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),

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.

Abstract

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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 cognitve 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

Kobayshi, 1979; Munday, 1977; Munday, Brush and Taylor,

1977; Munday, Brush and Taylor, 1981; O'Brien, Selby and

Symonds, 1980; Rubinow, Hoban, Grover, Galloway, Roy-

Byrne, Anderson and Merriam, 1988; Steiner and Carroll,

1977; Taylor, 1979; Webb, 1986; Zucker, 1969); an altered

pain threshold (Aberger, Denney and Hutchings, 1983;

Collins, Eneroth and Landgren, 1985; Herren, 1933;

Kuzmierczyk and Adams, 1986; Kuzmierczyk, Adams, Calhoun,

Naor, Giombetti, Cattalani and McCann, 1986; Moos, Kopell,

Melges, Yalom, Lunde, Clayton and Hamburg, 1969; Siegal,

1986; Tedford, Warren and Flynn, 1977; Veith, Anderson,

Slade, Thompson, Laugel and Getzlaf, 1984); an increased

metabolic need for energy (Bonora, Zavaroni, Alpi,

Pezzarossa, Dall'Aglio, Coscelli and Butturini, 1987;

Cohen et al. 1987; Dalvit, 1981; Fernstrom and Wurtman,

1971; Hamburg, 1966; Hastrup and Light, 1984; Hill and

Blundell, 1982, Horowitz, Maddern, Chatterton, Collins,

Petrucco, Seamark and Shearman, 1985; Jarrett and Graver,

1968; Munday et al. 1981; Reid, Greenaway-Coates and Hahn,

1986; Rosenburg, 1980; Solomon, Kurzer and Calloway, 1982;

Sommers, 1982; Spellacy, Carlson and Schade, 1967; Wade,

1972; Wurtman, 1985); altered neurotransmitter function

via endorphins, serotonin, or catecholamines (Armour and

Asso, 1986; Asso, 1978; Asso, 1986; Giannini, Price and

Loiselle, 1984; Giannini et al. 1985; Goldstein, Levinson

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 1970's 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 premenses 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

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

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 percieve 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.

REVIEW OF LITERATURE

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 betweeen 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 recieved 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 tolerence, 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, Warren, 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

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 sub-clinical 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 amd 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

accommodate this increased metabolic need for energy.

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; Rosenburg, 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 had 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 MC -- primarily the LP -- remains. Also, if there is an increased need, is the underlying mechanism physioligical 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 reversable by an opioid receptor antagonist, naltrexone (Blass et al. 1987). This ability of sugar and sugar's reversability 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 reversable 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 alieved 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 (1980) 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 hypothalmus is considered important with respect to eating behavior. Damage to the hypothalmus results in an altered set-point, the direction depends on where in the hypothalmus 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 inversly 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 withdrawl. 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.

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 norelnephrine: Both self reports and

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 sytem 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 premenses 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 reponsive 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 hypothalmic glucose responsive

neurons (Kow and Pfaff, 1985). Norepinephrine in the

hypothalmic 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
norepinephrine 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 flight-or-fight response (Korf, Aghajanian and Roth,
1973). The fight-or-flight stress response is mediated
through norepinephrine, which alone could stimulate
consumption. Since stress and thus ANS and norepinephrine
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 bulemia 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 bulemic 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 bulemic 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 premeneses 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 successfull 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; Lowe, 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, Goolkasian, 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 bulemia
nervosa because it more clearly distinguishes between

these patient groups and subclinical cases (ie. normal

dieters). The EDI consists of eight subscales:

interoceptive awareness; body dissatisfaction;

ineffectiveness; bulemia; 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

bulemics 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 bulemics, 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 bulemia. 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; Moskovitz, 1971;
Moskovitz, 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

important.

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 stairsise 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
senstivity. 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

percieved 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-threshhold 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 98.08 °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.

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
respectivley. 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 Messicks' (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

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

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; excercise 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 bulemia" (Garner, et al. 1983, p.15).

