phase level 
indicates that this interaction of MC phase and dietary 
group at premenses is due to the difference of stress 
between pre- and post-menses (p = 0.0205) (Table 19). The 
R/D group women experienced increases in stress, while 
the N group women experienced decreases in stress and the 
R group women evidenced no change in stress (Table 20). 
The difference in daily ratings of stress between 
premenses and menses is not significant. Daily ratings of 
stress were also significantly related to total 
consumption (p = 0.0001) (Table 21). As stress increased, 
so did total consumption.

Learning the effect of dietary behavior and its 
interaction with MC phase was important to understand how 
such behavior acted upon the theories of MC distress. It 
was hypothesized there would be some dietary effect on all
### TABLE 18: Effect of dietary behavior on women's daily ratings of "feeling stressed"

<table>
<thead>
<tr>
<th>DIETARY GROUP</th>
<th>FEELING STRESSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normals</td>
<td>6.0⁰ (3.6)</td>
</tr>
<tr>
<td>Restrainers</td>
<td>6.1⁰ (7.3)</td>
</tr>
<tr>
<td>Restrainer/Disinhibitors</td>
<td>8.0 (8.2)</td>
</tr>
</tbody>
</table>

*p = 0.0072

* means are in centimeters and were obtained from a rating scale ranging from -2 to +17
+ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
### TABLE 19: Effect of menstrual phase and dietary behavior on women's daily ratings of "feeling stressed": a profile analysis

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstrual Phase Effect</td>
<td>0.4141</td>
</tr>
<tr>
<td>Dietary Group Effect</td>
<td>0.5332</td>
</tr>
<tr>
<td>Menstrual Phase by Dietary Group Interaction</td>
<td>0.1095</td>
</tr>
<tr>
<td>Dietary Group Effect for Post-menses</td>
<td>0.3796</td>
</tr>
<tr>
<td>Dietary Group Effect for Premenses</td>
<td>0.0255</td>
</tr>
<tr>
<td>Dietary Group Effect for Menses</td>
<td>0.7130</td>
</tr>
<tr>
<td>Comparison of Pre- and Post-menses</td>
<td>0.3541</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of Pre- and Post-menses</td>
<td>0.0205</td>
</tr>
<tr>
<td>Comparison of Premenses and Menses</td>
<td>0.5795</td>
</tr>
<tr>
<td>Dietary Group Effect for the Comparison of Premenses and Menses</td>
<td>0.4050</td>
</tr>
</tbody>
</table>

Results and Discussion
TABLE 29: Effect of the menstrual cycle phase/dietary behavior interaction on women's daily ratings of "feeling stressed"

MENSTRUAL CYCLE PHASE BY DIETARY GROUP MEANS* (+/- standard deviation) AND ANOVA ANALYSIS

<table>
<thead>
<tr>
<th>MENSTRUAL CYCLE PHASE</th>
<th>Normals</th>
<th>Restrainers</th>
<th>Restrainers/Disinhibitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Menses</td>
<td>6.0 ± 0.8</td>
<td>6.5 ± 0.5</td>
<td>7.2 ± 0.7</td>
</tr>
<tr>
<td>Premenses</td>
<td>5.7 ± 0.5</td>
<td>6.4 ± 0.6</td>
<td>7.7 ± 0.4</td>
</tr>
<tr>
<td>Menses</td>
<td>5.0 ± 1.0</td>
<td>6.4 ± 0.7</td>
<td>7.8 ± 0.9</td>
</tr>
</tbody>
</table>

* means are in centimeters and were obtained from a rating scale ranging from -2 to +17
+ indicates means which are not statistically different at the 0.05% level according to a Profile Analysis
~ indicates means which are not statistically different at the 0.05% level according to a Profile Analysis
TABLE 21: Means of women's daily ratings of stress as average total consumption increased

<table>
<thead>
<tr>
<th>CONSUMPTION</th>
<th>FEELING STRESSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much Less than Normal</td>
<td>6.4+ (3.6)</td>
</tr>
<tr>
<td>Less than Normal</td>
<td>6.6+ (3.7)</td>
</tr>
<tr>
<td>Normal</td>
<td>6.3+ (3.6)</td>
</tr>
<tr>
<td>More than Normal</td>
<td>7.0+ (9.0)</td>
</tr>
<tr>
<td>Much More than Normal</td>
<td>10.3 (14.6)</td>
</tr>
</tbody>
</table>

p = 0.0001

* means are in centimeters and were obtained from a rating scale ranging from -2 to +17
+ indicates means which are not statistically different at the 0.05% level according to Tukey's Studentized Range Analysis (HSD)
the variables measuring MC distress, since women with
different dietary patterns evidence different reactions to
the same environmental cues. Usually non-dieters will
decrease consumption due to stress or a negative mood,
whereas dieters will increase consumption (Baucom and
Aiken, 1981; Fritjers, 1984; Herman and Polivy, 1975;
Polivy and Herman, 1976a-c; Ruderman 1985a; Ruderman 1986;
Zielinski, 1978). It was hypothesized that all women
would evidence fluctuations in experienced pain, which
could then affect their sensory data via the opioid
mechanism. However, dieters were expected to respond more
extremely. With respect to feeling hungry and tired
(measures of metabolic need), it was hoped the interaction
of the dietary behavior group might explain some of the
existing controversy.

