PHYSIOLOGICAL RESPONSES TO AFFECTIVE STIMULI OF OBESE
AND NONOBESE FEMALES DIFFERING IN DIETARY RESTRAINT

DISSERTATION

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By

Edward Marc Framer, M. A.
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The present study translated the major theories of obesity into physiological terms, then tested for the ways these theories might find physiological expression. Theoretical positions included the psychoanalytic perspective, emphasizing intrapsychic processes; psychosomatic perspective, emphasizing food as an anxiolytic agent; and Schachterian perspective, emphasizing heightened sensitivity to external stimuli. Additionally, two classificatory distinctions, age at onset of obesity and extent of dietary restraint, were examined. The later distinction suggested that Schachterian findings on obese behavior were due not to obesity, but to a dieting life style.

This study's major purpose was to integrate across theoretical perspectives and search for unifying themes. Secondly, it investigated the feasibility of psychophysiological measures as dependent variables in the study of obesity. Hypotheses fell into categories by underlying theory. Several examined the relationship between Schachterian, externality theory and restraint. The
contention was that restrained eaters were hyperarousable and would show more extreme behavior than unrestrained eaters. Other hypotheses, drawing on both psychosomatic and psychoanalytic theory, predicted that the obese, compared to the nonobese, would give differentiable responses to emotional and neutral stimuli. The obese were expected to give larger and longer, but slower reactions to stimuli which evoked strong emotion. Finally, integrating psychoanalytic theory with age at onset, it was predicted that juvenile-onset would be more aroused by emotional stimuli than adult-onset obese.

Of 127 female volunteers, 72 were invited to participate after the application of inclusion and exclusion criteria to questionnaire responses. The sample contained 57 Caucasian women who met all criteria and who completed the psychophysiological assessment. Subjects ranged in age from 21 to 50 years. They weighed from -7.2% to +145% of the average weights for their heights.

During psychophysiological assessment, a series of three 40-dB, 1000-Hz tones and one 80-dB, 1000-Hz tone was presented. These were followed by a standardized imagery sequence consisting of 2 practice scenes, 2 neutral scenes, 1 affectively positive scene, and 1 affectively negative scene. Throughout the session, skin resistance, heart beat, and frontalis muscle activity were recorded. Additional measures included latency to first skin resistance response and to scene visualization, as well as percent of maximum
skin resistance response maintained at one minute after visualization. Subjects also completed a variety of questionnaires and scene rating scales. Analyses were performed on raw scores and range corrected proportions.

None of the experimental hypotheses were supported. However, psychophysiological measurement validity was upheld. Supplemental analyses yielded significant differences between experimental groups. Differences were found during periods of relatively low stimulation, and in the rapidity of response to and recovery from periods of intense stimulation. Restrained eaters were generally more reactive to neutral stimulation than were the unrestrained, and they sustained higher tonic arousal during the postexperimental recovery period. Restrained and unrestrained eaters were equally aroused by strong, affectively negative stimuli, but the unrestrained reacted more rapidly to this stimulation. These results were considered support for the existence of at least two basic psychophysiological arousal-recovery patterns; patterns which more closely paralleled a restrained-unrestrained eater division, than one based upon obesity-nonobesity.

The existence of arousal-recovery patterns suggested that the obesity literature may be greatly simplified. Many apparently unrelated or conflicting findings can be understood in the context of differential arousal-recovery; some theories should prove more compatible with one another.
The findings also suggested a need for future study concerning the etiology and stability of the patterns discovered.
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PHYSIOLOGICAL RESPONSES TO AFFECTIVE STIMULI OF OBESE AND NONOBESE FEMALES DIFFERING IN DIETARY RESTRAINT

Obesity has demonstrated itself to be an important research topic. Medlars II and Psychological Abstracts searches retrieved over 1000 articles published between 1966 and 1978. Perhaps this intensity of interest was due to the growing evidence that obesity detracts from one's physical health (Baird, 1973; Chiang, Perlman & Epstein, 1969; Heyden, Hames, Bartel, Cassell, Tyrolo & Coron, 1971; Marks, 1960; Tobian, 1978). It may have been due to warnings from such noted researchers in the field of obesity as Bruch (1975), Brownell and Stunkard (1978), Coates and Thoresen (1978), and Mayer (1968), that the obese will lead less fulfilling lives, and that "for all of their days they are scolded, heckled, and blamed for their condition" (Mayer, 1968, p. 92). However, no matter what the basis of their concerns about obesity, it is apparent that many researchers have tried to understand and to treat obese people.

Success rates were mixed, with some studies (e.g., Stuart, 1967) indicating uniform loss and maintenance, while others (e.g., Stollack, 1967) showed variability during treatment or loss of effectiveness at follow-up. Furthermore, some studies (e.g., Buchanan, 1973; Mahoney, 1974) reported 0 to .5 percent dropouts while others (e.g., Levitz &
Stunkard, 1974; Stollak, 1967) reported a 20 to 67 percent range. Outcome prediction questions quickly arose. Why did some of the obese respond to treatment, while others did not? Why have some clients stayed for the duration of treatment while others dropped out? The answers to these questions were unlikely to be found by additional, isolated treatment studies.

An alternate approach was to examine theories of obesity for potentially unifying observations. Perhaps taking the theories together might have provided answers to more general-case questions. How have obese persons differed from the nonobese? Were there discrete ways in which the reactions of a person with a weight problem were different from the reactions of the nonobese person? Were there variations within the population of obese individuals which exerted differential effects on their eating behaviors? This investigation addressed itself to several prominent lines of theory examining categorical and behavioral variables within the obesity literature. It attempted to integrate several major, but currently diverse, theoretical lines.

Psychoanalytic Concepts of Obesity

A basic tenet of the psychoanalytic conceptualization stressed that the etiology of obesity had its roots in that time when eating was central to an infant's world—the oral stage. Two basic aspects related to the development of obesity were present. First, since the mother fed him, a
strong relationship was established for the infant between ingestion of food and its mother's love. Food became equated with love. According to Hamburger (1951), activities such as biting, chewing, etc., associated with food intake, become functionally autonomous. In more modern terms, the activities associated with eating became both discriminative stimuli and secondary reinforcers. Thus, the infant found a substitute, in its behavior, for food itself; these substitutes helped the infant escape from unpleasant situations.

Second, the period of infancy was an unusually dependent time. The child was totally dependent on its mother or other caregivers for the satisfaction of his needs. Thus the child simultaneously made demands of others and was very dependent upon them. This situation set the stage for the development of future dependence-independence conflicts.

Within the framework of psychoanalytic theory, the normal infant continued to be socialized, progressed through the oral stage, and eventually gained autonomy in this sphere. If this process broke down, then the child remained fixated at the oral stage of development. Behavior typical of an orally fixated individual would be dependent and passive, yet demanding. Also, increased oral activities would be expected during times of stress.

Observations by Bruch (1955, 1957) were supportive of the psychoanalytic position. She noted that developmentally obese persons were indeed dependent, passive, demanding
individuals. Other authors have also added observational support. Hamburger (1951) observed that many obese people tend to eat in times of stress or emotional upset. Buchanan (1973) reported that obese persons did engage in excessively high rates of eating, smoking, talking, gum chewing, mouth movements and fingernail biting; all of these were considered "oral" behaviors.

Bruch (1940, 1943, 1947, 1957) reported extensively on childhood experiences of the developmentally obese. She observed that the mother in the family was usually over-solicitous and anxious about the child, but rarely seemed able to love the child for itself. The child was seen to have food and material possessions lavished upon it instead of love. These mothers were overprotective and possessive; they were not seen as encouraging independent behavior by their children. Bruch felt that the child-mother relationship described above was the type that would produce the psychoanalytically described, orally-fixated, obese child.

Another theme that recurred in the analytic literature was that the obese often increased their weight or timed their food intake to protect themselves from intimate contact with the opposite sex. This theme was mentioned by Bruch (1947), Reeve (1942), Richardson (1946), Schick (1947) and most recently Rand and Stunkard (1977). Rand and Stunkard, citing data collected during a cooperative study by members of the American Academy of Psychoanalysis, noted that the
obese in their sample more often became fat, or engaged in eating behavior to avoid sexual intercourse, than did a matched control group of non-obese.

The picture painted of the obese person by the analysts was that of a neurotic—a person consistently troubled by anxiety, tension, and emotional upset. Richardson (1946) took this view. He proposed that obesity was a symptom of neurosis in his patients. He had noticed that many of his obese patients were highly anxious, and that they used food to reduce their anxiety. Richardson reasoned that since food intake was used to reduce the anxiety in almost all situations, then obesity must be part of a neurotically restricted pattern.

Bruch (1941, 1946, 1957, 1970) observed that many of her obese patients were suffering from severe emotional disorders. She maintained that one subset of the obese, the developmentally obese, exhibited maladjusted behaviors which interfered with the development of their personalities. As mentioned earlier, she characterized them as socially and emotionally immature, having unrealistic fantasies, as being deficient in social relationships, and as lacking aggressiveness. Bruch (1958) reported that these characteristics were symptoms of a very severe emotional illness, and concluded:

For many of the fat young people, being fat, the very experience represents a protection against more severe mental illness. Obesity serves as an alibi for the avoidance of threatening and unacceptable social demands, and food indulgence
permits the experience of at least a semblance of satisfaction in an otherwise dismal existence. (p. 67)

Brosin (1953), Hecht (1955) and Simon (1968), viewed obesity as a defense with which the person coped with internal conflicts. These therapists contended that (a) eating was a way to defend against conflicts between conscious and unconscious impulses; (b) eating in some manner reduced or nullified unpleasant feelings; and (c) some obese persons used their weight as an active defense to control the actions of others or to increase their own feelings of security. However, the literature was unclear about when or how eating reduced anxiety, when being fat constituted an avoidance response, and when the state of being obese furnished an excuse for future behavior. The literature was least clear on the nature of the supposed conflicts between conscious and unconscious impulses.

An alternate conceptualization, still within the framework of psychoanalysis and neurosis, was to view obesity as an obsessive-compulsive syndrome (Buchanan, 1973; Bychowski, 1950; Rubin, 1966; Salzaman, 1972). For the obsessive-compulsive, the obsessions and compulsions that he demonstrated were methods of fulfilling his needs and partially mitigating his inadequate and dismal existence. Unable to satisfy his desires and needs through normal, socially acceptable channels, he sought gratification through
the readily available means of drinking, taking drugs, smoking, or eating. Thus the obsessive-compulsive individual was said to exhibit an addiction to some element of life. Hamburger (1951) maintained that some of the obese were indeed addicted to food. He used "addiction to food" as part of his classification scheme. Additional support for this position came from a Rorschach study (Kotkov & Murawski, 1952) on the personality structure of obese women. The authors noted that "The pattern of the Rorschach variables approximates most nearly the psychic-economic structure of the compulsion neurotic" (p. 396). Furthermore, Kotkov and Murawski were able to reliably differentiate their sample of obese women from women of more ideal weight. Conclusions from the Rorschach study also sounded a theme which would be heard frequently throughout the later developing Schacterian literature: "Obese women may be expected to react more strongly to traumatic experiences" (p. 396).

Thus, within an analytic framework, several explanations for the appearance and maintenance of obesity have been generated over the past 50 years. Significantly, all of them portrayed the obese person as neurotic, or even psychotic (Bruch, 1973), and as unable to cope with the stresses and strains of everyday life in the usual, socially accepted ways. Instead, the obese found less socially interactive ways than normal of dealing with their
environment, and tended to seek the immediate gratification of food as a palliative for failure, anxiety, and unfulfilled desires.

**Internal-External Responsiveness and Obesity**

An alternative to theorizing about intrapsychic causes of obesity was to seek observable differences between obese and normal weight individuals. While the results of these studies might not have demonstrated a definite causation for obesity, they did elucidate empirical differences between the obese and nonobese. Many of these studies have found similar results.

**Seminal studies.** Stunkard and Koch (1964) broke the ground with their study of stomach contractions and concomitant self-reports of hunger in the obese and nonobese. The authors studied subjects who had not eaten breakfast, and were given a gastric balloon to swallow. The balloon measured stomach contractions which were correlated with the self-ratings of hunger solicited at 15-minute intervals. Normal weight individuals made reports of hunger which paralleled the rate of stomach contractions: the more contractions, the greater the rated hunger. Additionally, if their stomachs were not contracting, the nonobese were unlikely to report hunger. In contrast, self-reports of obese subjects did not correspond to stomach contractions; some obese subjects never reported hunger, some reported that they were hungry regardless of the status of their stomachs,
and others made infrequent reports of hunger that could not be related to any observed variable.

Based on Sunkard and Koch's findings, Schachter and his students (Schacter, Goldman & Gordon, 1968) initiated a line of research that has blossomed. They began by reasoning that the Stunkard and Koch findings indicated that the obese were less sensitive to internal physiological cues than the nonobese. Schachter et al. studied the effects of high and low deprivation levels on consumatory behavior. They found that normal subjects ate more crackers when deprived than when sated. In contrast, the obese ate as much when their stomachs were full as when they were empty.

The Schachter et al. (1968) results left a question. Was the concept of "defective internal feedback" sufficient to explain the observation that the obese had eaten more than normals even when they were full? Fortunately, an earlier study by Grigs and Stunkard (1964) provided closure. Grigs and Stunkard had demonstrated that visceral sensitivity in the obese was essentially unimpaired; they had easily been trained to label their gastric contractions as hunger in the manner of the nonobese. Changing perspective, Schachter et al. concluded that it was not internal insensitivity that causes the obese to eat without regard for their visceral state, but rather that eating was "determined by external, food-related cues such as sight, smell, and taste of food" (Schachter et al., 1968, p. 97). This was a conclusion that led to much contemporary research on
"externality" or "stimulus-binding" in the obese. Subsequent variables examined within the Schachterian framework included amount of effort necessary to obtain food, visibility of the food, perceived caloric value of the food, perceived time of the day, deprivation, and the effects of preloading on subsequent consumatory behavior.

Deprivation. Nisbett (1968b) examined the relationship between extent of food deprivation and the subjective reports of hunger with obese and non-obese subjects. His subjects were asked to arrive after differing numbers of hours of food deprivation, and standardized reports of hunger were gathered. He found little correlation between length of deprivation and perceived hunger among the obese. In contrast, there was a positive correlation between length of deprivation and the degree of hunger reported by the normal-weight subjects. It appears that the obese had not responded to internal cues despite their ability to experience such cues (Grigs & Stunkard, 1964).