It was chosen as the instrument to identify clinical cases
of anorexia and bulemia 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; bulemia; 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
bulemics 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 bulemic 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 recieve 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; excercise 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 bulemia nervosa, and to distinguish between these patient groups and subclinical cases (normal dieters). Clinical anorexics and bulemics score high on each of the EDI's eight subscales: interoceptive awareness; body dissatisfaction; ineffectiveness; bulemia; maturity fears; interpersonal distrust; perfectionism; and drive for thinness (Garner et al. 1984). Normal dieters express attitudes similar to clinical anorexics and bulemics, 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; bulemia; maturity fears; and interpersonal distrust) were not

invited to participate. Scores for the drive for
thinness, body dissatisfaction, and perfectionism scales
were not as closely inspected, since normal dieters are
expected to score high on these scales. (See Appendix H
for individual subject's scores on the EDI.)

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 (Stunkark 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/disinhibitor (R/D). (See Appenix 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 DMQs 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 accessable 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 variablity 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

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 ($p = 0.0881$). 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

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


            MEANS* (+/- standard deviation)

MENSTRUAL PHASE                 THRESHOLD

Post-Menses                     3.36+  (0.15)
Premenses                       3.44+  (0.13)
Menses              .           3.31+  (0.24)
```

* 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

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

MEAN* (+/- standard deviation)

DIETARY GROUP	THRESHOLD	
Normals	3.51+	(0.21)
Restrainers	3.25+	(0.16)
Restrainers/Disinhibitors'	3.44+	(0.13)

* 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

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

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

DIETARY BEHAVIOR GROUP

MENSTRUAL PHASE	Normals	Restrainers	Restrainers/ Disinhibitors
Post-Menses	3.52+ (0.29)	3.38+ (0.33)	3.19+ (0.17)
Premenses	3.43+ (0.26)	3.43+ (0.23)	3.47+ (0.22)
Menses	3.58+ (0.55)	2.95+ (0.29)	3.68+ (0.25)

* 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

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

VARIABLES	P VALUE
Menstrual Phase Effect	0.9118
Dietary Group Effect	0.4037
Menstrual Phase by Dietary Group Interaction	0.2940
Dietary Group Effect for Post-menses	0.8229
Dietary Group Effect for Premenses	0.5245
Dietary Group Effect for Menses	0.2065
Comparison of Pre- and Post-menses	0.5986
Dietary Group Effect for the Comparison of Pre- and Post-menses	0.4056
Comparison of Premenses and Menses	0.8589
Dietary Group Effect for the Comparison of Premenses and Menses	0.4667

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

VARIABLE	P VALUE	R VALUE+
Feeling Good	0.2344	0.0700
Feeling Hungry	0.0100	- 0.0557
Feeling Pretty	0.7204	0.0086
Menstrual Discomfort	0.3904	0.0224
Other Discomfort	0.0881	0.0352
Feeling Happy	0.7912	0.0057
Feeling Tired	0.0582	- 0.0373
Feeling Stressed	0.1258	- 0.0170

* 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

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. Consequentlly, 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

MEANS* (+/- standard deviation)

MENSTRUAL PHASE	PREFERENCE	
Post-Menses	2.58	(0.23)
Premenses	2.82+	(0.20)
Menses	2.80+	(0.26)