The relationship of dietary behavior to mood, pain,
and metabolic need has already been discussed in the above
sections.

The variable "stress" was not intended to stand
alone, but to be interpreted within its relationship with
dietary behavior. Indeed, stress was the only variable to
evidence a dietary group/MC-phase interaction. As
expected, this interaction was due more to the effect of
dietary behavior grouping than MC phase. MC phase alone
had no effect on daily ratings of stress. This study confirms the trend that dieters eat more when they are stressed. Stress increased with dietary pathology (from group N through group R to group R/D,) and consumption increased with stress. It is not clear why overall daily stress would be greater in women with subclinical eating disorders. Perhaps eating disorders have something to do with a particular lifestyle, or merely the reaction to a particular lifestyle. At any rate, the effect of the interaction of dietary group and MC phase is quite clear. Group N women evidenced decreasing stress with MC progression. Group R women revealed no change in stress with MC progression. The fact that Group R women did not evidence decreasing stress as the N group women did may indicate they experience more stress than did the group N women. Uniquely, the R/D group women expressed increasing levels of stress. This stress effect does lend support to the dietary behavior theory of MC distress and increased cravings and consumption. The R/D group women experienced greater overall daily stress, and they uniquely experienced a cyclic increase in stress due to MC-phase progression from the end of menses to the end of the next menses. Whatever the cause of this stress, its presence induced these R/D group women to eat more at premenses and even more during menses. The fact that there was no
effect of dietary behavior or its interaction with MC phase on threshold or preference suggests only that if the MC does promote eating disorders, this promotion does not occur via fluctuations in threshold and preference to sucrose.

SERENDIPITOUS FINDINGS

Although women's threshold to sucrose did not vary as a function of the MC, the association of threshold with several of the variables chosen to evaluate MC distress theories has proven quite interesting. A regression analysis (Table 5) showed a significant and negative association between threshold and hunger ($p = 0.0001$); a near significant negative relationship between threshold and being tired ($p = 0.0582$); and a non-significant positive correlation between other discomfort and threshold ($p = 0.0881$).

From the inspection of these relationships, one can investigate factors which will or will not affect sensory testing. Threshold testing can be an important part of any experiment -- from merely detecting thresholds to assessing the sweetness of a cake. The variables "hunger," "tired," and "other discomfort" all evidenced a relationship with threshold. It is important to point out...
that these variable responses were not obtained at the time of testing, but rather were obtained at the end of the day and were intended to provide an overall score for the day. Thus, on days when subjects felt overall more tired or hungry, they experienced a lower threshold for sucrose. One might speculate that the increased sensitivity to sucrose was the body's mechanism of making things taste better and thus increase food intake when it was low on energy. However, whatever the purpose of this increased sensitivity, since being tired or hungry increased taste sensitivity, researchers must avoid or account for these variables in any such sensory testing. In addition, since subjects had been asked to report to the testing facility feeling neither very hungry nor very full, merely ensuring a consistent test experience is not adequate to prevent the influence of hunger and fatigue on sensory responses. The variable "other discomfort" was positively associated with threshold responses. Thus, as other discomfort increased, threshold to sucrose also increased. This decrease in sensitivity could be due to several factors. The subjects could have been distracted by their discomforts and not concentrated adequately, thus a greater concentration of sucrose was required for them to detect any sweetness. This effect can be quite important considering the prevalence of colds and low-

Results and Discussion

141
grade fevers experienced by all people on a daily basis. Indeed, other discomfort would be a hard variable to control for and researchers must be especially careful to account for this in studies with even the narrowest focus or the shortest duration. The MC-phase effect on other discomfort accentuates the importance of this variable as an influence on threshold. Clearly if other discomfort increases during premenses, then so would the effect of other discomfort on threshold data.

Preference for sucrose was also affected by several variables. According to a Regression Analysis (Table 10), preference was significantly affected by daily ratings of both feeling good ($p = 0.0091$, positive relationship) and other discomfort ($p = 0.0486$, negative relationship). In addition, hunger had a non-significant ($p = 0.0994$), positive correlation with preference.

Overall daily ratings of feeling good, being hungry, and experiencing other discomfort influenced preference for sucrose. These effects could also have important implications for sensory testing, especially product development and market-acceptance testing. Although both being hungry and experiencing other discomfort are related to both threshold and preference, it is interesting and important to note that they are correlated in the opposite direction. Feeling better or hungrier overall on a
particular day will increase preferences for sucrose. Increasing daily discomfort will decrease sucrose preference. Since feeling good is influenced by dietary behavior and other discomfort is affected by MC phases, both dietary behavior and MC phases can indirectly influence the results of preference tests.
CONCLUSION