Price and Grinker (1973) utilized subjects who were food-deprived, partially preloaded, or preloaded with food to complete fullness. Subjects were then exposed to additional conditions where food consumption was possible. Their significant finding was that the obese ate more than the nonobese under all conditions of the experiment. Apparently, to be obese was to eat in the presence of food without regard to current deprivation status.
Effort. Schachter, Friedman and Handler (1974) executed the now famous "chopsticks" study. They visited Chinese and Japanese restaurants where they categorized the occidental diners as obese or nonobese. Major eating utensil was also recorded. Then they found that more normals (22.4%) than obese (4.7%) had eaten with chopsticks. It appeared that the obese were willing to expend less effort, in the presence of food, to ingest the food. This was viewed as an indication of increased externality; the obese had taken the path of least resistance and were more "controlled" by food cues.

Schachter and Friedman (1974) conducted a study where subjects could eat almonds while supposedly participating in a study on personality. Sometimes the almonds were shelled; at other times a nutcracker was provided. The obese consumed many fewer nuts when required to expend the effort to shell them; the nonobese consumed about as many nuts in both experimental conditions. Apparently the obese were less likely to work for food which was usually available with less effort.

Perceived caloric content. Wooley (1971), Wooley (1972) and Wooley, Wooley, and Dunham (1972) examined differences in food intake which could be viewed as a function of cognitive patterns. They reasoned that the obese might be less able to regulate food intake under conditions where feedback was lacking, as when they were
placed on a liquid diet whose caloric density was disguised. However, Wooley (1971) found that both obese and nonobese had adjusted intake according to caloric density while on liquid diets.

Wooley (1972) and Wooley et al. (1972) varied the caloric content and appearance of drinks given prior to the actual test condition. If a subject judged the drink to be high calorie, regardless of his accuracy, he ate less during the test condition. This result was consistent for both normal and obese subjects. The only significant difference was that the obese reported greater hunger than normals when the drink was low calorie (Wooley et al., 1972). Since the obese had eaten in well observed conditions, it was conceivable that they might have eaten more, but were restrained by social pressure.

Pliner (1974), drawing on results from Schachter et al. (1968), Wooley (1972), Wooley et al. (1972), and her own research, integrated many of the findings on caloric perception and intake regulation. She noted that obese subjects appeared to be differentially sensitive to solid and liquid food intake, and directly tested this by using high and low calorie preloads in both solid and liquid forms. The obese adjusted their caloric intake following liquid, but not following a solid preload. Normals reduced consumption slightly more to the liquid than to the solid preloads, but responded to increases in the caloric content
of either. Caloric perception, for the obese, apparently related to the form of the food as well as intake, perhaps with liquid food having provided more satiety cues.

Perceived time of day. Schachter and Gross (1968) examined the effects of perceived time of day on consumption of crackers during a "taste test." Some subjects were placed in rooms where the wall clock had been rigged to run at 1/2 normal speed, while others were with clocks that ran twice normal. All of the subjects' watches had been removed and the subjects were asked to wait for 15 minutes prior to the initiation of the experiment. Since they had all reported late in the afternoon, the experimental manipulation was designed to study the effect of their perception of nearness to dinner time on their eating behavior. The obese ate significantly more when they believed that the experiment had kept them until their usual dinner time. However, the results can only be cited as marginal support for increased externality, since the nonobese often reduced intake when they thought that dinner time was near. The reduction of food intake by the nonobese could have been cited as evidence of external reactivity.

Taste of food. Many authors have studied the effects of taste on food consumption (e.g. Goldman, Jaffe & Schachter, 1968; Nisbett, 1968b; Wooley, 1971). Nisbett (1968b) and Decke (cited in Schachter, 1971) allowed their subjects access to ordinary and quinine-adulterated ice cream in
supposed taste rating experiments. The dependent variable was the amount of ice cream consumed. The obese were more affected by taste, especially bad taste, than the nonobese. Goldman et al. (1968) executed a field study on students who had the option to retain or drop a dormitory food plan. The obese dropped the food plan more often than did the nonobese. Again, it appeared that the obese were less likely to continue to consume inferior food if an alternative was available.

**Visibility of food.** Nisbett (1968a), Johnson (1974), and Ross (1974) all provided experimental support for the externality hypothesis. The authors varied cue salience in a variety of ingenious ways. For example, Johnson (1974) wrapped sandwiches in clear or opaque paper. Ross (1974) varied the amount of light allowed to fall on a bowl of nuts. The results showed that obese ate more than normal weight subjects as cue salience increased.

An additional datum that bears on the responsiveness of the obese to food cues was provided by the Goldman et al. (1968) study mentioned earlier. They found that the obese were more likely than the nonobese to undergo prolonged voluntary fasting, and that they were more likely to be successful in fasting if they stayed away from the sight of food.

**Summary.** Almost without exception, the studies reviewed in this section have indicated that the obese generally responded more to external stimuli than did the
nonobese. This heightened external responsivity was found with regard to both food and non-food cues. The concept of increased external responsivity has found wide acceptance as the Schachterian literature continues to expand.

External Normal Weight Subjects

In its development as a theoretical position, externality theory generally viewed heightened external responsiveness as an attribute of obese people. The obese were categorized as more external than normal weight subjects. Research focused on how this externality set the obese apart from normals. Yet as early as 1968, Nisbett (1968b) observed that normal weight individuals who had formerly been obese responded as strongly to external cues as did subjects who were still obese. They also responded more strongly than did subjects who had never been obese. This seemed to indicate that externality was not something fat people "acquired" just by becoming fat. Additional experimentation by Decke (cited in Rodin, 1976) found that when subjects had been force-fed to body weights 20%-30% above their normal weight, they did not become more external. These findings suggested that heightened external responsiveness preceded the onset of obesity.

In 1976, Rodin and Slochower tested the hypothesis that heightened externality preceded obesity by studying normal weight children. They measured externality of children who were beginning summer camp, and split their
sample at the median value into two groups. The authors found that normal weight campers classified as "high externals" gained significantly more weight over the camp session than those campers classified as "low externals." Rodin and Slochower had succeeded in demonstrating that normal weight children could be externally oriented, and that their degree of externality predicted absolute weight change. The article also revealed an interesting possibility: "Perhaps externally responsive people who maintained normal weight are those who are responsive to major shifts in food cues that produce short-term weight gain but for whom long-term regulation is responsive to other factors" (p. 343).

What constituted "major shifts in food cues" and "other factors" in long-term regulation was left in question. However, their discovery of heightened externality among normal weight individuals dovetailed nicely into the restrained-unrestrained eating literature.

Restrained and Unrestrained Eating

Herman and Mack (1975) introduced what has become known as the restrained versus unrestrained eating dimension to obesity research. Conceptually, it derived from the work of Nisbett and his associate (Nisbett, 1968b, 1972; Nisbett & Knouse, 1969), who emphasized a physiological logic to the observed fact that the obese were demonstrably more external than the nonobese. Nisbett argued that the relevant variable was reduction "below biological
set-point." He maintained that the heightened externality displayed by the obese was a product of relative nutritional deprivation—their bodies were below normal weight for their given genetic endowment, developmental history, ventromedial hypothalamic status, etc. They were biologically hungry if not experientially so.

Herman and Mack interpreted this position to indicate that any person who was below his biological set point should show increased external responsiveness. They reasoned that it was the behavior, dieting or not dieting, that was relevant, and predicted that even dieting "normal weight" people should show increased externality. They then developed a restraint scale which measured degree of dieting behavior and weight stability, and initiated a study to test their hypothesis.

The study investigated the effects of 0, 1, and 2 milkshake preloads on subsequent eating behavior in a Schachter style "taste test" rating situation. During these taste tests subjects were left alone in a room to taste and rate the foods from containers so large and full that extra consumption would not be noticed. Results indicated that the restrained subjects consumed more ice cream during the tasting and rating procedure after they had consumed the milkshake preloads than when they had not consumed milkshakes. The unrestrained eaters reduced consumption following the preloads. Herman and Mack concluded that
The hypothesis that differences in the pattern of eating behavior correspond to two theoretically distinct classes of individuals, obese and normal (as measured by degree of overweight), no longer seems tenable, at least in its most elementary form. Within the population of normal weight individuals, fairly sizable differences exist with respect to concern with weight and eating behavior—in our terminology, restraint; and corresponding to these individuals differences in restraint are strong differences in actual eating behavior. (p. 657)

Hence, the heightened external responsivity formerly thought to differentiate normal weight from overweight individuals, could have been an artifact of differences in their food related behavior. Overweight individuals could have been dieting more often than their non-overweight counterparts. The concept of restraint represented a major shift in emphasis: a shift away from body weight and towards a behavior that externally oriented people were presumed to be engaging in frequently, namely dieting.

Several subsequent studies on restraint have examined other relationships between consumatory restraint, other behaviors and physiological variables. Polivy (1976) examined the effects of perceived caloric versus actual caloric preload and the future eating behavior of restrained and unrestrained normal weight male subjects. She found that the perceived, not the actual, value of the preload influenced eating behavior during a taste test. The restrained subjects ate more and remembered less of what they ate during the tasting session if they perceived the
caloric value of the preload as high instead of low. This demonstrates a clear counterregulation effect, and one that had been found in obesity studies by other investigators (Nisbett & Storms, 1974; Wooley, 1972). Subjects scoring low in restraint were unaffected by the manipulation. There seemed to be a strong cognitive component to the breakdown of dieting control in restrained eaters.

Hibscher and Herman (1977) examined the effects of degree of restraint on free fatty acids (FFA) in the blood of male undergraduate subjects. Additionally, they replicated the Herman and Mack (1975) procedure for testing the effect of food preload on subsequent eating. Both sections of the study were conducted on the same subjects. Hibscher and Herman predicted (on the basis of Herman and Polivy, 1975) that the free fatty acids elevation normally seen in the obese (Bjorntorp, Bergman, & Varnauskas, 1969; Bjorntorp, Gergman, Varnauskas, & Lindholm, 1969) was not due to obesity per se, but to the degree of dietary restraint exercised.

Findings showed that dieting status, not weight classification was the significant variable predicting the eating responses to preloads. This finding replicated and extended those of Herman and Mack (1975). Dieting was also the factor related to levels of free fatty acids "whereas weight classification in and of itself was unrelated to FFA level ($F < 1$)" (p. 377). This did not contradict
literature showing a correlation between weight and free fatty acids. Instead it demonstrated that the relationship is accounted for by the presence of a third variable, dieting status.

Herman, Polivy, Pliner, Threlkeld, and Munic (1978) extended the dieting-nondieting distinction into the obese-normal distractibility literature (e.g. Rodin, 1973). This literature has demonstrated that obese subjects displayed a decrement in performance on proofreading tasks when they were presented with distracting stimuli; conversely, normal weight subjects showed modest performance improvements when "distracted." Additionally, the authors investigated the effects of anxiety level as it interacted with distraction to effect the proofreading performance.

The authors discovered a third order interaction between restraint, distraction level, and anxiety level. This supported the Herman and Polivy (1975) finding of elevated responsiveness of restrained subjects to emotional stimuli, which will be discussed later. The relative distractibility of restrained and unrestrained eaters reversed depending on the level of anxiety. "Restrained eaters are more distractible than are unrestrained eaters only when they are calm; the induction of anxiety produces a reversal of the pattern" (Herman et al., 1978, p. 546). The reader was left to ponder the complexity of a situation where the combination of two potential arousers, distraction and anxiety, produced
better performance by restrained eaters than either alone, while among unrestrained eaters performance was better with one than with two. This finding strongly suggested that the "cognitive externality" of the obese/restrained was complex in its relationship to internal and external stimuli. The apparent "cognitive externality" of the restrained/obese may someday be reduced to differentially elevated levels of arousal.

A recent article incorporating the restraint concept was written by Polivy, Herman, and Warsh (1978). These authors investigated the combinations of internal and external reactivity which could account for the hyperemotionality of restrained eaters and, perhaps, some of the obese. They factored the restrained-unrestrained dimension by placebo versus caffeine pill to obtain a 2-by-2 matrix. Some restrained and some unrestrained subjects each received the caffeine and some received placebo. All subjects were then exposed to slides of varying emotional tone, each of which they were asked to rate. The scales were anchored at each end by adjectives, e.g. disliked-liked. Analysis indicated an interaction. In the placebo condition, restrained subjects were more positive, whereas in the caffeine condition, unrestrained subjects were more positive. Effects were non-significant for neutral and negative slides. This analysis also indicated that restrained eaters without caffeine were as emotional as unrestrained eaters with caffeine.
The results of the Polivy et al. (1978) study had practical as well as theoretical significance. As the authors noted in citing earlier work,

An additional aspect of concern is the linkage between emotions and arousal on one hand and eating and weight loss on the other. It is clear that emotional arousal affects eating, though the direction of the effect may differ for chronic dieters and nondieters (Herman & Polivy, 1975)...successful weight control must also involve the understanding and management of emotional arousal (p. 503).

The restraint dimension represented an important new development in the theoretical literature on obesity. It represented a shift from the measurement of overweight to a behavioral dimension which had clear experimental and treatment implications. A notable implication was that hyperreactivity previously attributed by researchers to the obese should be seen in the restrained; and indeed, evidence of their reactivity has been found (Herman et al., 1978; Polivy et al., 1978).

In view of the Herman et al. (1978) and Polivy et al. (1978) findings, the hypothesis that it was the restrained eater, rather than the obese individual, who was in a heightened state of environmental responsiveness should be seriously entertained. This heightened responsiveness should be found in shorter latencies of response to environmental stimuli in restrained subjects. Additionally, they might be expected to show a larger initial magnitude of response to all stimuli than do nondieters. The restrained have been shown to respond more
positively on rating scales (Polivy et al., 1978) to positive emotional stimuli, and it is possible that this responsiveness could have physiological concomitants as well.