* 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 7: Effect of dietary behavior on women's
preference for sucrose

MEAN* (+/- standard deviation)

DIETARY GROUP   PREFERENCE

Normals   2.76+   (0.24)
Restrainers   2.82+   (0.23)
Restrainers/Disinhibitors   2.71+   (0.22)

* 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)

DIETARY BEHAVIOR GROUP

MENSTRUAL PHASE	Normals	Restrainers	Restrainers/ Disinhibitors
Post-Menses	2.41+ (0.39)	2.68+ (0.38)	2.66+ (0.46)
Premenses	2.75+ (0.39)	2.85+ (0.33)	2.86+ (0.36)
Menses	3.13+ (0.45)	2.91+ (0.51)	2.59+ (0.35)

* 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

VARIABLES	P VALUE
Menstrual Phase Effect	0.1455
Dietary Group Effect	0.7233
Menstrual Phase by Dietary Group Interaction	0.6760
Dietary Group Effect for Post-menses	0.6408
Dietary Group Effect for Premenses	0.7733
Dietary Group Effect for Menses	0.6680
Comparison of Pre- and Post-menses	0.0441
Dietary Group Effect for the Comparison of Pre- and Post-menses	0.8756
Comparison of Premenses and Menses	0.7563
Dietary Group Effect for the Comparison of Premenses and Menses	0.5867

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*

VARIABLE	P VALUE	R VALUE[+]
Feeling Good	0.0091	0.0700
Feeling Hungry	0.0944	0.0438
Feeling Pretty	0.5191	0.0187
Menstrual Discomfort	0.3077	0.0321
Other Discomfort	0.0486	- 0.0490
Feeling Happy	0.1641	0.0360
Feeling Tired	0.4191	- 0.0192
Feeling Stressed	0.1954	- 0.0173

* 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

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

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preference for sucrose at premenses, perhaps the origen 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 ultimatey 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

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

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

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 overroad 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 in to 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

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 seperately. Thus, each of the variables choosen 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

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

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

DIETARY GROU	FEELING GOOD		FEELING PRETTY		FEELING HUNGRY	
Normals	6.7+ ~	(3.3)	6.7**	(3.1)	6.7~~	(3.3)
Restrainers	7.2+	(2.9)	6.2** ++	(2.5)	6.8~~	(2.8)
Restrainer/ Disinhibitors	6.2~	(2.9)	5.5++	(5.1)	6.7~~	(5.2)
	P = 0.0379		P = 0.0021		P = 0.0726	

* 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)

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

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

	P VALUES	
VARIABLES	MENSTRUAL DISCOMFORT	OTHER DISCOMFORT
Menstrual Phase Effect	0.0001	0.0593
Dietary Group Effect	0.4959	0.8277
Menstrual Phase by Dietary Group Interaction	0.5505	0.7492
Dietary Group Effect for Post-menses	0.8070	0.8100
Dietary Group Effect for Premenses	0.7358	0.8125
Dietary Group Effect for Menses	0.4698	0.6542
Comparison of Pre- and Post-menses	0.0363	0.1286
Dietary Group Effect for the Comparison of Pre- and Post-menses	0.8853	0.9442
Comparison of Premenses and Menses	0.0001	0.0190
Dietary Group Effect for the Comparison of Premenses and Menses	0.4762	0.5786

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

DIETARY GROUP MEANS* AND ANOVA ANALYSIS		
DIETARY GROUP	MENSTRUAL DISCOMFORT	OTHER DISCOMFORT
Normals	1.3+ (2.9)	2.6~ (3.1)
Restrainers	1.1+ (2.6)	2.9~ (3.6)
Restrainer/ Disinhibitors	0.9+ (2.4)	2.7~ (3.2)
	P = 0.3824	P = 0.5971

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

MENSTRUAL CYCLE PHASE MEANS* (+/- standard deviations)		
MENSTRUAL CYCLE PHASE	MENSTRUAL DISCOMFORT	OTHER DISCOMFORT
Post-Menses	0.4 (0.07)	2.7[+] (0.38)
Premenses	3.0 (0.11)	2.8[+] (0.31)
Menses	3.5 (0.54)	3.9 (0.45)

* 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

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"