Since the primary purpose of this study was to assess the effects of MC phase and dietary behavior on women's thresholds and preferences for sucrose solutions, the analysis of these relationships was foremost. It was hypothesized that these sensory measures would fluctuate as a function of MC phase and dietary behavior, and with other variables measured to investigate various theories of MC distress -- i.e., mood (feeling good, happy, and pretty), metabolic need for energy (appetite and fatigue), stress, and pain (menstrual and other discomfort). In addition, it was hypothesized these variables measured to investigate the theories of MC distress would be affected by MC phase and dietary behavior. Thus, the investigation was two-fold. If the sensory measures of threshold and preference did change due to dietary behavior and/or MC phases, and if the theory variables changed with threshold or preference and MC phases and/or dietary behavior, then one could speculate that these sensory fluctuations were the body's way of meeting the demands imposed by the diet and/or the MC. Furthermore, if any of the variables measured to investigate any of the MC distress theories fluctuated with MC phasing, this study could then substantiate the theory investigated using that variable.
It was found that, within the confines of the statistical analysis, threshold did not fluctuate with MC phase, dietary behavior, or the interaction of these two variables. Thus, it seems that the increase in sweet cravings and consumption experienced by women during their premenstrual and menstrual phases (Abraham et al. 1983; Cohen et al. 1987; Dalvit, 1981; Manocha et al. 1986; Siegal, 1986), whatever their underlying cause, are not manifested by alterations in sensitivity to sucrose (i.e. threshold). Preference for sucrose did fluctuate as a function of MC phase. However, the variables measured to assess the theories of MC distress which correlated with preference were not clearly related with MC phase indicating this preference/MC-phase relationship is not a manifestation of those theorized causes of MC distress -- i.e. increased sensitivity to pain, negative mood, or metabolic need for energy.

Of the presented theories of MC distress, in particular those theories dealing with increased consumption and cravings for sweets, hormonal and neuronal influences were not directly investigated. It is important to note that if brain neurotransmitters or altered hormonal patterns are the answer to the MC cravings, this study with a high prevalence of dieters may not have been able to demonstrate it. Kaplan and Woodside

Conclusion 145
(1987) indicated that irregular eating patterns alter brain neurotransmitters and thus change the release of hypothalamic hormones. The theories investigated were increased negative mood, increased pain sensitivity, elevated metabolic need for energy, and dietary behavior. No relationship between MC phase and negative mood or metabolic need for energy was found. Thus, though this study cannot support these theories, it cannot discredit them either, given the power of the statistical test and the complexity of the MC phenomenon. Both the elevated pain sensitivity and dietary behavior theories of MC distress were supported, however.

The effects of dietary behavior on MC distress symptoms were of primary concern. It was postulated that women with different dietary behaviors would react differently to MC phasing. This dietary effect was not as prevalent as predicted, since the only MC distress symptom effected by the MC-phase/dietary behavior interaction was "feeling stressed." However, because the MC has been implicated in the genesis of eating disorders, the MC-phase/dietary behavior/stress relationship alone substantiates the need to counsel women of this potentially dangerous binge-precipitating relationship. In this study, although average menstrual discomfort was the same for all three dietary behavior groups, the R/D
group women uniquely evidenced an increase in daily stress with MC-phase progression. This increase in stress corresponded to an increase in consumption. Clearly the R/D group women had a different MC experience, or a different reaction to the same experience, than did either the N or the R group women. Given the R/D group's predisposition to eating disorders, these women must be warned of this potentially dangerous binge-precipitating premenstrual time of the month. In an effort to decrease the risk of exacerbating their binge-restraint cycle, these women must be taught to deal with their increasing MC-related stress without eating, since any increase in intake to accommodate their unique premenstrual experience may precipitate a binge. This counseling approach is especially important since no physiological cause of this stress and resultant consumption can be substantiated, as mentioned earlier, women in all dietary behavior groups experienced the same degree of menstrual discomfort. Clearly a psychological approach seems to be justified.

Finally, the serendipitous finding that the variables: feeling good, feeling hungry, feeling tired, and experiencing other discomfort, alone influenced thresholds and preferences for sucrose could also have important implications for sensory testing. Overall daily ratings of feeling good, being hungry, and experiencing
other discomfort influenced preferences for sucrose. Since feeling good is influenced by dietary behavior and other discomfort is affected by MC phase, both dietary behavior and MC phasing can indirectly influence the results of preference tests. The variables "feeling hungry," "feeling tired," and "experiencing other discomfort" all evidenced a relationship with women's threshold to sucrose. Since subjects had been asked to report to the testing facility feeling neither very hungry nor very full, merely ensuring a consistent test experience is not adequate to prevent the influence of hunger and fatigue on sensory responses. Other discomfort decreased subjects' sensitivity for sucrose. The subjects could have been distracted by their discomforts and not concentrated adequately. This effect can be quite important considering the prevalence of colds and low-grade fevers experienced by all people on a daily basis. Indeed, other discomfort would be a hard variable to control for and researchers must be especially careful to account for this in studies with even the narrowest focus or the shortest duration. The MC-phase effect on other discomfort accentuates the importance of this variable as an influence on threshold. Researchers must avoid or account for all these variables in any such sensory testing.