The Psychosomatic Conception of Obesity

Two basic tenets have historically been associated with the psychosomatic hypothesis: (a) the obese confused hunger with negative affect (Bruch, 1961), and (b) the obese overate in response to aversive emotional states (Kaplan & Kaplan, 1957). The mechanism proposed was that eating had anxiety reducing effects for the obese; the compulsive overeating and consequent obesity of those patients who felt an irresistible urge to eat without unusual hunger was attributed to this hypothesized anxiety reduction. Although undisussed in the literature, corollary logic suggests that the obese should become aroused more quickly, more intensely, for a longer period of time or to more stimuli so that the proposed anxiety reduction process would have a chance to operate differentially on them and normal weight people.

Schachter et al. (1968) demonstrated that normal weight subjects were sensitive, in terms of future food consumption, to fear and food deprivation manipulations. They reduced consumption when fearful and increased consumption when deprived, while the obese were not sensitive to those manipulations. This finding was considered partial evidence against the psychosomatic hypothesis. After this
demonstration, the literature split into studies which looked for sensitivity to external cues, and those which examined the parameters of fear, anxiety, anxiety reduction, and emotional reactivity on which the obese and nonobese might be differentiated (Bruch, 1961; Kaplan & Kaplan, 1957; Schachter et al., 1968). Some studies pitted psychosomatic theory (anxiety reduction by food) against Schachterian theory (heightened external responsiveness).

McKenna (1972) manipulated three independent variables: weight, food cue valence, and anxiety level. He used an elaborate preloading sequence to equate subjects on both hunger and fullness. Then he created high and low anxiety groups by manipulation. Finally, food-cue valence was varied by using tasty, visually appealing chocolate chip cookies, or a gray-green, tasteless quasi-shortbread.

"Normals actually out-ate obese subjects in the high-valence-low-anxiety condition, contrary to expectations based on the external cue conception" (p. 315). Additionally, the obese ate more low valence food than was consumed by the normals, and they increased intake under high anxiety conditions. These trends were contrary to early Schachterian expectations. Contributions were made to the interaction both by the obese having eaten more under high anxiety and normals having eaten less. This was congruent with psychosomatic theory. However, the anxiety reduction data offered little support for the supposition that eating
reduced anxiety for either group. McKenna speculated that food could still have served to reduce anxiety "by temporarily removing attention from the anxiety stimulus, by focusing attention on the problems of eating" (p. 317). However, his anxiety measure, taken 12 or more minutes after eating, would have missed any temporary anxieolytic effect of consumption.

Abramson and Wunderlich (1972) further examined the psychosomatic hypothesis. Observing (after Burdon & Paul, 1951) that fear of social failure was cited as a cause of overeating among the obese, they added a "fear of social incompetence" condition to the usual objective fear and control conditions. This fear was induced by a procedure which placed subjects at the 20th percentile of fictitious test norms, then gave them an interpretation which seriously questioned their social adequacy. Only obese subjects as opposed to normals reported increased anxiety due to the social fear manipulation or the threat of electric shock. The authors were unable to compare differential eating patterns because the normals did not respond to the anxiety manipulations. These results lend support to the Schachter (1971) hypothesis of increased emotional lability among the obese. However, their results were too flawed by procedural unknowns for anything to be said with confidence concerning anxiety reduction.
Pliner, Meyer, and Blankstein (1974) tested the hypothesis that the obese were more responsive than normals to both positive and negative affective stimuli. This was a two part study where (a) high school males rated slides and (b) the behavior of obese and normal children was observed in arousing situations.

The first study found that both obese and nonobese rated positive slides more positively and negative slides more negatively than neutral slides. Additionally, the obese were shown to give more extreme ratings on affective slides. The authors noted that the response to the positive stimulus could have been specific to the slide's content, an attractive, scantily clad female.

In the observational study of young, hospitalized children, the obese did not respond more extremely to the negative stimulus, insertion of a hypodermic; however, they responded more rapidly to the positive stimulus, cuddling, than did the normals. The authors noted that "it would appear either that responsiveness to external cues causes obesity or that both obesity and externality are caused by some third variable . . . Determination of what of the two is correct will of course entail further research" (p. 80). This third variable might have been restraint.

An important outcome of the Pliner et al. (1974) study was that for the first time a definite behavioral difference was shown between obese and normal subjects. The
obese were calmed more quickly by a positive stimulus when they were discomforted. While not utilizing food, this finding represented a conceptual victory for the psychosomatic hypothesis.

One study (Herman & Polivy, 1975), utilizing the restrained-unrestrained eating dimension, has addressed itself directly to the psychosomatic hypothesis. Using restrained and unrestrained subjects, the study utilized high and low anxiety conditions with a "taste test" and hidden anxiety questionnaire format. The amount of ice cream consumed and anxiety ratings constituted the dependent measures. The principal prediction of the study was that restrained normal weight subjects would parallel the obese in earlier externality studies, while the unrestrained would approximate the performances of the usual normal weight group. Also, if overeating was actually a consequence of adipose tissue demand rather than aversive psychic states, as Nisbett (1972) had implied, then Herman & Polivy predicted that "if and when restrained eaters exhibited excessive eating, such behavior would not necessarily be anxiety-reducing" (p. 688).

An anxiety manipulation check demonstrated that differences had been induced between the high and low anxiety groups. Furthermore, in the high anxiety condition, the restrained subjects demonstrated greater anxiety levels than the normal weight unrestrained subjects. This finding
paralleled the "obese are hyperreactive" findings of earlier externality literature.

Food consumption patterns also paralleled earlier findings (e.g. Schachter et al., 1968). The restrained 
eaters ate slightly more when anxious, the unrestrained 
eaters ate significantly less when anxious. It seemed 
reasonable to conclude that the obese-normal distinction 
could be conceptualized as a distinction between restrained 
and unrestrained eaters.

The reduction of anxiety among restrained eaters after 
food consumption in the Herman and Polivy (1975) study was 
marginal. Herman and Polivy (1975) also added marginal 
support (along with Schachter et al., 1968; McKenna, 1972) 
to the position that anxiety augmented eating behavior by 
the obese/restrained, but provided no evidence for anxiety 
reduction via food consumption. However, it was still 
possible that anxiety increased the probability of eating 
behavior occurring, a discriminative stimulus function, 
without implicating the mechanism of large or long-lasting 
intrapsychic anxiety reduction as a reinforcer for the 
eating. This logic has remained consistent with McKenna's 
(1972) statements that eating could have obviated anxiety's 
effect without reducing the anxiety level. In this area, 
the responsiveness and fine grain of physiological measures 
might have been helpful in assessing the actual interactions 
of food consumption or passage of time with anxiety.
Slochower (1976) examined the effects that the presence of a reason for empirical anxiety had on subsequent eating. She discovered that when the obese could label the source of their anxiety, they ate significantly less than when they could not label, and thus were experiencing "free-floating" anxiety. The presence or absence of a label did not affect the eating patterns of normal weight subjects. This may have been due to the restricted responsiveness of normals to the experimental manipulations. In general, the normals ate more when hungry and less when full, and also ate less when they reported themselves aroused.

As regards the psychosomatic hypothesis, Slochower made an interesting and supportive discovery. Her obese subjects experienced significant anxiety reduction after eating. Further, this effect was most noticeable among her obese, aroused subjects. Their correlation between amount eaten and degree of anxiety reduction was 0.63. The Slochower study concurrently demonstrated support for Schachterian (greater external responsiveness among the obese), general psychosomatic (anxiety reduction via eating), and Bruchian psychosomatic (relative internal inaccuracy) positions. No one theoretical position predicted all the observed outcomes.

Abramson and Stinson (1977) studied the effects of boredom on eating behavior in obese and normals. The obese were found to consume more food than normals, but both obese and normal subjects increased their food consumption while
engaging in boring as compared to interesting activity. While boredom appeared to act as a general stimulus for increased food consumption, the authors found no interaction between weight status and interest level of the task. This finding was inconsistent with both psychosomatic and Schachterian theory.

Age at Onset of Obesity

People who develop excessive adipose stores do so at varying times during their lives. The most frequently noted distinction was childhood, or juvenile, versus adult-onset (e.g., Grinker, Hirsch & Levin, 1973), although some preferred a simple early-onset versus late-onset distinction (e.g., Schumaker & Wagner, 1977). Another attempt at differentiation was made by Bruch (1957), who delineated the "reactive" obese, frequently adults, who overeat during times of stress, and the "developmental" obese, frequently children or adolescents for whom overweight played an integral part in their overall development. Many authors have been interested in the time of life during which a person becomes obese, and an examination has been made of the available data on age at onset of obesity.

Psychological/behavioral studies. Several authors (Mendelson, 1964; Stunkard & Mendelson, 1967) observed that the body images of the obese were disturbed. Stunkard and Burt (1967) noted that this disturbance seemed restricted to juvenile-onset subjects, or that at least severe
reactions seemed thus restricted. These findings reinforced the concept of two or more "types" of obesity, with the distinction being based on age at onset. Subsequent investigations (Grinker, Hirsch & Levin, 1973; Grinker, Glucksman, Hirsch, & Viseltear, 1973) added further support to the notion that the juvenile-onset obese were reliably different from adult-onset cases. Grinker, Hirsch and Levin (1973) indicated that juvenile-onset obese suffer affective problems following weight loss (drawing additionally on work by Glucksman & Hirsch, 1968; Gluckman, Hirsch, McCully, Barron, & Knittle, 1968), but that adult-onset obese do not. A second study (Grinker, Glucksman, Hirsch, & Viseltear, 1973) revealed that juvenile-onset subjects underestimated time passage following weight loss, while adult-onset and normal weight subjects did not show changed time perception following weight loss. These findings of behavioral differences were also buttressed at the physiological level by apparent differences in adipose tissue cellularity.

Adipose tissue cellularity. Numerous sources (e.g., Bjorntorp, 1974; Bjorntorp & Sjostrom, 1971; Brook, Lloyd, & Wolff, 1972; Hirsch & Knittle, 1970; Salans, Cushman, & Weismann, 1973; Sjostrom & Bjorntorp, 1974; Sjostrom, Bjorntorp, & Varna, 1971) have presented data indicating differences in the number of adipose cells and their size distribution among obese individuals who became obese at different ages. The primary distinction was drawn between
hypertrophic obesity (large size adiposites) and hyperplastic obesity (many fat cells although not necessarily large ones). Hyperplastic obesity was often linked with childhood onset and hypertrophic obesity with adult onset, although exact ages were not clearly delineated. At least one set of authors (Krotkiewski, Sjostrom, Bjorntorp, Carlgren, Carellick, & Smith, 1977) had found that hyperplastic and hypertrophic obesity are not mutually exclusive. They locates a "combined" hypertrophic-hyperplastic group of subjects. These combined subjects were noted to have an earlier age at onset than the other groups in their study.

**External responsiveness.** Several studies (Rodin, Slochower, & Fleming, 1977; Schumaker & Wagner, 1977; Wagner & Schumaker, 1976) have examined age at onset as it related to the Schachterian notion of heightened external responsiveness. Wagner and Schumaker (1976) worked with obese children, as opposed to adults who had become obese as children. They required the children to fill out questionnaires while sitting at a table with a bowl of either wrapped or unwrapped Hershey's Kisses. The obese children gave no evidence of being strongly controlled by the visual cues. Thus only the adult-onset obese behaved externally.

found no differences between early- or late-onset subjects in amount consumed, in the food visible or food invisible conditions. However, their early-onset subjects consumed more candy overall than did the late-onset subjects.

Rodin et al. (1977) examined the effects of age at onset, degree of overweight, and weight loss on responsiveness to sensory and external stimuli. Supporting Schumaker & Wagner (1977), they found that in general, the age at onset of the obesity was not a relevant factor in the degree of externality. However, they did find a three way interaction between externality, age at onset, and amount of overweight. This interaction, while difficult to interpret, suggested that age of onset was in some fashion related to differences in responsiveness among the obese.

Review and Integration

Hyperemotionality and arousal. The most prevalent theoretical perspective presented here was the Schachterian position, which stressed heightened external responsivity among the obese to a variety of stimuli. The aspect most immediately important to the present investigation was hyperemotionality (e.g. Pliner et al., 1974; Polivy et al., 1978), since emotionality related to so much of the obesity literature. For example, the psychoanalytic literature made distinctions between the severity of emotional problems displayed by obese people, often finding that juvenile-onset cases had more, and perhaps more psychopathological
personality involvement (e.g. Bruch, 1973). Age-at-onset literature (Grinker, Hirsch, & Levin, 1973) also showed that juvenile-onset cases were more prone to severe affective reactions following weight loss. Additionally, psychosomatic theory noted that food intake should serve to reduce anxiety levels among the obese. All of these theories could have predicted increased or prolonged arousability or emotional lability.

Increased arousability has come in many forms. One could have become aroused more quickly, more intensely, or for a longer period of time. Any or all of these could have been considered evidence for heightened externality. Additionally, the obese could have become highly aroused to all environmental stimuli or to only emotionally charged stimuli.

The studies reviewed have spoken only partially to the parameters of arousal. There were reports of more negative and more positive verbal ratings of emotionally toned slides as compared to neutral slides (Pliner et al., 1974; Polivy et al., 1978), but no comparison of these to an unstimulated baseline. A unique study (Yaremko, Fisher, & Price, 1973), demonstrated that obese subjects showed increased GSR responses when compared to normal weight subjects during both simple, tone presentations, and Pavlovian conditioning. However, one could not tell if the arousal persisted nor about possible differential latency until first response. Also, it was not known if other stimuli would engender equivalent physiological results.
Age at onset and restraint. Investigation of how age at onset of obesity interacted with restrained and unrestrained eating styles would have represented a natural extension of the way the restraint dimension has followed general externality theory into additional areas of obesity research. Restraint and age at onset could have related, with one dimension overriding the other. For example, juvenile-onset obese could have had a more difficult time losing weight than adult-onset obese, regardless of their restraint status. Alternately, the two dimensions could have interacted. Perhaps restrained juvenile-onset obese reacted more to emotional and less to general environmental stimuli, while unrestrained adult-onset obese reversed that pattern. Few implications of crossing the age at onset with the restraint dimension have been explored. It appeared reasonable to search for domination by one dimension, or for interaction between one dimension and the other. The current study was structured to allow exploration of interplay between juvenile-onset and adult-onset obesity with restraint, although it was impossible to assure that sufficient subjects for statistical tests of these relationships could be recruited.