DIETARY GROUP MEANS* AND ANOVA ANALYSIS

DIETARY GROUP	FEELING HUNGRY	FEELING TIRED
Normals	5.3+ (3.1)	6.3~ (3.4)
Restrainers	5.1+ (3.1)	6.4~ (3.6)
Restrainer/ Disinhibitors	5.1+ (3.0)	7.7 (5.2)
	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 cyclephase and dietary behavior on women's daily ratings of "feeling hungry" and "feeling tired": a profile analysis

	P VALUES	
VARIABLES	FEELING HUNGRY	FEELING TIRED
Menstrual Phase Effect	0.5620	0.2539
Dietary Group Effect	0.9540	0.5888
Menstrual Phase by Dietary Group Interaction	0.9195	0.7020
Dietary Group Effect for Post-menses	0.7736	0.7174
Dietary Group Effect for Premenses	0.9738	0.2850
Dietary Group Effect for Menses	0.9944	0.6740
Comparison of Pre- and Post-menses	0.5371	0.4504
Dietary Group Effect for the Comparison of Pre- and Post-menses	0.6864	0.2214
Comparison of Premenses and Menses	0.3207	0.3113
Dietary Group Effect for the Comparison of Premenses and Menses	0.9906	0.8587

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

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

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TABLE 18:   Effect of dietary behavior on women's
            daily ratings of "feeling stressed"
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        DIETARY GROUP MEANS* (+/- standard deviation)
                    AND ANOVA ANALYSIS


                                    FEELING
        DIETARY GROUP               STRESSED

        Normals                     6.0+  (3.6)
        Restrainers                 6.1+  (7.3)
        Restrainer/Disinhibitors    8.0   (8.2)


                                    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

VARIABLES	P VALUE
Menstrual Phase Effect	0.4141
Dietary Group Effect	0.5332
MenstrualPhase by Dietary Group Interaction	0.1095
Dietary Group Effect for Post-menses	0.3796
Dietary Group Effect for Premenses	0.0255
Dietary Group Effect for Menses	0.7130
Comparison of Pre- and Post-menses	0.3541
Dietary Group Effect for the Comparison of Pre- and Post-menses	0.0205
Comparison of Premenses and Menses	0.5795
Dietary Group Effect for the Comparison of Premenses and Menses	0.4050

TABLE 20: 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

DIETARY BEHAVIOR GROUP

MENSTRUAL CYCLE PHASE	Normals	Restrainers	Restrainers/ Disinhibitors
Post-Menses	6.0+ (0.8)	6.5+ (0.5)	7.2 (0.7)
Premenses	5.7+ (0.5)	6.4+ (0.6)	7.7~ (0.4)
Menses	5.0+ (1.0)	6.4+ (0.7)	7.8~ (0.9)

* 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

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TABLE 21:   Means of women's daily ratings of stress
            as average total consumption increased
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MEAN* (+/- standard deviation) AND ANOVA ANALYSIS

CONSUMPTION	FEELING STRESSED	
Much Less than Normal	6.4+	(3.6)
Less than Normal	6.6+	(3.7)
Normal	6.3+	(3.6)
More than Normal	7.0+	(9.0)
Much More than Normal	10.3	(14.6)

$$p = 0.0001$$

* 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 tjey expereince 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 choosen 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-

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
developement 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.

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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

(1987) indicated that irregular eating patterns alter
brain neurotransmitters and thus change the release of
hypothalmic 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 accomodate 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.

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 percieve 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 bulemic 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 and 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 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 shoud 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.

     DAYS   EVENTS