Conclusion
In conclusion, one last comment is warranted. Despite the enlightening results of this study, a more powerful statistical analysis than the Profile test is required to get the true and more complete picture of these complex relationships. It seems a "Catch-22" has evolved: The best way to study alterations in women's taste sensitivity as a function of the menstrual cycle is to do a continuous study of the MCs of many women and let the women serve as their own controls, but the study which would allow for the most complete statistical analysis would require the use of many more women who would be tested during only one phase of the MC. This latter technique would not measure the cyclic fluctuations in threshold or preference which women may experience during their MC. To study fluctuation in these sensory variables, subjects must serve as their own controls. If women were evaluated at only one phase, an average of their scores cannot provide a valid indication of how the MC phases affect thresholds and preferences for sucrose. Because all of the MC phase and MC-phase/dietary behavior effects on threshold, preference and all the other variables were determined using this Profile analysis, the existence of any of these relationships cannot be discredited on the basis of this study. In addition, as explained above, this study has implications in MC
distress syndromes, dietary counseling, and sensory testing. Thus, finding a new method to analyze these responses is justified and should be used in all subsequent studies of this nature.
SUMMARY

Normal eating in North American women is now characterized by dieting, and, as dieters, these normal eaters display characteristics of eating disorders (Polivy and Herman, 1987). There has been an association between the MC phenomenon and eating disorders. Indeed, some authors contend MC phasing can perpetuate eating disorders (Cohen et al. 1987; Leon et al. 1986). Although increased consumption manifested by cravings may be a natural requirement for some women during their MC, for many, this behavior represents an unwelcome break in their regular routine. Since mere perceptions of overeating may trigger a binge episode (Ruderman, 1986; Spencer and Fremouw, 1979; Woody et al. 1981), the dieter may perceive any intake to accommodate the premenstrual demand for carbohydrates as overeating and thus trigger a binge.

In this study, some of the suggested causes and manifestations of the increased intake and sweet cravings associated with premenses was investigated. The primary purpose of this study was to assess the effects of MC phase (post-menses, premenses, and menses) and dietary behavior (Normal (N), Restrainer (R), and Restrainer/Disinhibitor (RD)) on women's thresholds and preferences for sucrose solutions. It was postulated that...
cyclic alterations in threshold and preference for sucrose were the mechanism of increasing consumption and cravings for sweets. Several well-known theories and speculated causes of MC distress were studied via their relationship with MC phases, and threshold and preference. These relationships were studied in order to identify how the underlying theorized causes of these MC distress symptoms interacted with threshold and preference for sucrose, MC phasing, and dietary behavior. These theories of underlying causes of MC distress included lowered pain threshold, elevated negative mood, increased metabolic need for energy, and dietary behavior.

Subjects were invited to participate in this study based on their responses to three questionnaires. Women who smoked, drank greater than one to two drinks on any given day, took oral contraceptives, followed a therapeutic diet, experienced irregular menstrual cycles, were not within ten percent of their ideal weight for their height, were not of age (18 to 30), or were identified as anorexic or bulimic on the basis of their responses to the EDI (Garner et al. 1983) were not invited to participate. The TFEQ (Stunkard and Messick, 1985) was used to place all qualifying candidates into one of three dietary behavior groups and to ensure an equal number of subjects in each group.
Data collection involved three basic procedures. Each evening subjects filled out a DMQ, which required them to report their temperatures, taken each morning, and which assessed their overall daily consumption; cravings; mood; pain; metabolic need for energy; and stress. In addition, every third day subjects reported for both preference and threshold testing.

The results revealed no effect of dietary group, MC phase, or the interaction of these two variables on threshold. Preference, on the other hand, did fluctuate as a function of MC phase. However, the variables, other discomfort, feeling good, and feeling hungry, which correlated with preference were not clearly related with MC phase indicating this preference/MC-phase relationship is not a manifestation of those theorized causes of MC distress -- i.e. increased pain sensitivity, negative mood, and metabolic need for energy, respectively. Of the investigated theories, no relationship between MC phase and negative mood or metabolic need for energy was found. There was a relationship between MC phase and elevated pain sensitivity and dietary behavior. This study seems to support these theories of MC distress.

The effects of dietary behavior on MC distress symptoms were of primary concern. It was postulated that women with different dietary behaviors would react
differently to MC phasing. This dietary effect was not as prevalent as predicted since "feeling stressed" was the only MC distress symptom effected by the MC phase/dietary behavior interaction. Because the MC has been implicated in the genesis of eating disorders, this MC-phase/dietary behavior/stress relationship alone substantiates the need to counsel women of this potentially dangerous binge-precipitating relationship. The R/D group women had a different MC experience, or a different reaction to the same experience than did either the N or the R group women. Given the R/D groups predisposition to eating disorders, these women must be warned of this potentially dangerous binge-precipitating premenstrual phase. This counseling approach is especially important since women in all dietary behavior groups claimed the same degree of menstrual discomfort. Since no physiological cause of this stress and resultant consumption can be substantiated, a psychological-counseling approach seems justified.

Although quite important and enlightening results were found, it is believed more significant relationships would have surfaced if a more powerful statistical test could have been used. Since this study has many applications (MC distress syndromes, dietary counseling, sensory testing...), finding a new method to analyze these
responses is justified and should be used in all subsequent studies of this nature.
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APPENDIX A: THE MENSTRUAL CYCLE (Fox, 1987; Moghissi et al. 1972)

The MC is classified by the changes that occur in the ovary -- i.e. the luteal and follicular phases -- and changes that occur in the endometrium -- i.e. the menstrual, secretory, and proliferative phases. Typically associated with MC symptomology are the luteal and follicular phases and menstruation. A typical MC lasts approximately 28 days, starting on the first day of menses and ending on the day before the first day of the next menses.