Physiological parameters. The current study examined the responses of female subjects to tones and to verbally presented, imaginal scenes. Simultaneously, as dependent measures, each subject's heart rate, skin resistance
response, and frontalis electromyographic activity was acquired. These three physiological responses are frequently taken as indicators of emotional arousal (e.g., Carroll, 1971; Geer & Klein, 1969; Giesen & McGlynn, 1977; Goldstein, Pink & Mattee, 1972; Lacy, 1956; Shagass & Malmo, 1954). Parameters investigated were (a) latency; (b) magnitude of response; (c) duration of response; and (d) stimuli engendering a response. Any combination of these parameters could have contributed to previously reported differences between obese and nonobese, or between the restrained and unrestrained.

The most critical parameter for general Schachterian theory was magnitude of response; the obese/restrained having been reported as giving more extreme responses than the nonobese/unrestrained. A second important parameter for externality theory was response latency during the cognitively neutral, tone stimuli. Psychosomatic and psychoanalytic theory reacted more to findings from the duration of response and differential response to affective stimuli dimensions.

Structure and linkage. The experimental structure included segregating the subjects into restrained and unrestrained eaters; further separations split the restraint classes into subjects of normal weight, those who had become obese as children, and those who had become obese as adults. This structure allowed preliminary tests for
arousal of sufficient duration so that eating would have had an arousal state to diminish. Furthermore, examination of the amount of time that it took the obese versus the nonobese to visualize a negative scene allowed the process of repression to be tested as it related to the generation and maintenance of the obese state.

There was special reason to examine closely the relationship between weight status and restraint status. Whenever early Schachterian literature showed that the obese differed from the nonobese, restrained eaters have been shown to differ from the unrestrained eaters. In one study (Hibscher & Herman, 1977), restraint status has also been shown to better account for the observed variance than does weight status; the authors demonstrating a superior relationship between restraint, and both blood levels of free fatty acids and amount of ice cream eaten during a "taste test," than these two variables showed with weight status. Thus examining the possibility that emotionality as assessed by Pliner et al. (1974), with the obese, might also be better accounted for by restraint status was deemed reasonable. While Polivy et al. (1978) demonstrated a relationship between restraint and emotionality, the possibility of separate contributions by obesity and restraint had not been assessed.

Summary. Several theories of obesity, as well as many experimental strategems for studying mechanisms by which obesity might originate or be maintained have been reviewed.
Additionally, various subcategories of obesity (e.g. adult-onset, juvenile-onset) or general categorizations of behavior with regard to dieting (e.g. restrained-unrestrained eating) have been invoked to deal with data from the many areas of obesity research. The current study considered a strategy by which to evaluate (a) a psychophysiological approach to studying the responses of obese and normal weight subjects; and (b) hypotheses generated from several theoretical perspectives.

**Hypotheses**

Restrained eaters are seen as being more easily aroused, and as showing more extreme behavior than unrestrained eaters. Therefore, it is hypothesized that compared to the unrestrained:

1. Restrained eaters will respond to the tone stimuli by showing shorter latencies from tone onset until initial skin conductance response.

2. Restrained eaters will show a larger magnitude of response to tone stimuli on skin conductance, heart rate, and frontalis electromyograph.

3. Restrained eaters will show a larger magnitude of response to all imaginal scene stimuli during their presentation. These results are expected for skin conductance, heart rate, and frontalis electromyograph.

4. The restrained eaters will give more extreme ratings to the scene stimuli on their rating scale responses.
Drawing on both the psychosomatic and psychoanalytic literatures, it is hypothesized that, compared to the never obese,

5. The obese will show a larger magnitude of response to emotional scene than neutral scene stimuli. This finding is expected for the time period from the end of scene presentation until the time the subjects signal that they have generated a clear mental image. The finding is expected to obtain for skin conductance, heart rate and frontalis electromyograph.

6. The obese will show less recovery per unit time from the emotional scenes than from the neutral scenes on the skin conductance measure.

7. The obese will take longer to signal that they have generated a clear image for the negative scene than for the neutral scenes.

Based on the psychoanalytic notion of extensiveness of personality involvement, and upon the consistent findings of differences between an adult-onset and juvenile-onset obese, it is hypothesized that

8. Juvenile-onset obese will show a larger summed-emotional-arousal score than the adult-onset obese.

9. On the positive and negative scenes, correlations of the scene rating scales of juvenile-onset obese with the concurrent physiological measures will be less congruent than those of the adult-onset obese.
10. The difference between the amount of time needed to clearly visualize the negative scene as compared to the neutral scenes will be greater for the juvenile-onset obese than for the adult-onset obese.

Method

Subjects

Female volunteers were drawn from among a university medical center's staff, students, and employees; women from the center's metropolitan area were also solicited. Volunteers were recruited via advertisements, posters, announcements, direct solicitation of local groups, and requests to medical and psychological practitioners. The notices stated that an investigation was being conducted into the effects of diets, sleep, and body weight on women's responses to tone and imaginal scene stimuli, and that volunteers would be paid $3 to compensate them for their time, travel expenses, etc. The total time commitment was estimated at 75 to 90 minutes.

At first contact, candidates were asked to fill out and mail in questionnaires to determine their suitability for inclusion in the study. A total of 127 applied. Their age range was from 18 to 51 years.

Subjects were placed into groups according to pre-determined criteria. Obesity was defined as being 15% or more above the average standard for sex, height, and age. The cutoff was based on the Fogarty International Center
Conference on Obesity (1975) table of recommended weights in relation to heights (see Appendix A, Table 1). The never obese group was formed from volunteers who had never been overweight, and who at the weigh-in ranged from -7.5% to +10% of tabled ideal weight values. The lower limit excluded clearly underweight women from the subject groups. Additionally, women 10.01% to 14.99% above chart weights were considered to be in between average weight and overweight; eliminating them as subjects increased the opportunity for differences between the experimental groups to be found.

Cutoff values for restrained eaters and unrestrained eaters were determined by using the Herman et al. (1978) Eating Habits Questionnaire (see Appendix B). Women who scored 18 and below were assigned to the unrestrained group; those scoring 19 and above were assigned to the restrained group. This procedure established a-priori categories commensurate with cutoffs already used by others reporting in the literature (after Polivy et al., 1978).

Age at onset of obesity was determined from answers on the Background and Behaviors Questionnaire (see Appendix C). Volunteers who reported their overweight as having begun after age 18 were considered adult-onset obese; those reporting onset prior to age 13 were designated juvenile-onset obese (adapted from Grinker, Hirsch & Levin, 1973). An insufficient number of juvenile-onset obese who were also restrained eaters was obtained. This precluded several planned statistical analyses.
A series of exclusion criteria was adopted to reduce variability. Women below age 21 or above age 50, or women who acknowledged taking stimulants, sedatives, tranquilizing, or anorexic medications were excluded from the study. A further exclusion was made for any woman who acknowledged active participation in contact or strength sports; such participation could have increased the lean body mass, and thus invalidated the height-to-weight tables (Behnke, Osserman, & Welham, 1953). Only Caucasian women were admitted to the study.

On the basis of inclusion and exclusion criteria, 72 of the 127 volunteers were invited to participate in the study. Inaccuracy of self-report for height or weight eliminated five of the invited volunteers; inappropriate age at onset of obesity caused three more to be dropped; restraint classification changes from the pre- to post-measurement removed seven volunteers from consideration. Subjects thus consisted of 57 women distributed as follows: nonobese and unrestrained, N = 14; nonobese and restrained, N = 10; obese and unrestrained, N = 10; and obese and restrained, N = 23. These four divisions formed the experimental groups for the majority of the analyses performed. Additionally, the obese were distributed with 18 subjects in the juvenile-onset group and 15 in the adult onset group. This second division formed the experimental framework for analyses of age at onset.
The subjects ranged in age from 21 to 50 years. They weighed from -7.2% to +145% of tabled norms. Additional descriptive information appears in Appendix D, Table 2 and Appendix E, Table 3.

**Apparatus and Materials**

Sound equipment. Tones were generated by a Coulbourn Instruments precision signal generator (S81-06) and presented over Beltone audiometric headphones. Tone intensity calibration was accomplished with a Brueel and Kjoer sound level meter (type 2203), octave filter set (#1613), and artificial ear (type 4152). Imaginal scenes were played on a tape recorder (Sony TC-45) in a separate room, and presented over the same headphones as the auditory stimuli.

Polygraph. Physiological recordings were made with a Grass Instrument Company polygraph (Model 7B). The polygraph was equipped with a Grass 7P1B preamplifier for skin resistance measurement, Grass 7P4D preamplifier and tachograph for heart rate acquisition, Grass 7P3 preamplifier and integrator for electromyographic recording, and six Grass 7DAE output driver amplifiers for driving the data-recording pens. A motor drive advanced the chart paper at 100 mm per minute.

Written materials. A Consent Form (see Appendix F) was designed to obtain informed agreement for participation in the study. It gave pertinent information on the procedures that subjects would experience, and apprised them of risks, discomforts and benefits.
The Background and Behaviors Questionnaire was a multi-purpose instrument devised for this study. It requested a wide variety of demographic data (e.g. age, weight, height, race, marital status, education) and a complete weight history. The weight history section elicited information on thinness, obesity, age at onset if obese, and how other people might know that one was thin or obese if the subject did not tell them. Information about past and present medical problems, medication usage, sleep patterns, and exercise habits was also requested. Embedded in the Background and Behaviors Questionnaire were three rating scales designed to examine general emotional states.

The Same Day Behavior Questionnaire (see Appendix G) was devised to assess a volunteer's conformity to requested behaviors on the day of her participation in the study (e.g. no caffeine within two hours of arrival). It also contained the general rating scales for emotional states.

The Eating Habits Questionnaire (Herman et al., 1978; Polivy et al., 1978) was used to estimate dietary restraint. The scale contained questions on weight fluctuations, food-related behaviors, and food-related feelings. It was designed to distinguish between those whose history was that of a nondieter, and those who appeared as chronic dieters.

The Post-Scene Questionnaire (see Appendix H) contained another set of the general emotional states rating scales.

The Rating Scale Series (see Appendix I) was a series of 7
rating scales repeated for each experimental scene. It obtained a subject's standardized verbal report of her responses to visualizing an experimental scene.

**Stimuli.** Stimuli consisted of both auditory tones and verbally presented, imaginal scenes. There were 3, 40 dB, 1000-Hz tones and 1. 80-dB, 1000-Hz tone, in that order. All tones were of 5 seconds duration. Intervals between tones were 50, 30 and 70 seconds.

The imaginal stimuli (see Appendix J) consisted of two practice scenes, two neutral scenes and two emotive scenes, one positive and one negative. Scenes had been taped recorded by a female voice, for standard presentation. Two practice scenes were always presented first. These were followed by the four experimental scenes. The two neutral scenes always occupied the first and third positions, but the positive and negative scenes alternated between the second and fourth positions. Each order was presented to half of the subjects.

**Procedure**

All potential subjects were given or mailed the informed Consent Form, the Eating Habits Questionnaire, and the Background and Behaviors Questionnaire. Volunteers found suitable were phoned and given appointments. They were reminded not to take any coffee, tea, caffeine pills or colas within two hours, or to smoke within 30 minutes of their appointment times. Volunteers were also reminded not
to take stimulants, diet pills, alcohol, tranquilizers, or sedatives on the day of their session.

Upon arrival, each volunteer was administered the Same Day Behaviors Questionnaire. Volunteers who disregarded telephone instructions were either dismissed or asked to wait until sufficient time had passed for them to meet the standard conditions.

The examiner invited each woman to the physiological recording laboratory and seated her in a comfortable, reclining chair. Watches, rings, and other jewelry were removed, and the experimenter prepared the electrode placement sites by cleaning them with alcohol. Each woman was reminded that she would not be shocked, and that the equipment would not harm her.

**Electrode placements.** Skin resistance was recorded via Beckman silver-silver chloride electrodes (9 mm diameter) affixed to the whorl of the thumb and index fingers on the non-dominant hand. Beckman Electrode Electrolyte was used as the contact medium, and Beckman Adhesive Collars were placed around each electrode to insure proper electrical isolation.

Heart rate signals were acquired via three Beckman silver plate electrocardiograph electrodes (3.75 by 4.75 cm) affixed, one each, to the inside of the left wrist (active), the inside of the left leg above the ankle (ground), and the inside of the right leg above the ankle (active).
Electromyographic recordings from the frontalis muscle were made using three Beckman silver-silver chloride electrodes (9 mm diameter). The electrodes had been affixed with an electrically isolating plaster to a plastic headband. This allowed all three electrodes to be mounted simultaneously. The first active electrode was approximately 2.54 cm above the center of the left eye, the second above the center of the right eye, and the reference electrode in between the two active electrodes, and above the top of the nose (Lippold, 1967). Beckman Electrode Electrolyte was the contact medium.

Physiological inputs, outputs and transformations. The Grass 7P1B preamplifier was set to PGR and acquired skin resistance levels and skin resistance responses directly, using the constant-current method (Venables & Martin, 1967). Output was in ohms of resistance. However, approximate sweat gland activity (Darrow, 1934, 1964a) more accurately reflected physiological events (Lykken & Venables, 1971) when the resistance values were transformed into conductance values, called mhos. The exact conversion (Darrow, 1964a) was: $\text{Conductance} = (1 / \text{resistance}) \times 10^6$. This transformation yielded conductance in micromhos.

Heart beats were recorded with the Grass 7P4D preamplifier set to lead three configuration. Heart rate was then determined by counting the beats in any interval of interest, measuring the interval on the polygraph recording,
and calculating the average beats per minute for the period of time under study. Since some subjects respond to arousal with cardiac deceleration and others with acceleration (Goldstein, Fink, & Mettee, 1972; Hare, 1972), heart rate was recorded both in relative and absolute value of rate change.

Electrical currents from the frontalis muscle were preamplified (50 microvolts per cm) and integrated electronically to yield a smoothed moving average of activity. The time constant of integration was .5 seconds. Integrator sensitivity was calibrated to two or four microvolts per millimeter, as determined by a subject's responsiveness. The conditioned signal was recorded on a polygraph record.

A variety of derived and transformed scores were generated for the final data analyses. For more extensive discussion the reader is directed to Appendix K.

Experimental session. When instrumentation was completed, the experimenter read the general instructions (see Appendix L) to the subject. He then placed an audio-headset on the subject and left the room.