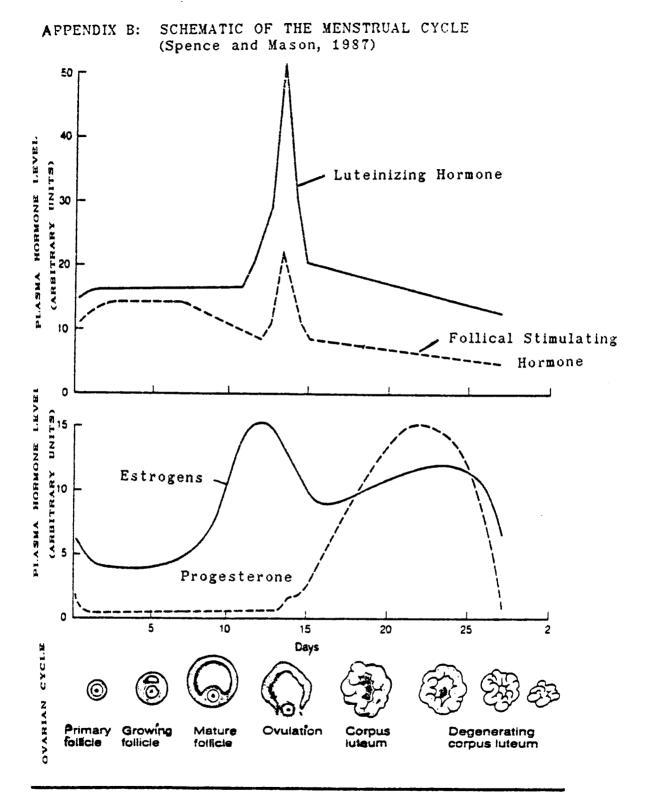   1-4   MENSES -- low levels of ovarian hormones
                     permit menses

     1-13   FOLLICULAR PHASE (FP)
                 growth of the follicles under stimulation of
                     Follical Stimulating Hormone (FSH)
                 granulosa secrete estradiol

     12   HIGHEST CONCENTRATION OF ESTRADIOL in the
                     blood

     13   LUTEINIZING HORMONE (LH) SURGE
                 estradiol provides a positive feedback to the
                     anterior pituitary and hypothalmus
                 estradiol stimulates anterior pituitary to
                     secrete LH
                 occurs 24-16 hours prior to ovulation.

     14   OVULATION
                 follicle releases oocyte and is now empty
                 occurs 16 hours after LH peak
                 FSH PEAK

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 corpeus
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 Follical Stimulating Hormone, Luteinizing Hormone, Estrogens, and Progesterone during a typical ovarian cycle

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NAME:

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   T F
        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   T F
        occasions, like parties and
        picnics.

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

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

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

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

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

8.ᴴ   Since I am often hungry, I sometimes wish   T F
        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.   T F

10.ᴿ˒* Life is too short to worry about dieting.   T F

11.^ᴰ Since my weight goes up and down, I have   T   F
         gone on reducing diets more than once.

12.^ᴴ I often feel so hungry that I just have to   T   F
         eat something.

13.^ᴰ When I am with someone who is overeating,   T   F
         I usually overeat too.

14.^ᴿ I have a pretty good idea of the number of   T   F
         calories in common food.

15.^ᴰ Sometimes when I start eating, I just   T   F
         can't seem to stop.

16.^{ᴰ,*} It is not difficult for me to leave   T   F
         something on my plate.

17.^ᴴ At certain times of the day I get hungry   T   F
         because I have gotten used to eating then.

18.^ᴿ While on a diet if I eat food that is not   T   F
         allowed, I consciously eat less for a
         period of time to make up for it.

19.^ᴴ Being with someone who is eating often   T   F
         makes me hungry enough to eat also.

20.^ᴰ When I feel blue, I often overeat.   T   F

21.^{ᴿ,*} I enjoy eating too much to spoil it by   T   F
         counting calories or watching my weight.

22.^ᴴ When I see a real delicacy, I often get so   T   F
         hungry that I have to have it right
         away.

23.^ᴿ I often stop eating when I am not really   T   F
         full as a conscious means of limiting
         the amount that I eat.

24.^ᴴ I get so hungry that my stomach feels like   T   F
         a bottomless pit.

25.^{ᴰ,*} My weight has hardly changed at all in the   T   F
         last 10 years.

26.^ᴴ ·I am always hungry so it is hard for me to   T   F
         stop eating before I finish the food
         on my plate.

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27.ᴰ   When I feel lonely, I console myself by   T   F
         eating.

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

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

30.ᴿ·ᴹ   I eat anything I want, any time I want.   T   F

31.ᴰ·ᴹ   Without even thinking about it, I take a   T   F
         long time to eat.

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

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

34.ᴴ   I am always hungry enough to eat anytime   T   F

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

36.ᴰ   While on a diet, if I eat a food that is   T   F