<table>
<thead>
<tr>
<th>DAYS</th>
<th>EVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>MENSES -- low levels of ovarian hormones permit menses</td>
</tr>
<tr>
<td>1-13</td>
<td>FOLLICULAR PHASE (FP) growth of the follicles under stimulation of Follicular Stimulating Hormone (FSH) granulosa secrete estradiol</td>
</tr>
<tr>
<td>12</td>
<td>HIGHEST CONCENTRATION OF ESTRADIOL in the blood</td>
</tr>
<tr>
<td>13</td>
<td>LUTEINIZING HORMONE (LH) SURGE estradiol provides a positive feedback to the anterior pituitary and hypothalamus estradiol stimulates anterior pituitary to secrete LH occurs 24-16 hours prior to ovulation.</td>
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<td>OVULATION follicle releases oocyte and is now empty occurs 16 hours after LH peak</td>
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<td>FSH PEAK</td>
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</table>

Summary of days 1-14 ----- FSH stimulates follicles to grow and therefore estradiol secretion from the follicles increases and causes the LH surge which causes the follicle to rupture (ovulation).

14-28 LUTEAL PHASE DEVELOPMENT OF CORPEUS LUTEUM (CL)--after ovulation LH stimulates the follicles to become the corpeus luteum which will
secrete PROGESTERONE as well as estradiol (NOTE: this is a structural and functional change -- the follicles released only estrogen, the corpus luteum releases progesterone as well)

**21 PROGESTERONE PEAK**

high levels of estradiol and progesterone prevent FSH and LH secretion and therefore prevent a multi-ovulation -- in essence the woman is infertile at this time

**22-28 CL REGRESSES and stops functioning -- due to the high levels of estradiol and progesterone there are low levels of LH. Without high levels of LH to prevent the breakup of the CL, the CL regresses. levels of ESTRADIOL AND PROGESTERONE DECREASE -- as the CL regresses, it stops secreting these ovarian hormones.**

**1-4 MENSES -- with decreasing levels of ovarian hormones menses can begin**

************************CYCLE REPEATS..............................
APPENDIX B: SCHEMATIC OF THE MENSTRUAL CYCLE
(Spence and Mason, 1987)

Plasma Levels of Follicular Stimulating Hormone, Luteinizing Hormone, Estrogens, and Progesterone during a typical ovarian cycle
This part of the assessment contains a series of TRUE or FALSE questions. Please read each statement and decide how you feel about it. If you agree with the statement, or feel that it is true about you, answer TRUE by circling the T next to the statement. If you disagree with the statement, or feel that it is FALSE as applied to you, answer FALSE by circling the F next to the statement.

ALL RESPONSES ARE CONFIDENTIAL

1. D When I smell a sizzling steak or see a juicy T F piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.

2. D I usually eat too much at social occasions, like parties and picnics.

3. H I am usually so hungry that I eat more than three times a day.

4. R When I have eaten my quota of calories, I am usually good about not eating anymore.

5. H Dieting is hard for me because I just get too hungry.

6. R I deliberately take small helpings as a means of controlling my weight.

7. D Sometimes things just taste so good that I keep on eating even when I am no longer hungry.

8. H Since I am often hungry, I sometimes wish that while I am eating an expert would tell me that I have had enough or that I can have something more to eat.

9. D When I am anxious, I find myself eating.

10. R Life is too short to worry about dieting.
11. Since my weight goes up and down, I have gone on reducing diets more than once.
12. I often feel so hungry that I just have to eat something.
13. When I am with someone who is overeating, I usually overeat too.
14. I have a pretty good idea of the number of calories in common food.
15. Sometimes when I start eating, I just can't seem to stop.
16. It is not difficult for me to leave something on my plate.
17. At certain times of the day I get hungry because I have gotten used to eating then.
18. While on a diet if I eat food that is not allowed, I consciously eat less for a period of time to make up for it.
19. Being with someone who is eating often makes me hungry enough to eat also.
20. When I feel blue, I often overeat.
21. I enjoy eating too much to spoil it by counting calories or watching my weight.
22. When I see a real delicacy, I often get so hungry that I have to have it right away.
23. I often stop eating when I am not really full as a conscious means of limiting the amount that I eat.
24. I get so hungry that my stomach feels like a bottomless pit.
25. My weight has hardly changed at all in the last 10 years.
26. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.

Appendix C
27. When I feel lonely, I console myself by eating.

28. I consciously hold back at meals in order not to gain weight.

29. I sometimes get very hungry late in the evening or at night.

30. I eat anything I want, any time I want.

31. Without even thinking about it, I take a long time to eat.

32. I count calories as a conscious means of controlling my weight.

33. I do not eat some foods because they make me fat.

34. I am always hungry enough to eat anytime.

35. I pay a great deal of attention to my figure.

36. While on a diet, if I eat a food that is not allowed, I often then splurge and eat other high-calorie foods.

PLEASE answer the following questions by circling the number above the response that is appropriate for you.

37. How often are you dieting in a conscious effort to control your weight?

   1. rarely  2. sometimes  3. usually  4. always

38. Would a weight fluctuation of 5 lbs affect the way you live your life?

   1. not at all  2. slightly  3. moderately  4. very much

39. How often do you feel hungry?

   1. only at mealtimes  2. sometimes between meals  3. often between meals  4. almost always

Appendix C
40. Do your feelings of guilt about overeating help you to control your food intake?