Following the equipment operations checks and calibration, which required about 10 minutes, the subject spent another 5 minutes in complete silence. Recordings from the last 30 seconds of this period became each subject's initial baseline values. Tone presentation was then initiated. After all tones had been presented, the scene instructions (see Appendix M) were played to the subject and scene
presentation was initiated. Each scene was between 25 and 30 seconds long. The experimenter then waited for the subject to signal by pressing a button with her dominant hand that she had formed a clear, vivid image. Depressing the push-button made a mark on the polygraph recording. Two minutes after she pressed the button the subject was asked to "Relax and forget the scene; just let it fade away." Between 2 and 4 minutes were then allowed for return towards baseline. The sequence was repeated until all practice and experimental scenes had been presented.

After the last rest period, the experimenter announced:

The tones and scenes are all done. Please rest quietly for several more minutes while I shut down the equipment. I will be in soon to remove the wires from you.

Data collection actually continued for two additional minutes. The last 30 seconds constituted the postexperimental data period.

Upon completion of the measurements, the experimenter asked each woman to complete the Post-Scene Questionnaire, the Rating Scale Series, and a second Eating Habits Questionnaire. Then all electrodes were removed from the woman. Her actual height to the nearest .25 inch (.635 cm), and her weight to the nearest .25 pound (.1136 kg) were measured on a Healthometer balance beam scale (Continental Scale Corporation). Finally, she was debriefed, given the
$3 as promised, and asked not to discuss the scenes, tones or other details of the study for at least 2 months.

**Results**

Prestimulation Baseline

A between groups comparison was made on each of the baseline values for the three physiological measures. The Statistical Analysis System (1979) was used for these and all subsequent analyses. Group means are displayed in Table 4. None of the baseline measurements differentiated between subject groups, i.e., weight class, restraint status or weight class with restraint status interactions (all $p > .05$). On the basis of these findings, the groups were considered physiologically equivalent prior to the introduction of the experimental stimuli. However, the difference in heart rate between weight classes approached significance, $F(1, 53) = 3.68$, $p = .0606$, as did the interaction pattern between weight and restraint on the skin conductance measure, $F(1, 53) = 5.56$, $p = .1155$.

**Age, Weight and Restraint Correlations**

Two spaced samples of the Eating Habits Questionnaire were obtained from 84 volunteers; correlation between administrations was $r = .957$, $p = .0001$. When calculations were restricted to the 57 subjects of this study, the correlation rose marginally to $r = .963$, $p = .0001$. The scale exhibited good test-retest reliability.
Table 4

Physiological Response Levels During the Prestimulation Baseline

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Skin conductance</th>
<th>Frontalis activity</th>
<th>Heart rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonobese</td>
<td>24</td>
<td>10.32</td>
<td>12.40</td>
<td>72.97</td>
</tr>
<tr>
<td>Obese</td>
<td>33</td>
<td>9.79</td>
<td>13.15</td>
<td>78.66</td>
</tr>
<tr>
<td>Restraint status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unrestrained</td>
<td>24</td>
<td>9.73</td>
<td>12.08</td>
<td>76.22</td>
</tr>
<tr>
<td>Restrained</td>
<td>33</td>
<td>10.22</td>
<td>13.38</td>
<td>76.30</td>
</tr>
<tr>
<td>Weight and restraint combinations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unrestrained</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonobese</td>
<td>14</td>
<td>11.32</td>
<td>11.34</td>
<td>75.13</td>
</tr>
<tr>
<td>Obese</td>
<td>10</td>
<td>8.93</td>
<td>13.13</td>
<td>77.74</td>
</tr>
<tr>
<td>Restrained</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonobese</td>
<td>10</td>
<td>7.50</td>
<td>13.89</td>
<td>69.94</td>
</tr>
<tr>
<td>Obese</td>
<td>23</td>
<td>10.78</td>
<td>13.15</td>
<td>79.06</td>
</tr>
</tbody>
</table>

Note. Skin conductance in micromhos, frontalis activity in microvolts, and heart rate in beats per minute.

The relationship between subjects' weight and restraint as measured in the post experimental period was $r = .63$, 
n = 57, p = .0001. This indicated a 39.69% shared variance component between the two dimensions. The relationship between age and restraint score was close to chance, r = .092, n = 57, p = .4926. However, there was a significant relationship between age and percent overweight, r = .338, n = 57, p = .0028. In this population, restraint was independent of age, but body weight was not.

Preliminary Analyses of Scene Stimuli

Neutral scenes. The scene stimuli were constructed to induce positive, negative, or neutral affect. Statistical analyses required that the responses to the two neutral stimuli be averaged. To justify this procedure, tests were performed on the Rating Scales Series. Of seven potential significant differences between the two scenes, only one emerged. The subjects rated the "beach" scene as more emotionally arousing than the "plant potting" scene (see Table 5). This finding was unusual, since the two scenes received equivalent ratings on clarity of visualization, degree of involvement, upset caused, anxiety aroused, happiness generated, and feelings of safety engendered (see Table 5). Additionally, the emotional arousal ratings on both the positive and negative scenes were clearly different from either neutral scene, by Duncan Multiple Range Test, p < .01. As the neutral scenes were clearly more alike than different, they were averaged for all additional analyses.
Table 5
Comparison of the Ratings for the Two Neutral Scenes

<table>
<thead>
<tr>
<th>Scale</th>
<th>Scenes (as means)</th>
<th>ANOVA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plant</td>
<td>Beach</td>
<td>F</td>
</tr>
<tr>
<td>Clarity</td>
<td>8.82</td>
<td>8.37</td>
<td>2.10</td>
</tr>
<tr>
<td>Upset</td>
<td>.40</td>
<td>.35</td>
<td>.16</td>
</tr>
<tr>
<td>Anxiety</td>
<td>1.26</td>
<td>1.35</td>
<td>.08</td>
</tr>
<tr>
<td>Happiness</td>
<td>6.61</td>
<td>7.12</td>
<td>1.77</td>
</tr>
<tr>
<td>Emotion</td>
<td>3.47</td>
<td>4.95</td>
<td>10.83</td>
</tr>
<tr>
<td>Safety</td>
<td>7.37</td>
<td>6.95</td>
<td>1.75</td>
</tr>
<tr>
<td>Involvement</td>
<td>6.82</td>
<td>7.2</td>
<td>1.10</td>
</tr>
</tbody>
</table>

Note. Degrees of freedom for all analyses are 1 and 56.

Clarity. To aid in understanding the experimental results, the clarity of visualization ratings for the three scene types was compared. The analysis of variance (ANOVA) utilizing weight, restraint, and scene type found no difference in visualization clarity for the scenes, $F(2, 106) = .47, p = .6238$. Thus, differences that emerged in later statistical analyses were not due to scene differences in visualization clarity.

Equality and Symmetry Assumptions

The dominant analytic frame for this study was the multidimensional repeated measures ANOVA. This technique
forced explicit assumptions concerning the equivalence and shape of the variance-covariance matrices. All two- and three-way repeated measures ANOVAs were tested for equality and symmetry of the matrices (Appendix N, Table 6; Appendix O, Table 7; Appendix P, Table 8; Appendix Q, Table 9; and Appendix R, Table 10). Where equality violations occurred, dimensions were systematically dropped from the design until equality was established. At that point symmetry or lack of symmetry was tested, and the Epsilon coefficient calculated. Using Epsilon, the degrees of freedom for the F tests were retained or reduced as warranted by the symmetry test.

The result of this process was that some hypotheses were tested by three-way, others by two-way, and still others by one-way repeated measures ANOVAs. The latter were coupled with two-way non-repeated measures ANOVAs which had no equality and symmetry restrictions. Thus, at times the analyses were reduced in complexity, in accord with the outcomes of the equality tests. This reduction was chosen as preferable to reporting findings which were likely to contain statistical distortions. In each such case, the most complex design which met the equality assumptions was utilized (see Appendix S, Table 11).

**Discriminability of Stimuli**

Six types of dependent measures were utilized in this study: (a) heart rate; (b) frontalis muscle activity
(c) skin conductance: (d) time to response (e) amount of maximum response sustained over time and (f) scene ratings. The first three measures form a group best labeled as direct physiological indices. The two time-related measures form another logical group; and the scene ratings stand by themselves as a clearly delineated unit.

**Physiology.** The heart rate measure never detected any differences between stimuli. This was true both for responses to the four tones (see Table 12) and for responses to the scenes (see Table 13). Since it was insensitive to the changes in stimuli, the heart rate measure was unlikely to detect differences between groups.

Skin conductance responses did discriminate between the individual tones (see Table 12). The 80-dB tone produced the largest response; it was followed in magnitude by the first 40-dB tone, with the second and third 40-dB tones forming a pair which were separable from the other two.

The experimental scenes were also differentiable with this measure (see Table 13). It was clear that for the subjects, taken as a whole, the most emotionally negative scene produced greater skin conductance responding than did the other scenes.

ANOVA's on frontalis muscle activity data yielded outcomes similar to those from the skin conductance measure. Electromyography was able to differentiate the 80 dB tones (see Table 12). It was also able to separate the negative
and neutral scenes from each other, and sometimes the negative from the positive scenes as well (see Table 13).

Table 12
Differentiation of the Tone Stimuli by Four Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>F</th>
<th>df</th>
<th>p</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart</td>
<td>.82</td>
<td>3</td>
<td>159</td>
<td>.4887</td>
<td>.218</td>
<td>.160</td>
<td>.188</td>
</tr>
<tr>
<td>Skin</td>
<td>59.44</td>
<td>3</td>
<td>165</td>
<td>.0001</td>
<td>.191</td>
<td>.086</td>
<td>.039</td>
</tr>
<tr>
<td>Muscle</td>
<td>7.54</td>
<td>3</td>
<td>168</td>
<td>.001</td>
<td>.170</td>
<td>.079</td>
<td>.043</td>
</tr>
<tr>
<td>Time</td>
<td>12.19</td>
<td>3</td>
<td>132</td>
<td>.0001</td>
<td>.158</td>
<td>.607</td>
<td>.692</td>
</tr>
</tbody>
</table>

Note. Means superscripted with different numbers differ from each other; Duncan Multiple Range test, p \( \leq .01 \).

\(^{a}\)Range corrected proportion from beats per minute.

\(^{b}\)Range corrected proportion from micromhos.

\(^{c}\)Range corrected proportion from microvolts.

\(^{d}\)As the log of seconds from the tone onset until skin conductance response.

Latency and magnitude-duration. The logarithm of seconds until skin conductance response also differentiated between stimuli. This was true for both tones (see Table 12) and the time taken to visualize scenes (see Table 14). The patterns of tone differentiation were similar to those found for the physiological measures of skin conductance and electromyography. The 80-dB tone engendered the most rapid
Table 13
Scene Differentiation by Physiological Measures

<table>
<thead>
<tr>
<th>ANOVA</th>
<th>Scenes (as mean range corrected proportions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Internal</td>
</tr>
<tr>
<td></td>
<td>F</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin conductance</td>
<td></td>
</tr>
<tr>
<td>Presenting b</td>
<td></td>
</tr>
<tr>
<td>11.73</td>
<td>2, 112</td>
</tr>
<tr>
<td>Imaging c</td>
<td></td>
</tr>
<tr>
<td>7.79</td>
<td>2, 110</td>
</tr>
<tr>
<td>Frontalis muscle activity</td>
<td></td>
</tr>
<tr>
<td>Presenting</td>
<td></td>
</tr>
<tr>
<td>8.16</td>
<td>2, 90</td>
</tr>
<tr>
<td>Imaging</td>
<td></td>
</tr>
<tr>
<td>5.47</td>
<td>2, 99</td>
</tr>
<tr>
<td>Heart rate</td>
<td></td>
</tr>
<tr>
<td>Presenting</td>
<td></td>
</tr>
<tr>
<td>.53</td>
<td>2, 106</td>
</tr>
<tr>
<td>Imaging</td>
<td></td>
</tr>
<tr>
<td>.44</td>
<td>2, 106</td>
</tr>
</tbody>
</table>

Note. Means superscripted with different numbers differ from each other, Duncan Multiple Range test, p ≤ .01.

^a Scene abbreviations: Neg = Negative, NN = averaged neutral, and Pos = positive.

^b Interval from scene onset to offset, for unrestrained eaters.

^c Interval from scene offset to scene visualization signaled, for the nonobese versus the obese.

response, followed in order of increasing latencies by 40-dB tones 1, 2, and 3. The third 40-dB tone took the longest of all to initiate a response.
Table 14

Scene Differentiation by Time
Dependent Measures

<table>
<thead>
<tr>
<th>Interval</th>
<th>ANOVA</th>
<th>Scenea (as means range corrected proportions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F  df p</td>
<td>Neg</td>
</tr>
<tr>
<td>Log latencyb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imagingc</td>
<td>4.87 2, 106</td>
<td>1.022</td>
</tr>
<tr>
<td>Imagingd</td>
<td>5.05 2, 62</td>
<td>1.002</td>
</tr>
<tr>
<td>Magnitude duratione</td>
<td></td>
<td>3.00 2, 106</td>
</tr>
</tbody>
</table>

Note. Means superscripted with different numbers differ from each other, Duncan Multiple Range test, p ≤ .05.

aScene abbreviations: Neg = negative, NN = averaged neutral, and Pos = positive.

bLogarithm of time in seconds from the completion of scene presentation until a clear image was signaled.

cObese versus nonobese.

dJuvenile-onset versus adult-onset versus never obese.

eProportion of a scene's maximum skin conductance response maintained during the minute after a clear image was signaled.

fObese versus nonobese.

Latency of response to the affective scenes followed the patterns found for the direct physiological measures (see Tables 13 and 14). The averaged neutral scenes
required more time to visualize clearly than did the positive or negative scenes. The positive and negative scenes were not differentiable from each other. "Unemotional" scenes were visualized more slowly than were "emotional" scenes.

The magnitude-duration measure, which represented the proportion of the maximum skin conductance response maintained 1 minute after clear scene visualization was signaled, was not successful at discriminating between scenes (see Table 14). However, at $p = .0542$, it came very close to conventionally accepted significance levels. The pattern of means was consistent with that of other measures; the negative scene provoked the most sustained responding, the positive scene was intermediate, while the averaged neutral scenes returned towards baseline most rapidly.

Scene ratings. With the exceptions of clarity of visualization and involvement, all ratings were analyzed in two-dimensional ANOVAs. To keep all scales directionally aligned for changes in arousal level, the safety and happiness ratings for the negative scene were each inverted. That is, the zero end of the scale became ten and the ten end of the scale became zero.