         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   2   3   4
    rarely   sometimes   usually   always

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

    1   2   3   4
    not at all   slightly   moderately   very much

39. How often do you feel hungry?

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

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

1	2	3	4
never	rarely	often	always

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

1	2	3	4
easy	slightly difficult	moderately difficult	very difficult

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

1	2	3	4
not at all	slightly	moderately	extremely

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

1	2	3	4
almost never	seldom	usually	almost always

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

1	2	3	4
unlikely	slightly likely	moderately likely	very likely

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

1	2	3	4
never	rarely	often	always

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

1	2	3	4
unlikely	slightly likely.	moderately likely	very likely

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

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

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

1	2	3	4
unlikely	slightly likely	moderately likely	very 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 like me	pretty good description of me	describes me perfectly

---

ᴰ denotes items on the Disinhibition scale
ᴴ denotes items on the Hunger scale
ᶜ denotes items on the Cognitive Restraint scale
* denotes negatively directed items

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

NAME:

This is 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.ᴰᵀ'*   I eat sweets and carbohydrates without feeling nervous.

A U O S R N   2.ᴮᴰ   I think that my stomach is too big.

A U O S R N   3.ᴹᶠ   I wish that I could return to the security of childhood.

A U O S R N   4.ᴮ   I eat when I am upset.

A U O S R N   5.ᴮ   I stuff myself with food.

A U O S R N   6.ᴹᶠ   I wish that I could be younger.

A U O S R N   7.ᴰᵀ   I think about dieting.

A U O S R N   8.ᴵᴬ   I get frightened when my feelings are too strong.

A U O S R N   9.ᴮᴰ   I think that my thighs are too large.

A U O S R N   10.ᴵ   I feel ineffective as a person.

A U O S R N   11.ᴰᵀ   I feel extremely guilty after overeating.

A U O S R N 12.ᴮᴰ·* I think that my stomach is
just the right size.

A U O S R N 13.ᴾ Only outstanding performance
is good enough in my family.

A U O S R N 14.ᴹᶠ The happiest time in life is
when you are a child.

A U O S R N 15.ᴵᴰ·* I am open about my feelings.

A U O S R N 16.ᴰᵀ I am terrified about gaining
weight.

A U O S R N 17.ᴵᴰ·* I trust others.

A U O S R N 18.ᴵ I feel alone in the world.

A U O S R N 19.ᴮᴰ·* I feel satisfied with the
shape of my body.

A U O S R N 20.ᴵ·* I feel generally in control of
things in my life.

A U O S R N 21.ᴵᴬ I get confused about what
emotion I am feeling.

A U O S R N 22.ᴹᶠ·* I would rather be an adult
than a child.

A U O S R N 23.ᴵᴰ·* I can communicate with others
easily.

A U O S R N 24.ᴵ I wish I were someone else.

A U O S R N 25.ᴰᵀ I exaggerate or magnify the
importance of my weight.

A U O S R N 26.ᴵᴬ·* I can clearly identify what
emotion I am feeling.

A U O S R N 27.ᴵ I feel inadequate.

A U O S R N 28.ᴮ I have gone on eating binges
where I have felt that I
could not stop.

A U O S R N 29.ᴾ As a child, I tried hard to
avoid disappointing my
parents and teachers.

A U O S R N   30.ᴵᴰʼ*   I have close relationships.

A U O S R N   31.ᴮᴰʼ*   I like the shape of my
                               buttocks.

A U O S R N   32.ᴰᵀ   I am preoccupied with the
                               desire to be thinner.

A U O S R N   33.ᴵᴬ   I don't know what is going on
                               inside me.

A U O S R N   34.ᴵᴰ   I have trouble expressing my
                               emotions to others.

A U O S R N   35.ᴹᶠ   The demands of adulthood are