1 never  2 rarely  3 often  4 always

41. How difficult would it be for you to stop eating halfway through dinner and not eat for the next four hours?

1 easy  2 slightly  3 moderately  4 very difficult
difficult moderate difficult

42. How conscious are you of what you are eating?

1 not at all  2 slightly  3 moderately  4 extremely

43. How frequently do you avoid "stocking up" on tempting foods?

1 almost never  2 seldom  3 usually  4 almost always

44. How likely are you to shop for low-calorie foods?

1 unlikely  2 slightly  3 moderately  4 very likely
likely

45. Do you eat sensibly in front of others and splurge alone?

1 never  2 rarely  3 often  4 always

46. How likely are you to consciously eat slowly in order to cut down on how much you eat?

1 unlikely  2 slightly  3 moderately  4 very likely
likely

47. How frequently do you skip dessert because you are no longer hungry?

1 almost never  2 seldom  3 at least  4 almost
once a week  every day

Appendix C 182
48. How likely are you to consciously eat less than you want?

1 2 3 4
unlikely slightly moderately very likely likely

49. Do you go on eating binges though you are not hungry?

1 2 3 4
never rarely sometimes at least once a week

50. On a scale of 0 to 5, where 0 means no restraint in eating (eating whatever you want, whenever you want it) and 5 means total restraint (constantly limiting food intake and never "giving in"), what number would you give yourself?

0 eat whatever you want, whenever you want it
1 usually eat whatever you want, whenever you want it
2 often eat whatever you want, whenever you want it
3 often limit food intake, but often "give in"
4 usually limit food intake, rarely "give in"
5 constantly limiting food intake, never "giving in"

51. To what extent does this statement describe your eating behavior? "I start dieting in the morning, but because of any number of things that happen during the day, by evening I have given up and eat what I want, promising myself to start dieting again tomorrow."

1 2 3 4
not like me little pretty good describes me like me description perfectly of me

^ denotes items on the Disinhibition scale
* denotes items on the Hunger scale
± denotes items on the Cognitive Restraint scale
* denotes negatively directed items

Appendix C 183
APPENDIX D: EATING DISORDER INVENTORY  
(Garner et al. 1983)  

NAME:  

This is a scale which measures a variety of attitudes, feelings, and behaviors. Some of the items relate to food and eating. Other items ask you about your feelings about yourself. There are no right or wrong answers, so try to be completely honest. PLEASE read each question very carefully, and circle the letter of the response that best applies to you.  

A = ALWAYS   U = USUALLY   O = OFTEN   S = SOMETIMES   R = RARELY   N = NEVER  

A U O S R N 1. I eat sweets and carbohydrates without feeling nervous.  
A U O S R N 2. I think that my stomach is too big.  
A U O S R N 3. I wish that I could return to the security of childhood.  
A U O S R N 4. I eat when I am upset.  
A U O S R N 5. I stuff myself with food.  
A U O S R N 6. I wish that I could be younger.  
A U O S R N 7. I think about dieting.  
A U O S R N 8. I get frightened when my feelings are too strong.  
A U O S R N 9. I think that my thighs are too large.  
A U O S R N 10. I feel ineffective as a person.  
A U O S R N 11. I feel extremely guilty after overeating.
12. 
I think that my stomach is just the right size.

13. 
Only outstanding performance is good enough in my family.

14. 
The happiest time in life is when you are a child.

15. 
I am open about my feelings.

16. 
I am terrified about gaining weight.

17. 
I trust others.

18. 
I feel alone in the world.

19. 
I feel satisfied with the shape of my body.

20. 
I feel generally in control of things in my life.

21. 
I get confused about what emotion I am feeling.

22. 
I would rather be an adult than a child.

23. 
I can communicate with others easily.

24. 
I wish I were someone else.

25. 
I exaggerate or magnify the importance of my weight.

26. 
I can clearly identify what emotion I am feeling.

27. 
I feel inadequate.

28. 
I have gone on eating binges where I have felt that I could not stop.

29. 
As a child, I tried hard to avoid disappointing my parents and teachers.
I have close relationships.

I like the shape of my buttocks.

I am preoccupied with the desire to be thinner.

I don't know what is going on inside me.

I have trouble expressing my emotions to others.

The demands of adulthood are too great.

I hate being less than the best at things.

I feel secure about myself.

I think about binging (overeating).

I feel happy that I am not a child anymore.

I get confused as to whether or not I am hungry.

I have a low opinion of myself.

I feel that I can achieve my standards.

My parents have expected excellence of me.

I worry that my feelings will get out of control.

I think my hips are too big.

I eat moderately in front of others and stuff myself when they're gone.

Appendix D
47. I feel bloated after eating a small meal.

48. I feel that people are happiest when they are children.

49. If I gain a pound, I worry that I will keep gaining.

50. I feel that I am a worthwhile person.

51. When I am upset, I don't know if I am sad, frightened or angry.

52. I feel that I must do things perfectly or not do them at all.

53. I have thought of trying to vomit in order to lose weight.

54. I need to keep people at a certain distance (feel uncomfortable if someone tries to get too close).

55. I think that my thighs are just the right size.

56. I feel empty inside (emotionally).

57. I can talk about personal thoughts or feelings.

58. The best years of your life are when you become an adult.

59. I think my buttocks are too large.

60. I have feelings I can't identify.

61. I eat or drink in secrecy.
I think that my hips are just the right size.

I have extremely high goals.

When I am upset, I worry that I will start eating.