Except for visualization clarity, all individual scales, as well as their sum (happiness, safety, emotional arousal, upset and anxiety), demonstrated differences between scene ratings. This indicates that the scenes did possess positive, negative, or neutral emotional loadings. With
remarkable consistency, the negative scene produced ratings equivalent to or higher than those of the positive scene, while the positive scene produced ratings equivalent to or higher than those of the neutral scene. The $F$ tests and associated scale means appear in Table 15.

**Summary.** Heart rate and magnitude-duration were unable to reliably discriminate between any of the stimuli. Thus they were not likely to detect interactions between group membership and type of stimulus. Skin conductance, electromyography, latency and ratings were clearly able to separate most of the experimental stimuli from one another. Therefore they were capable of being tested for the hypothesized interrelationships between groups and stimuli.

**Examination of Hypothesized Differences**

A wide variety of differences was hypothesized between restrained and unrestrained eaters, between the obese and nonobese, and between ages of onset within the obese. These hypotheses will be reviewed within a framework composed of the experimental stimuli applied, the measurement systems employed, and the between subjects groupings. Heart rate and magnitude-duration failed to discriminate between either tones or scenes. They will be dropped from further discussion in this section.

**Physiology.** It had been hypothesized that the physiological measures would differentiate restrained from unrestrained eaters, by means of differential reactivity, on
Table 15
The Differentiation of Affective Scenes by Rating Scale Scores

<table>
<thead>
<tr>
<th>Scale b</th>
<th>ANOVA a</th>
<th></th>
<th>Scene (means)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>df</td>
<td></td>
<td>Negative</td>
</tr>
<tr>
<td>Clarity</td>
<td>.47</td>
<td>2, 106</td>
<td>.6278</td>
<td>8.72 (^1)</td>
</tr>
<tr>
<td>Involvement</td>
<td>6.95</td>
<td>2, 106</td>
<td>.0015</td>
<td>8.49 (^1)</td>
</tr>
<tr>
<td>Emotion</td>
<td>40.57</td>
<td>2, 110</td>
<td>.0001</td>
<td>8.07 (^1)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>128.14</td>
<td>2, 85</td>
<td>.0001</td>
<td>8.04 (^1)</td>
</tr>
<tr>
<td>Upset</td>
<td>356.76</td>
<td>2, 87</td>
<td>.0001</td>
<td>8.54 (^1)</td>
</tr>
<tr>
<td>Safety</td>
<td>10.85</td>
<td>2, 88</td>
<td>.001</td>
<td>8.93 (^1)</td>
</tr>
<tr>
<td>Happiness</td>
<td>34.13</td>
<td>2, 103</td>
<td>.0001</td>
<td>9.70 (^1)</td>
</tr>
<tr>
<td>Sum e</td>
<td>107.52</td>
<td>2, 91</td>
<td>.0001</td>
<td>43.28 (^1)</td>
</tr>
</tbody>
</table>

aClarity and involvement are three dimensional, happiness is a two dimensional weight x scene and the other ANOVAs are restraint x scene.

bScale direction was inverted for negative scene happiness and safety.

cProbability is equal to or less than tabled value.

dProbability levels are for the Duncan Multiple Range test. Superscripted raw means with differing numbers differ at this probability level.

eSum equals the sum of emotion, anxiety, upset, safety, and happiness.
both scene and tone stimuli. Specifically, the restrained were expected to be more reactive than the unrestrained.

There was no difference in the skin conductance responses to tones which could be attributed to restraint, $F(1, 55) = 2.75, p = .1027$, although the trend was appropriate. The planned repeated measures ANOVA for differences between the restrained and unrestrained when visualizing the scenes was found to be invalid. Multiple non-repeated measures ANOVAs at each level of scene indicated no significant difference between groups (see Table 16).

Table 16

Tests on the Skin Conductance Responses to the Scenes for Unrestrained and Restrained Eaters

<table>
<thead>
<tr>
<th>Scene</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>.85</td>
<td>.3598</td>
</tr>
<tr>
<td>Neutral</td>
<td>.71</td>
<td>.4030</td>
</tr>
<tr>
<td>Positive</td>
<td>.58</td>
<td>.4502</td>
</tr>
</tbody>
</table>

Note. All tests were conducted on range corrected proportions; each had 1 and 56 degrees of freedom.

These findings suggest that there was no strong effect for restraint status on skin conductance reactivity, regardless of the level of complexity of the statistical test or the type of stimuli employed.
Equality violations also restricted the scope of the statistical tests for frontalis activity to the stimuli. No differences between restraint classifications were detected in the less complex analyses that resulted (see Table 17).

Table 17
Tests on Frontalis Responses for the Tones

<table>
<thead>
<tr>
<th>Tone</th>
<th>Restraint</th>
<th>Weight</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>P</td>
<td>F</td>
</tr>
<tr>
<td>One</td>
<td>1.59</td>
<td>.2133</td>
<td>.08</td>
</tr>
<tr>
<td>Two</td>
<td>.29</td>
<td>.5933</td>
<td>3.25</td>
</tr>
<tr>
<td>Three</td>
<td>1.74</td>
<td>.1929</td>
<td>.10</td>
</tr>
<tr>
<td>Four</td>
<td>.24</td>
<td>.6276</td>
<td>.37</td>
</tr>
</tbody>
</table>

Note. Each analysis had 1, 53 degrees of freedom.

There is no clear pattern of results, but a simple relationship between the unrestrained and restrained eaters appears absent. Table 17 suggests that had it been legitimate, a more complex ANOVA might have discovered a complicated interaction effect between weight, restraint, and tones.

The electromyographic data did show a clear interaction effect where a main effect had been expected for hypothesis three. Instead of restrained eaters' showing greater responsivity to all scene stimuli than unrestrained eaters, there was an interaction between scene valence and restraint status, F (2, 90) = 4.33, p ≤ .025 (see Figure 1). A
Figure 1. Frontalis responses to affective scenes by restrained and unrestrained subjects.
Duncan Multiple Range test, $p \leq .05$, indicated that unrestrained eaters reacted more strongly to the negative scene than to the neutral or positive scenes, while the restrained eaters did not show a differential reaction to the three scene types.

Hypothesis five predicted that emotional scenes would induce greater responding among the obese than would neutral scenes. A smaller or non-existent differential was expected for the nonobese. The interval tested was that between scene presentation and the subject's signaling a clear visualization. The ANOVA for skin conductance did not yield the expected interaction, $F(2, 101) = .09, p = .9169$. The analysis of the electromyographic measure also produced negative results, $F(2, 99) = 1.08, p = .3426$.

Latency. Hypothesis one, which predicted that restrained eaters would show shorter latencies from tone onset until initial skin conductance response was not supported, $F(1, 53) = .87, p = .354$. Hypothesis six predicted that obese subjects would take more time than nonobese subjects to signal that they had generated a clear image for the negative as compared to the neutral scene. This interaction hypothesis was not supported, $F(2, 106) = .51, p = .5998$.

Hypothesis ten examined the assumption that the juvenile-onset obese would have a longer latency of visualization than the adult-onset obese, when the two were
compared on the negative scene. This difference was not predicted for the neutral scene. An ANOVA comparing onset with scene type was utilized for the statistical test. The expected interaction was nonsignificant, $F(2, 62) = 1.25, p = .2949$.

**Scene ratings.** Hypothesis four predicted that the restrained would be more reactive than the unrestrained. Thus, their rating scale scores should have indicated more arousal than those of the unrestrained. However, neither the individual rating scales nor the summed-ratings scores were able to differentiate between unrestrained or restrained groups (all $p > .05$). Additionally, there were no significant interactions (all $p > .05$).

**Age at onset and arousal.** The subjects were divided into three groups based on the rankings of their summed emotional arousal scores (high, medium, and low). A three-by-three Chi Square with never-obese, juvenile-onset, and adult-onset as the second dimension was then performed. Neither the Chi Square with scores constituted using raw heart rate difference data, $\chi^2(4) = 5.932, p = .2042$, nor the one constituted using absolute values of heart rate change, $\chi^2(4) = 3.625, p = .4592$ was significant. Extent of overall physiological arousal to the scenes was not related to age at onset of obesity.

It was hypothesized that the correlation between ratings of physiological arousal during emotional scenes
would be stronger for adult-onset obese. Correlations were performed for each type of physiological response, yielding a series of correlation matrices for each age-at-onset group. The sets were then compared.

Out of 168 opportunities for agreement, none of the Spearman correlations were significant in both obese groups. The distribution of those correlations was examined. The nonobese group's correlations were added for comparison (see Table 18).

Table 18
Distribution of Significant Correlations Between Scene Ratings and Physiological Measures in the Age at Onset Groups

<table>
<thead>
<tr>
<th>Measure</th>
<th>Nonobese</th>
<th>Juvenile</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Skin conductance</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Electromyography</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

The 13 specific correlations did not form a comprehensive picture. However, one rating scale, clarity of visualization, accounted for 38% of the correlations and was of interest (see Table 19). Where correlations occurred, the juvenile-onset obese reported seeing the scenes less clearly, the more they had responded on the physiological measure. The nonobese reported clearer visualization when their responses had been more intense.
Table 19
Relationship of Physiological Responses to Clarity of Visualization

<table>
<thead>
<tr>
<th>Physiology</th>
<th>Age at Onset</th>
<th>Scene</th>
<th>( \rho )</th>
<th>( p )</th>
<th>( n )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle(^a)</td>
<td>Nonobese</td>
<td>+</td>
<td>0.4150</td>
<td>0.0437</td>
<td>24</td>
</tr>
<tr>
<td>Muscle(^b)</td>
<td>Juvenile</td>
<td>-</td>
<td>-0.6412</td>
<td>0.0041</td>
<td>18</td>
</tr>
<tr>
<td>Muscle(^b)</td>
<td>Juvenile</td>
<td>+</td>
<td>-0.5838</td>
<td>0.0110</td>
<td>18</td>
</tr>
<tr>
<td>Skin(^a)</td>
<td>Nonobese</td>
<td>-</td>
<td>0.4212</td>
<td>0.0404</td>
<td>24</td>
</tr>
<tr>
<td>Skin(^b)</td>
<td>Nonobese</td>
<td>-</td>
<td>0.4777</td>
<td>0.0182</td>
<td>24</td>
</tr>
</tbody>
</table>

Note. Physiological measures, as range corrected proportions, were converted to ranks prior to correlation.

\(^a\)During scene presentation.
\(^b\)During scene visualization.

Postexperimental Physiology
Examination of the postexperimental physiological recordings yielded only one significant effect; an interaction occurred between weight class and restraint status on the skin conductance measure, \( F(1, 53) = 4.63, p = 0.0361 \). A Duncan Multiple Range test did not indicate any differences between the means, \( p > 0.05 \). This suggests that the variances were too large for the source of the interaction effect to be differentiated with confidence. Group means for the three measures which were examined appear in Table 20.
Table 20

Postexperimental Values from the Physiological Measures

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Skin conductance</th>
<th>Frontalis activity</th>
<th>Heart rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrestrained</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonobese</td>
<td>14</td>
<td>14.05</td>
<td>10.74</td>
<td>73.43</td>
</tr>
<tr>
<td>Obese</td>
<td>10</td>
<td>7.34</td>
<td>10.16a</td>
<td>77.26</td>
</tr>
<tr>
<td>Restrained</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonobese</td>
<td>10</td>
<td>9.32</td>
<td>13.59</td>
<td>71.09</td>
</tr>
<tr>
<td>Obese</td>
<td>23</td>
<td>12.33</td>
<td>14.82</td>
<td>78.06</td>
</tr>
</tbody>
</table>

Note. Skin conductance in micromhos, frontalis activity in microvolts, and heart rate in beats per minute.

a n = 9 in this cell.

The large but nonsignificant heart rate difference between weight classes, which first appeared during the prestimulation baseline, was still present, \( F(1, 53) = 3.48, p = .0676 \). A sizable, but again nonsignificant difference had developed between the unrestrained and restrained eaters in frontalis activity by the postexperimental period, \( F(1, 53) = 3.30, p = .0750 \).

General Emotional States

Three general emotional state questions were repeated, measuring the states in anticipation of, just before, and after participation in the physiological session.
ANOVA analyses which showed significant differences between administrations are displayed in Table 21. In general, the subjects' emotional states were elevated when filling out the Background and Behaviors Questionnaire, and in the case of "worry" prior to the physiological recording session. However, the elevations are always mild (eg. "just a little tense"), apparently came in response to the questionnaires or the experimental setting, and quickly faded away when the study concluded.

Table 21

Ratings of General Emotional States at Different Times in the Study

<table>
<thead>
<tr>
<th>Question</th>
<th>ANOVA</th>
<th>Emotional State Scores(^a) (as means)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>df</td>
</tr>
<tr>
<td>Upset</td>
<td>5.66</td>
<td>2, 100</td>
</tr>
<tr>
<td>Tense</td>
<td>10.31</td>
<td>2, 102</td>
</tr>
<tr>
<td>Worried</td>
<td>6.41</td>
<td>2, 89</td>
</tr>
</tbody>
</table>

Note. All asterisked (*) means differ from others in their row, Duncan Multiple Range Test, \( p \leq .01 \).

\(^a\)Column order represents administration order over time.

Of the three times that weight class and restraint status could affect each other on the general emotional state ratings, only one interaction occurred, \( F (1, 53) = 4.02, p = .05 \). This outcome is displayed in Figure 2.
Figure 2. Relationship between weight and restraint as depicted by self-report of tension.
Supplemental Physiological Analyses

When the data did not conform to a view of the field, shaped by the previous literatures, the decision was made to let the understanding of this area be directed by the force of the findings. Differential responding, both by group membership and by stimulus type, had been predicted. However, the expected differences did not appear. Supplemental analyses were done to confirm the observation of other apparent patterns. These supplemental analyses extended the study to include changes in each physiological system over time, and comparisons of multiple physiological systems at a single point in time. Examination of response patterns accented the similarities and differences between all physiological systems. Heart rate again became a viable measure, since changes in heart rate could discriminate between measurements at different points in time.