                               too great.

A U O S R N   36.ᴾ   I hate being less than the
                               best at things.

A U O S R N   37.ᴵʼ*   I feel secure about myself.

A U O S R N   38.ᴮ   I think about binging
                               (overeating).

A U O S R N   39.ᴹᶠʼ*   I feel happy that I am not a
                               child anymore.

A U O S R N   40.ᴵᴬ   I get confused as to whether
                               or not I am hungry.

A U O S R N   41.ᴵ   I have a low opinion of
                               myself.

A U O S R N   42.ᴵʼ*   I feel that I can achieve my
                               standards.

A U O S R N   43.ᴾ   My parents have expected
                               excellence of me.

A U O S R N   44.ᴵᴬ   I worry that my feelings will
                               get out of control.

A U O S R N   45.ᴮᴰ   I think my hips are too big.

A U O S R N   46.ᴮ   I eat moderately in front of
                               others and stuff myself when
                               they're gone.

A U O S R N 47.ᴵᴬ   I feel bloated after eating a small meal.

A U O S R N 48.ᴹᶠ   I feel that people are happiest when they are children.

A U O S R N 49.ᴰᵀ   If I gain a pound, I worry that I will keep gaining.

A U O S R N 50.ᴵ⋅*   I feel that I am a worthwhile person.

A U O S R N 51.ᴵᴬ   When I am upset, I don't know if I am sad, frightened or angry.

A U O S R N 52.ᴾ   I feel that I must do things perfectly or not do them at all.

A U O S R N 53.ᴮ   I have thought of trying to vomit in order to lose weight.

A U O S R N 54.ᴵᴰ   I need to keep people at a certain distance (feel uncomfortable if someone tries to get too close).

A U O S R N 55.ᴮᴰ⋅*   I think that my thighs are just the right size.

A U O S R N 56.ᴵ   I feel empty inside (emotionally).

A U O S R N 57.ᴵᴰ⋅*   I can talk about personal thoughts or feelings.

A U O S R N 58.ᴹᶠ⋅*   The best years of your life are when you become an adult.

A U O S R N 59.ᴮᴰ   I think my buttocks are too large.

A U O S R N 60.ᴵᴬ   I have feelings I can't identify.

A U O S R N 61.ᴮ   I eat or drink in secrecy.

A   U   O   S   R   N   62.^{BD,*}   I think that my hips are just
                                            the right size.

A   U   O   S   R   N   63.^P   I have extremely high goals.

A   U   O   S   R   N   64.^{IA}   When I am upset, I worry that
                                            I will start eating.

---

^{DT} denotes items on the Drive for Thinness scale
* denotes items which are negatively directed
^{BD} denotes items on the Body Dissatisfaction scale
^{MF} denotes items on the Maturity Fears scale
^B denotes items on the Bulemia scale
^{IA} denotes items on the Interoceptive Awareness scale
^I denotes items on the Ineffectiveness scale
^P denotes items on the Perfectionism scale
^{ID} denotes items on the Interpersonal Distrust scale

DAILY MINI-QUESTIONNAIRE

DAY_____   DATE_____   NAME_____

PLEASE record you 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                                            very good



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



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



-----I----------------------------------------------------I-----
  no menstrual                                 alot of menstrual
    discomfort                                        discomfort
```

```
-----I------------------------------------------------I-----
   no other                                      alot of other
  discomfort                                       discomfort


-----I------------------------------------------------I-----
   not happy                                        very happy


-----I------------------------------------------------I-----
   not tired                                         very tired


-----I------------------------------------------------I-----
   not stressed                                    very stressed
```