\textbf{DT} denotes items on the \textit{Drive for Thinness} scale
\textbf{*} denotes items which are negatively directed
\textbf{BD} denotes items on the \textit{Body Dissatisfaction} scale
\textbf{MF} denotes items on the \textit{Maturity Fears} scale
\textbf{B} denotes items on the \textit{Bulemia} scale
\textbf{IA} denotes items on the \textit{Interoceptive Awareness} scale
\textbf{I} denotes items on the \textit{Ineffectiveness} scale
\textbf{P} denotes items on the \textit{Perfectionism} scale
\textbf{ID} denotes items on the \textit{Interpersonal Distrust} scale
Appendix E: DAILY MINI-QUESTIONNAIRE

DAILY MINI-QUESTIONNAIRE

DAY________ DATE________ NAME__________________________

PLEASE record your temperature every morning. REMEMBER, you need to take your temperature as soon as you get up and before you get out of bed. Even the activity of getting out of bed to retrieve the thermometer may cause your temperature to rise and yield inaccurate results.

PLEASE fill in the rest in the evening so that you may reflect on the day.

PLEASE return all completed forms each day that you taste solutions.

Morning temperature________

Please slash the line which describes how you are feeling today—you may slash the line outside the words if you are feeling a particular extreme.

-----I----------------------------------------------I-----
not good

-----I----------------------------------------------I-----
not hungry

-----I----------------------------------------------I-----
not pretty

-----I----------------------------------------------I-----
no menstrual discomfort

-----I----------------------------------------------I-----
alot of menstrual discomfort

Appendix E 189
Please circle the appropriate response.

Do you have a test today or tommorrow? YES NO

Did you experience menstrual cycle bleeding today? YES NO

Did you experience an INCREASED desire for SWEET foods today? YES NO

Did you experience a DECREASED desire for SWEET foods today? YES NO

Today I ate MUCH MORE than normal
MORE than normal
THE SAME than normal
LESS than normal
MUCH LESS than normal

List any medications you have taken today (ex. cold medicine, aspirin, digel, cough syrup, caffeine...)

THANK YOU!!!!!!!

Appendix E 190
APPENDIX F: INNITIAL SCREENING QUESTIONNAIRE

SUBJECT ASSESSMENT

NAME:
PHONE #
ADDRESS:

THANK YOU very much for your time in filling out this questionnaire and for your INTEREST in this study.

I think you will learn a lot about YOURSELF and have FUN doing it!!!

PLEASE take your time and answer honestly. ALL RESPONSES ARE CONFIDENTIAL!!

Answer the following questions to the best of your knowledge. IF you have ANY questions, PLEASE feel FREE to ASK!!!

1. What is your date of birth?__________

2. What is your approximate weight?__________

3. How tall are you?__________

4. Are you on any special type of diet? YES NO

   If YES, what kind (ex.--weight reduction, diabetic...?)__________

5. How often do you drink alcohol?

   Rarely/Never  1-3 times/week  Almost every day

6. If you do drink alcohol, how much do you drink when you do drink?

   1-2 drinks  3-4 drinks  5-6 drinks  7 or more drinks

7. What are your typical sleep habits? -- Please check all that apply.

   _____regular set bedtime
   _____no set bedtime
   _____regular number of sleep hours each night
   _____number of hours of sleep varies each night

Appendix F
8. What are your eating habits? -- Please check all that apply.

   ____ eat a regular number of meals a day
   ____ nibble frequently, but do not eat a regular number of meals
   ____ nibble frequently and do eat a regular number of meals
   ____ eat breakfast most days
   ____ eat lunch most days
   ____ eat dinner most days

9. Do your eating habits ever change? -- Please check all that apply.

   ____ with seasonal changes
   ____ over the weekend
   ____ during your menstrual cycle
   ____ after you drink
   ____ before a big test

10. How frequently do you exercise? 

   Rarely/Never  1-3 times/week  almost every day

11. How regular are your menstrual periods?

   ____ very regular
   ____ somewhat regular
   ____ very irregular
   ____ not menstruating

12. Approximately how many days does your menstrual cycle last (from the first day of menstrual bleeding to the day before the next onset of menstrual bleeding)?____

13. In your opinion, are you generally in good health?

   YES  NO

   If NO, why not?______________________________________________

14. Do you smoke cigarettes?  YES  NO

15. Please check all prescription and non-prescription drugs that you take on a regular basis (that is, those that you take at least TWICE a week).
____ antibiotics
____ prescription pain medication
____ birth control pills or other hormones
____ aspirin/Tylenol
____ diet pills
____ caffeine tablets (No-Doz, Vivarin, etc.)
____ other ____________________________

16. If I were chosen as a subject for this study, I would be a very reliable subject.

YES    NO

THANK YOU VERY MUCH!!!!
If selected for further screening, you will be receiving a call from me -- Amanda -- within a few weeks!!!!!
APPENDIX G: EATING DISORDER INVENTORY: MEAN SCALE (+/- STANDARD ERROR) SCORES FOR ANOREXIA NERVOSA AND FEMALE COMPARISON GROUPS
(Garner et al. 1983)