An example, in graphic form, of a pattern which led to additional analysis can be seen in Figure 3. Note that despite a jumble of rankings prior to stimulation, and similar confusion at the postpractice point (see Appendix T, Figure 4 for a clarification of the temporal order of stimuli and measurements for this and all other sequences of data collected), there is a clear difference between restrained and unrestrained eaters during the postexperimental period. This difference holds for all three physiological systems. In each case the restrained subjects maintain higher levels
Figure 3. Tonic levels of the physiological measures at three points in time: prior to the first tone (PT); after the practice scenes (PP); and during the postexperimental recovery period (RP).
of arousal during the final unstimulated interval than do the unrestrained. Statistical tests on the postexperimental data points, across measures, established only a trend towards significance, $F(1, 53) = 3.32, p = .0739$. However, the consistency of all three physiological indices during the postexperimental period indicated that the restrained-unrestrained distinction warranted further scrutiny.

Additional differences between the restrained and unrestrained groups emerged from analyses within the imaginal scenes. During the interval after a clear image had been signaled, the restrained groups gave a larger average response, across physiological systems, than the unrestrained on the neutral scenes, $F(1, 53) = 12.94, p = .0007$. This effect was not seen for the positive or negative scenes.

Examining the same measures at three points in time during scene stimulation (presentation, visualization, and continued visualization) also indicated significant patterns. For the negative scene there was a relationship between magnitude of frontalis muscle response and time, $F(2, 83) = 4.01, p < .025$. A Duncan Multiple Range test indicated that the initial frontalis muscle response was smaller for the restrained as compared to the unrestrained group, $p < .05$. A further relationship involving weight, restraint status, and time was also found, $F(2, 106) = 3.59, p = .0310$. The nonobese-unrestrained showed an earlier peak in amount of heart rate change than did the other groups, Duncan
Multiple Range test, $p \leq .05$. Examination of the neutral scene showed only one clear difference between the restrained and unrestrained groups. The restrained group gave a larger skin conductance response during all three measurement periods, $F(1, 36) = 10.08$, $p \leq .005$. The difference was not separable by the Duncan Multiple Range test ($p > .05$).

Examination of the responses to the first soft tone and the loud startling tone yielded additional findings. The skin conductance response clearly differentiated the two tones from each other $F(1, 53) = 43.85$, $p = .0001$. The obese group consistently gave a larger response than did the nonobese group, $F(1, 53) = 5.93$, $p = .0182$, while the unrestrained group of subjects gave a larger response than did the restrained, $F(1, 53) = 7.15$, $p = .01$. Neither the obese-nonobese difference, nor the restrained-unrestrained difference was separable by Duncan Multiple Range test, $p > .05$.

The strong startling tone caused differential reactivity among the physiological systems, $F(2, 106) = 15.28$, $p = .0001$. Skin conductance response was larger than heart rate or frontalis responses, Duncan Multiple Range test, $p \leq .01$. The unrestrained group responded more strongly to the startle tone than did the restrained, $F(1, 53) = 4.69$, $p = .0349$. Again, the Duncan Multiple Range test, $p > .05$, was not able to support the initial $F$ test. This suggested that many of the effects were small and the variability moderate to large.
Discussion

The present study examines the physiological responses of obese and nonobese dieters and nondieters to both purely sensory stimuli and stimuli designed to engender a variety of affect-laden visualizations. The intent is to address several prominent lines of theory about obesity, integrating where and when possible. Four questions are at the forefront of this discussion: (a) Are there any underlying physiological response dimensions, such as response magnitude, response latency or response duration, on which the obese and/or restrained eaters respond differently than the nonobese and/or nondieters? (b) Are there physiological indices which are adequate to the task of studying these potential underlying response dimensions? (c) Can the differences between groups explain weight gains despite the attendant social and physical discomforts (Bruch, 1975; Mayer, 1968) often associated with obesity? And (d) Are any theories, either singly or together, capable of explaining the findings; that is, are any theories congruent with the observations?

Review of Initial Findings

There is a positive correlation between percent overweight and a self-report of restrained eating behavior. The moderate magnitude of this correlation indicates that overweight and extent of restraint are somewhat dependent on one another, or that both relate to a third variable. It
appears that the dependence is strongest in the upper weight ranges. That is, the heavier the woman, the more she reports a restrained life style with regard to weight and diet.

When the affectively negative imaginal stimulus is presented, the unrestrained group gives a larger frontalis muscle response than the restrained. This is contrary to the initial hypothesis of this study. The restrained and unrestrained subjects are not different in their responses to stimuli meant to generate positive and neutral affects.

Finding no relationship to self-report of reactivity between either the positive or negative scene and restraint status is clearly counter to recent reports by others (e.g. Polivy et al., 1978). The results are also counter to this study's hypotheses.

The direction of the correlations between electromyographic responses and self-report of clarity of covert visualization differs for juvenile-onset obese and nonobese women. Juvenile-onset obese report less clarity of visualization the more strongly they exhibit frontalis activity. Nonobese women report clearer visualizations as frontalis responding increases. This suggests that in everyday situations, those people who are obese since childhood may be less conscious of physiological arousal, or less likely to label the course which generates their arousal, or both. This is not true for those whose obesity began in later years.
There is an interactive relationship between dietary restraint and weight as these two variables affect a subjective rating of tension. Regardless of the time when tension ratings are made, the unrestrained-nonobese group reports less tension than do the other three groups (unrestrained-obese, restrained-nonobese, and restrained-obese). At apparent odds with this finding, raw (not corrected for range) recovery period skin conductance level relates in an inverse manner to both weight and restraint. The unrestrained-nonobese, who report less subjective tension, and the restrained-obese both show elevated levels. The restrained-nonobese resemble the unrestrained-obese in demonstrating lower skin conductance levels than the first two groups. While statistical analysis is not able to separate the groups on skin conductance, the data form a definite pattern (see Table 20).

**Initial Findings and the Hypotheses**

**Restraint.** Four hypotheses describe differential expectations for restrained and unrestrained eaters. The restrained should show shorter response latencies to the sensory stimuli, larger physiological responses to both sensory and imaginal stimuli during presentation, and more extreme ratings of their covert responsivity as an indication of arousal. None of these experimental hypotheses are supported. Restrained eaters do not show a simple, across-the-board increase in either speed or initial magnitude of
response. Neither do they evidence a strong or consistent tendency to give more extreme ratings to their experiences. These negative findings imply that the restraint dimension taps something more complex than consistently extreme responsivity.

**Obesity.** Experimental predictions state that the obese are more sensitive to and aroused by emotional stimuli than neutral stimuli. The specific hypotheses for the obese are that they demonstrate (a) higher and (b) more sustained physiological arousal during the covert visualization of emotional versus neutral stimuli and (c) slower visualization of the negative stimuli than the positive or neutral stimuli. In short, the obese are hypothesized as less able to engage in negative ideation, and as more physiologically aroused by either positive or negative emotional ideation than by neutral ideation, once they begin to respond.

All three obesity hypotheses fail to find support from the physiological measurements in this study. The obese are found to be neither psychologically more disturbed by negative imagery than are the nonobese, nor physiologically more aroused by emotional imagery.

**Age at onset.** Juvenile-onset as compared to adult-onset obese women are hypothesized to show more overall arousal, as well as to show poorer congruence between their ratings of arousal to the emotional stimuli and their indices of physiological arousal. An additional hypothesis is that the
juvenile-onset obese need longer times to visualize the negative versus the neutral scenes. Again, none of these hypotheses receive experimental confirmation.

**Physiological Measurements Validity**

When all experimental hypotheses fail to find confirmation, it is both reasonable and proper to question the validity of the measurement methods. This issue is examined now.

That physiological indices can be used to assess arousal, anxiety, relaxation or fear has become the bedrock of the large and growing field of psychophysiology. Darrow (1964b) defined psychophysiology as "the science which concerns those physiological activities which underlie or relate to psychic functions" (p. 4). One need not be overly mentalistic to understand Darrow's meaning. As Ax (1964) has indicated, psychophysiology examines the "code" or relationship between what the psychologist has studied, and biological processes that the physiologist has discovered.

Many authors have found psychophysiological relations. For example, Carroll (1971) demonstrated that dominant flexor muscle activity was observed with unpleasant visual stimuli. Others have made similar discoveries with skin conductance or heart rate (e.g., Geer & Klein, 1969; Hare & Blevings, 1975; Lacey, 1956; Shagass & Malmo, 1954). The general finding has been that the physiological measures can detect changes in affect/arousal. Historically, validity for
the psychophysiological measurement approach has been established.

The present study supports earlier findings; the measures employed do separate one type or intensity of stimulation from another, even though hypothesized group differences are lacking. Additionally, other, not originally hypothesized differences appear between groups. The presence of these differences leads us to reexamine not measurement, but theory, or theory as it interfaces with measurement. It does not lead us to place the entire burden of negative results on measurement validity.

**Supplemental Findings**

The supplemental analyses located distinct, if often small, differences between the experimental groups. Discovering these differences requires comparing responses to the same stimulus over time and across type of measure, instead of limiting the examination to responses to different stimuli at the same relative point in time.

A general pattern does emerge. In that pattern, the restrained-unrestrained distinction accounts for more of the physiological response differences than does the obese-nonobese distinction. However, the two dimensions are not completely independent in their effects, and both distinctions might have utility in explaining behavior.

Differences in response style to potential affective stimuli differentiate the restrained from unrestrained
subjects in the following ways. In comparison to the unrestrained group, the restrained subjects: (a) activate more strongly, regardless of physiological system, to neutral stimuli after a successful covert visualization signal is given; (b) show larger skin conductance responses during the entirety of the neutral imaging experience; and (c) during negative imaginal stimulation, give less of an initial frontalis response. Additionally, during negative scene stimulation, the unrestrained-nonobese group shows an earlier peak in heart rate change than do the other groups. In sum, unrestrained women respond more rapidly to intense stimulation than do the restrained, while restrained women show a larger magnitude of responding during less intense stimulation than do the unrestrained.

In response to purely sensory stimulation, the obese tend to react with greater magnitude than the non-obese; unrestrained subjects give marginally larger responses than the restrained. When the three physiological systems are compared it becomes apparent: (a) that the skin conductance measure registers stronger responses than the heart rate or frontalis muscle measures to a loud noise and (b) that the unrestrained generally give larger skin conductance responses than the restrained when so stimulated. In common with the responses to the strongly affective material, a loud startling sensory stimulus evokes more initial response magnitude from the unrestrained.
Examination of the final recovery interval also indicates marginal, but consistent differences between the restrained and the unrestrained groups. Regardless of which physiological system is examined, the members of the restrained group show more sustained levels of responding; that is, they return to baseline levels less rapidly than do the unrestrained subjects.

**Physiological Patterning**

Two distinct physiological response patterns emerge from this study. The patterns correspond, one each, with the two groups which are labeled restrained and unrestrained eaters. The patterns are composed of the following components:

(a) the group labeled as restrained reacts more slowly than does the unrestrained group, both to the strong sensory and the strong affective stimulation; (b) the magnitude of the response across time to the negative affective stimulation is at least as large if not larger for the restrained as for the unrestrained; (c) the restrained subjects return towards baseline levels of arousal more slowly than do the unrestrained; and (d) the restrained show more skin conductance responding during the neutral scene visualization condition than do the unrestrained. Another basic finding is that the unrestrained-nonobese show the highest uncorrected skin conductance level during both the prestimulation and recovery measurement periods; this is clearly not the case when the range-corrected data are examined.
The general patterns can be simplified even further. The restrained tend to respond more slowly than the unrestrained to severe stimulation, but eventually reach equally intense response levels which they maintain for a longer time. The unrestrained tend to respond rapidly and intensely, if they respond at all, but they also recover equilibrium more rapidly. Additionally, the restrained show heightened arousability to "neutral" types of stimulation. The interactions between initial physiological levels, rate of and relative amount of change in response to varying stimulation, and the absolute and relative returns towards baseline values during the recovery period are pivotal in clarifying the findings from this study.

When obesity and restraint do exhibit interactive effects, the occurrence of obesity in some way moderates the expression of the restrained-unrestrained patterns. At these times the unrestrained become more like the restrained in their self-reports as well as their physiological responses.

The current findings are not unequivocal, and their interpretation requires the acceptance of a combination of clearly significant results and strong trends; however, it is the overall pattern of the results, and their consistency that I will emphasize. The proposed interpretation of the pattern found here explains a number of hitherto anomalous and otherwise confusing reports in the obesity/restraint literature. From this point on, and for the sake of
simplified discussion, I will accept the suggested patterns as a matter of fact. That is, the restraint dimension is assumed to represent differences in patterns of physiological arousal and recovery.

Integration of Externality and Restraint

Historical integration. Between the mid-1960's and 1970's it had been well established that when only the obese-nonobese distinction was examined, obese individuals were more externally oriented than were the nonobese (e.g. Grigs & Stunkard, 1964; Johnson, 1974; Schachter & Friedman, 1974; Stunkard & Koch, 1964). However, concurrent work (e.g. Decke, cited in Rodin, 1976; Nisbett, 1968b; Rodin & Slochower, 1976) was simultaneously demonstrating that externally oriented behavior patterns were not exclusive to obese individuals. This was made especially clear by Rodin and Slochower (1976). They demonstrated that degree of externality among normal weight children would predict absolute weight change in a summer camp situation. Externality preceded obesity for at least some individuals; but not every external individual became obese. Another concept became necessary to explain why some external individuals were not and did not become obese.

This additional concept was provided by Herman & Mack (1975). They shifted the focus from a topography to a behavior; that is, from the state of obesity to the act or life style of dieting. They and other subsequent researchers (e.g. Hibscher & Herman, 1977; Polivy, 1976) replicated and
extended early discoveries of externality among the obese to normal weight dieters and nondieters. The earlier findings were often better accounted for by dieting-nondieting status, now usually referred to by the terms restrained and unrestrained than by the state of obesity. Subject behaviors became more and more important.