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 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

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)

	Anorexia Nervosa *	Female Comparison
Drive for Thinness	15.4 (.50)	5.0 (2.2)
Bulemia	R=2.7 (.55) B=10.8 (.69)	0.3 (.14)
Body Dissatisfaction	R = 14.2 (1.0) B = 17.4 (1.0)	10.2 (.32)
Ineffectiveness	14.4 (.75)	2.0 (.15)
Perfectionism	10.0 (.47)	5.2 (.16)
Interpersonal Distrust	7.7 (.49)	2.2 (.12)
Interoceptive Awareness	12.5 (1.1)	2.9 (.47)
Maturity Fears	6.0 (.99)	2.5 (.33)

* R=Restricters; B=Bulemics; when bulemic and restricter
subgroups do not differ significantly on subscale scores,
only total group means are reported.

			Inventory Scales					
Subjects	B*	I*	ID*	IA*	MF*	DT+	BD+	P+
1	0	0	0	0	2	0	0	8
2	1	0	1	1	1	7	25	5
3	0	0	0	0	0	0	0	11
4	0	5	5	2	6	1	4	11
5	0	1	0	0	2	0	2	0
6	2	2	3	3	3	0	4	13
7	0	0	0	0	0	0	0	3
8	0	0	0	0	0	0	0	2
9	0	0	0	0	0	0	5	4
10	0	0	0	0	0	1	20	9
11	1	0	2	0	0	0	2	8
12	1	0	0	2	0	8	9	6
13	0	0	0	4	4	2	3	6
14	0	3	1	1	0	0	15	0
15	0	0	0	1	3	1	5	11
16	0	0	0	0	0	1	0	9
17	0	0	0	0	0	14	16	10
18	0	0	9	1	3	1	4	2
19	0	0	0	0	0	2	20	0
20	0	0	0	1	2	0	2	5
21	0	3	0	0	0	1	3	0
22	0	0	0	1	2	2	6	4
23	3	0	1	4	3	5	23	9
24	6	7	0	8	3	2	13	4
25	0	6	3	6	9	0	1	9
26	1	9	7	7	6	8	12	8
27	0	0	0	0	1	2	16	4
28	2	1	1	2	0	16	15	8
29	2	0	0	2	0	12	26	5
30	2	4	0	1	4	10	19	6
31	0	0	0	0	0	3	3	8
32	1	0	0	1	0	6	15	0
33	6	0	5	9	1	10	20	12
34	9	1	0	8	4	18	25	5
35	3	6	6	1	0	9	27	3

B = Bulemia   MF = Maturity Fears
I = Ineffectiveness   DT = Drive for Thinness
ID = Interpersonal Distrust   BD = Body Dissatisfaction
IA = Interoceptive Awareness   P = Perfectionism

* Scales which distinguish anorexics and bulemics from
    normal dieters.
+ Scales which do not distinguish anorexics and bulemics
    from normal dieters.

APPENDIX I: PRELIMINARY NORMATIVE GUIDELINES FOR INTERPRETING RAW SCORES ON
THE THREE FACTOR EATING QUESTIONNAIRE (Stunkard and Messick, 1988)

	Cognitive Restraint Scale	Disinhibition Scale	Hunger Scale
Low to Average Range	0 to 10	0 to 8	0 to 7
High Range	11 to 13	9 to 11	8 to 10
Clinical Range	14 or more	12 or more	11 or more

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APPENDIX J: SUBJECT SCORES FOR THE THREE FACTOR EATING
              QUESTIONNAIRE

Eating Factor

Subject	Cognitive Restraint	Disinhibition	Hunger	
1	5	1	5	
2	6	8	7	
3	7	4	5	
4	6	2	9	
5	7	2	4	
6	2	4	10	Group 1*
7	3	3	3	
8	8	3	3	
9	4	5	4	
10	5	9	9	
11	6	8	3	
12	6	10	7	
13	11	3	5	
14	17	2	2	
15	10	5	4	
16	11	0	1	
17	20	5	6	
18	15	4	2	Group 2+
19	19	5	4	
20	14	7	12	
21	16	6	5	
22	11	6	2	
23	13	6	3	
24	7	13	8	
25	8	9	4	
26	15	10	4	
27	9	10	3	
28	20	7	2	
29	13	8	5	Group 3~
30	13	14	10	
31	14	15	4	
32	10	10	7	
33	17	9	5	
34	11	12	8	
35	13	10	6	

* 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 availabe 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

DATE	FLAVOR+ F	EXPECTED RESPONSE~ 1	ACTUAL RESPONSE** 2

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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