<table>
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<tr>
<th></th>
<th>Anorexia Nervosa *</th>
<th>Female Comparison</th>
</tr>
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<tbody>
<tr>
<td>Drive for Thinness</td>
<td>15.4 (.50)</td>
<td>5.0 (2.2)</td>
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<td>Bulemia</td>
<td>R=2.7 (.55)</td>
<td>0.3 (.14)</td>
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<td>B=10.8 (.69)</td>
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<tr>
<td>Body Dissatisfaction</td>
<td>R = 14.2 (1.0)</td>
<td>10.2 (.32)</td>
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<td>B = 17.4 (1.0)</td>
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<tr>
<td>Ineffectiveness</td>
<td>14.4 (.75)</td>
<td>2.0 (.15)</td>
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<td>10.0 (.47)</td>
<td>5.2 (.16)</td>
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<td>2.2 (.12)</td>
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<td>Interoceptive Awareness</td>
<td>12.5 (1.1)</td>
<td>2.9 (.47)</td>
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<td>Maturity Fears</td>
<td>6.0 (.99)</td>
<td>2.5 (.33)</td>
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* R=Restricters; B=Bulemics; when bulemic and restricter subgroups do not differ significantly on subscale scores, only total group means are reported.
APPENDIX H: SUBJECT SCORES ON THE EATING DISORDER INVENTORY

<table>
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<tr>
<th>Subjects</th>
<th>B*</th>
<th>I*</th>
<th>ID*</th>
<th>IA*</th>
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B = Bulimia
I = Ineffectiveness
ID = Interpersonal Distrust
IA = Interoceptive Awareness
MF = Maturity Fears
DT = Drive for Thinness
BD = Body Dissatisfaction
P = Perfectionism

* Scales which distinguish anorexics and bullemics from normal dieters.
+ Scales which do not distinguish anorexics and bullemics from normal dieters.
APPENDIX I: PRELIMINARY NORMATIVE GUIDELINES FOR INTERPRETING RAW SCORES ON THE THREE FACTOR EATING QUESTIONNAIRE (Stunkard and Messick, 1988)

<table>
<thead>
<tr>
<th></th>
<th>Cognitive Restraint Scale</th>
<th>Disinhibition Scale</th>
<th>Hunger Scale</th>
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<td>0 to 8</td>
<td>0 to 7</td>
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<tr>
<td>High Range</td>
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<tr>
<td>Clinical Range</td>
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### APPENDIX J: SUBJECT SCORES FOR THE THREE FACTOR EATING QUESTIONNAIRE

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<th>Subject</th>
<th>Cognitive Restraint</th>
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<th>Hunger</th>
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<tr>
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</tr>
</tbody>
</table>

* Group 1 = Normals (N) (i.e. non-restrainers/ non-disinhibitors)
+ Group 2 = Restrainers (R)
~ Group 3 = Restrainers/Disinhibitors (R/D)
CONSENT FOR PARTICIPATION

Subjects will come to Wallace Hall on the Virginia Tech campus and be tested for taste sensitivity and taste preference. In addition, subjects will be given a thermometer and a supply of daily questionnaires. Basal body temperature is to be recorded each morning, and daily questionnaires are to be filled out each evening. All completed questionnaires are to be returned on the subject's next test day. In addition, height and weight may be recorded at one test session.

Subjects may be called or written to, to clarify information that has been recorded or to be reminded of testing dates.

The identity of the subjects will be held confidential in all reports of this research. No compensation is available if injury is suffered as a result of this research. However, subjects are at essentially no risk by participating in this project. There will be no monetary cost for participation in this study. However, subjects can gain interesting and valuable information about themselves and their food habits. In addition, there will be a monetary compensation of $50.00 for study completion. Consent for participation may be withdrawn at any time. Monetary reward will be pro-rated accordingly. Questions regarding this project will be answered by the investigators.

I understand the above, and agree to participate in this study at the times designated between January 23 and March 10, 1989.

SUBJECT

Investigators:
Amanda A. McGinnis 951-2069
Dr. Mary K. Korslund 961-7618
Dr. Ernest R. Stout 961-5712
Chairman, Institutional Review Board
APPENDIX L: DATA RECORDING FORMAT

Sample Page:

Subject's name
Subject's address
subject's phone number

<table>
<thead>
<tr>
<th>DATE</th>
<th>FLAVOR</th>
<th>EXPECTED RESPONSE</th>
<th>ACTUAL RESPONSE</th>
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</thead>
<tbody>
<tr>
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<td>F</td>
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<td>2</td>
</tr>
</tbody>
</table>

Threshold:
Preference:

* A separate data book was used for each testing group

+ Each of the seven threshold concentrations was coded in order of increasing concentration F, L, A, V, O, R, S. This column was used to indicate which concentration was under consideration. In the sample, the lowest concentration, coded "F," was being tasted.

~ The pairs of solutions to be compared were given sequentially. A "1" or a "2" in this column indicates which of the pair (the first or the second) was the actual test solution. This column was called "expected response" because if the subject were able to detect the test solution, she would name that solution as the sweeter solution. In the example, the test solution was given as the first sample of the pair. So if the subject could detect this concentration as being sweet, she would respond with a "1."

** The subjects responded with a "1," a "2," or a "no difference" depending on whether they thought solution 1 or solution 2 was sweeter, if they even thought there was a difference. These actual subject responses were placed in this column. If the subject's response and the expected response matched it indicated the subject could detect sweet at the test-solution concentration. In the example, the subject thought the spring water was sweeter than the test solution.
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