**Externality-restraint and current findings.** Results from the current study extend the logical research sequence on heightened external sensitivity among the obese, among some nonobese, and among the restrained. It is now clear that many previous findings on externality describe behaviors which may have common underlying psychophysiological response patterns. Such patterns may be dictated by different combinations of (a) **initial** physiological levels, (b) stimulus intensity **threshold** necessary for responding to begin, (c) category of **stimuli** which engender responses, (d) **speed** of physiological arousal, (e) **magnitude** of physiological responses, (f) **speed** of recovery from stimulation, and (g) specific physiological **system(s)** undergoing arousal. The paucity of physiological findings which can be attributed to weight alone, compared with the number related to restraint, or weight and restraint taken together, in this study, supports the idea that restraint does define a dimension of physiological responsivity. The current study begins the explication of restraint as a physiological or psychophysiological phenomenon.
This study's synthesis, that arousal patterns are responsible for the presence or absence of highly external behavior, puts into clearer perspective the results of several studies which hitherto had invoked arousal based theories, but which did not present supporting physiological data (e.g. Herman et al., 1978; Polivy et al., 1978). In Herman et al., the presentation of a distractor to calm, restrained subjects led to a decrement in their accuracy on a proofreading task. Calm, unrestrained subjects were, in contrast, minimally effected. These reports parallel present findings of limited physiological arousal to neutral stimuli by the unrestrained, but significant arousal by the restrained. A lower threshold for physiological responding to a wide range of environmental stimuli, among the restrained, seems implicated.

Another point of support for Herman et al. (1978) is the rapid physiological response by unrestrained subjects to strong affective stimulation. This pattern of responding to strong affective stimulation parallels their finding of improvement by unrestrained subjects in proofreading under "high anxiety" conditions. Current findings of increased visualization clarity with increased frontalis activation, among the nonobese, also seems to relate to this pattern. These paired findings are clearly congruent with the idea that arousal brings the unrestrained more "on task."
The dramatic increase in error rates among the restrained subjects, under the Herman et al. high anxiety condition, is not so easily explained by the physiological outcomes. The physiological data show that both restrained and unrestrained subjects begin at approximately equivalent arousal levels, and eventually reach approximately equivalent maximum arousal. Response patterns for the two groups differ primarily in the rapidity with which they respond to strong stimulation, and in the length of time they remain aroused. In each instance, the restrained take more time than do the unrestrained. It is conceivable that the additional parameters of arousal speed and recovery speed are responsible for the Herman et al., high anxiety condition performance differences, between the restrained and unrestrained. However, why differences in speed of arousal and recovery would cause the two groups to diverge so completely in their proofreading error rates is still unclear.

Similarly, the results of Polivy et al. (1978) are partially clarified when viewed with the aid of the current formulation. In their study, subjects rated slides after consuming caffeine or a placebo. The stimulant affected the restrained and unrestrained differentially. Restrained subjects gave less extreme responses after consuming caffeine; the unrestrained gave more extreme responses. Polivy et al. speculated about the possibility of different
optimal levels of arousal, suggesting that the restrained/obese have higher internal levels of arousal than do the unrestrained/nonobese.

This study's physiological data do not support that contention. Instead, the data suggest that when restrained subjects, such as those in the Polivy et al. study, consume caffeine, their general arousal level increases, and they respond less strongly to nonaversive, nonintrusive stimuli. They are physiologically changed from restrained to unrestrained in terms of external sensitivity. This is conceptually similar to adjusting the circuits in a radio receiver so that the weak signals are suppressed, and only the signals from strong, clear sources are passed along for amplification. Why the unrestrained subjects also reverse their normal response patterns under the influence of caffeine is not explained by the current physiological findings. The monitoring of drugged and undrugged arousal levels, as well as drugged and undrugged physiological response patterns to neutral and affective stimuli, may yield the results necessary for further clarification.

Counterregulation. A currently unexplained finding in the externality/restraint literature is the "cognitive components" or "counterregulatory" effect. For example, results from Polivy (1976) demonstrate that nonobese, restrained eaters consume more during a taste test if they believe that they have eaten a high calorie preload,
regardless of its actual caloric value. Similar effects are reported by Nisbett and Storms (1974) and Wooley (1972) with obese subjects. One candidate for a "cognitive control" mechanism is language, and Skinner (1957) has proposed that language does allow the establishment of "rule governed behaviors" in humans. If the restrained eater does have rules which help govern weight maintenance, then consuming the high-calorie preloads might be perceived as behaving in violation of those rules. Such a violation might serve as a sufficient arouser to disrupt future, short-term rule governed eating behavior by the restrained subjects. This conception is grounded in the observed increase in physiological arousal of the restrained to neutral scenes, as well as their more prolonged arousal after stimulation is removed. Loss of control is analogous to and parallels the reduction of proofreading accuracy by the distracted, restrained subjects or the anxious, restrained subjects in Herman et al. (1978).

Impairing the subjects' ability to respond to their own rules may leave them under the more immediate control of the pervasive food cues in a taste test situation. The subjects most likely affected, according to the theory advanced here, by immediate but mild stimuli in such a setting are the restrained. They will eat, while the stimulation is still too weak to have an effect on the unrestrained. Within this formulation, the counterregulation effect is no longer mysterious; instead it becomes another instance of the
differential effects that the two basic arousal-recovery patterns might govern.

Additional Theoretical Integration

Psychoanalysis. The broad band of psychoanalytic theory has consistently made three points with regard to obesity. The first is that the obese are neurotic—dependent, demanding, passive-aggressive, compulsive, restricted, upsettable, etc. Point two is that there are at least two subtypes of obesity. Bruch (1957) refers to these as developmental and reactive obesity. The third point is that the obese are clearly different from "normals" in the constitution of their psychic economy. They do not experience the world as others experience it, and they use food as a palliative for their more frequently hurt feelings, or to reduce their contacts with threatening situations (e.g. sex).

Such speculations are difficult to test, since they refer to poorly defined, often hidden mental states. However, some psychoanalytic speculations are quite compatible with, and enormously simplified within the findings of the present study. Differential arousability, and hence differences in external responsiveness, could cause (a) at least two distinct patterns of behavior, (b) differences in probability of upset from engaging in daily activities, and (c) differences in rate of recovery from activation. Such differences might bring about life styles which would reduce perceived arousal to tolerable levels. Accepting these
three premises, one can integrate much of psychoanalytic observation, if not psychoanalytic explanation into the current physiological findings. Findings that show the restrained to be generally more arousable than the unrestrained, not the obese as generally more arousable than the nonobese. Further, the restrained eater displays many of the behaviors that psychoanalysts attribute to the obese.

It becomes more difficult to integrate the psychoanalytic contention that strong emotions are the basis of excessive eating behavior (e.g. Brosin, 1953; Bruch, 1958; Hecht, 1955; Simon, 1968). The current study demonstrates that it is on neutral scene materials that the restrained show consistently stronger physiological responses. When strongly emotive or startling stimuli appear, it is the unrestrained whose physiology actually responds more rapidly, although not more strongly. Obesity per se does not seem to be the controlling factor.

Psychosomatic theory. Psychosomatic theory leads directly to the expectation of altered arousal states or patterns, but with the exception of Slochower (1976), little validation of anxiety reduction via food consumption is found. The researchers may have been looking with inappropriate assessment methods. The majority of such studies are conducted with verbal reports as the assessment instruments, and verbal reports need not be isomorphic with
physiological functioning. The lone study using behavioral indices of recovery from arousal, Pliner et al. (1974), finds that obese children recover faster from the short term upset caused by insertion of a hypodermic needle, if cuddled, than do children of average weight. The obese seem to be responding to the immediacy of the new stimulation.

The current study provides physiological support for the psychosomatic position on prolonged arousal states in the absence of further intervention after initial stimulation. It suggests that a search be made for other stimuli (e.g. food) that reduce arousal levels, or blunt arousal responses. I suggest that future searches be made among the restrained, and with highly responsive measurement techniques, such as physiological monitoring.

The present study is also able to account for a finding that the psychosomatic literature often considers more of a methodological problem than an actual datum. Abramson and Wunderlich (1972), Herman and Polivy (1975) and Slochower (1976) all report that the nonobese/unrestrained show limited arousal in response to anxiety-producing manipulations. The obese/restrained respond as expected. The current findings of minimal physiological arousal among the unrestrained, to any but intense stimulation, clearly demonstrate that the limited response to anxiety manipulations is not a methodological problem. Instead it should be viewed as an identifying characteristic of the unrestrained.
Age at onset. Of the five lines of theory and research presented, the least light is shed upon the age-at-onset distinction. Too few unrestrained juvenile-onset obese women were obtained to include restraint as a factor in the age-at-onset analyses. However, here too, the current findings offer some insight. The low frequency of unrestrained juvenile-onset subjects shows that some selective factor is at work. That factor might be the physiological response patterns which differentiate the restrained and unrestrained. Perhaps only the very arousable become obese when young. Some who are less extreme on the arousal/externality continuum may become obese only if specific factors impact their lives over time. Perhaps for others, a simple decrease in activity as they age may account for weight gains. This would imply a group for whom arousal is not relevant to their obesity. Thus, the very restrained would be the most likely to become obese early in life, due to an intensified sensitivity to general environmental stimuli and prolonged arousal levels. Others may or may not become obese due to their physiological arousal patterns, and the exact pattern of controlling variables remains to be discovered.

Nature or Nurture

The discovery of distinct patterns of physiological arousal-recovery suggests that the question of nature or nurture as prime mover be addressed. This study is not organized
to answer that question and the following comments should be taken as speculative.

It appears that the simplest explanation for the current findings is that people are born that way. That is to say, it seems unreasonable to assume that we learn all our response/arousal patterns on the basis of experience. However, it is most likely that neither nature or nurture alone is primarily responsible for adult patterns of responding. It is probable that we are born with certain tendencies to respond physiologically, and that these are then shaped by the environment; such a process would augment or reduce the magnitude of the responses, as well as allow the learning of differential responding to various stimuli. This position does little violence to any of the theories reviewed for this study, and emphasizes a significant need for future research.

Some support for this position can be gathered from a study by Charney, Goodman, McBride, Lyon, Pratt, Breese, Disney, and Marx (1976). These authors examined the relationship between infant weight and adult weight. They found that there was a strong positive correlation between the two. However, not all obese children became obese adults, nor did all thin infants become thin adults. There was opportunity for change regardless of starting weight. Perhaps there is also some room for change regardless of starting arousal pattern. Also, the extent to which rule
governed behavior might obviate or augment basic physiological patterns, or itself be affected by basic physiological patterns is unknown. This area remains uncharted.

Summary and Recommendations

Two basic patterns of physiological arousal and recovery emerge among the restrained/obese and the unrestrained/nonobese. These patterns account for many of the anomalous findings within the restraint, externality, and psychosomatic literatures. Additionally, in light of the current findings, disparate segments of the obesity literature begin to undergo a pleasant unification. This includes the early Schachterian work on obese externality, its descendant studies on nonobese externality, the restrained-unrestrained distinction, psychoanalytic and psychosomatic theory, and in part the age-at-onset findings. Whether or not the current physiological distinction will withstand the test of time, or give way to even more precise distinctions, will depend upon the course of future research.

Upon review of the historical development of theory and research on obesity, it becomes clear that the part-whole logical fallacy pervades speculation in this area. Each researcher examines a small, specialized piece of the puzzle, then generalizes from that part in an attempt to entirely explain the phenomena from his viewpoint. Without strong commitment to any position, and by working across many theories, this study avoids the part-whole fallacy. It makes available
a brief glimpse of physiological phenomena which may simplify, unify and clarify much of the previous weight regulation literature.

For the future, several lines of study suggest themselves. First, it is important to determine whether or not the physiological patterns found in adults also appear in infants or children. This would add a developmental perspective to current findings. Secondly, genetic studies on parents and children would be helpful. By this I do not mean chromosome analyses, but rather concordance studies of physiological arousal-recovery patterns. To the extent that parent and child are isomorphic, or that their patterns follow known genetic distributions of traits, the nature or nurture component of arousability might be given greater weight. Third, the stability of both restraint and the physiological arousal-recovery dimension believed to underlie it must be determined. Finally, experimental verification of obesity onset, and its relationship to the physiological arousal-recovery patterns need investigation. While the current findings are exciting and suggestive, they are post-hoc in their formulation. Predictive confirmation from long term studies would be welcome.
# APPENDIX A

## Table 1

Womens' Height in Relation to Weight

<table>
<thead>
<tr>
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<th>Metric Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Meters</td>
</tr>
<tr>
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<td>Pounds</td>
</tr>
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<tr>
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<td>Metric Units</td>
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<td>150.0</td>
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<td>152.0</td>
</tr>
<tr>
<td>72.0</td>
<td>154.0</td>
</tr>
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</table>

Note: Height without shoes. Weight in summer clothes (2 lbs., 9 kg). Adapted from the Fogarty International Center Conference on Obesity 1975 table of recommended weight in relation to height.
APPENDIX B

Eating Habits Questionnaire

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Sex</th>
<th>Date</th>
</tr>
</thead>
</table>

1. How often are you dieting? (Circle one)
   - Never
   - Rarely
   - Sometimes
   - Usually
   - Always

2. What is the maximum amount of weight (in pounds) you have ever lost within one month? (Circle one)
   - 0 - 4
   - 5 - 9
   - 10 - 14
   - 14 - 19
   - 20+

3. What is your maximum gain within a week? (Circle one)
   - 0 - 1
   - 1.1 - 2
   - 2.1 - 3
   - 3.1 - 5
   - 5.1+

5. Would a weight fluctuation of 5 lbs. affect the way you live your life? (Circle one)
   - Not at all
   - Slightly
   - Moderately
   - Very much

6. Do you eat sensibly in front of others and splurge alone? (Circle one)
   - Never
   - Rarely
   - Often
   - Always

7. Do you give too much time and thought to food? (Circle one)
   - Never
   - Rarely
   - Often
   - Always

8. Do you have feelings of guilt after overeating? (Circle one)
   - Never
   - Rarely
   - Often
   - Always

9. How conscious are you of what you're eating? (Circle one)
   - Not at all
   - Slightly
   - Moderately
   - Extremely
Appendix B--Continued

10. How many pounds over your desired weight were you at your maximum weight? (Circle one)

   0 1 - 5  6 - 10  11 - 20  21+
APPENDIX C

Background and Behaviors Questionnaire

Date
Name: ___________________________ Home phone: ______________
       Bsn. phone: __________________
Mailing Address: ___________________________ __________________________
       Number & Street  City  State  Zip Code
Age (at last birthday): _____ Height: _____ Weight: _____
Education (Please circle last year completed):
   1  2  3  4  5  6  7  8  9  10  11  12
       College: Freshman  Sophomore  Junior  Senior
       Graduate: Masters  Ph.D., M.D., L.L.D., Ed.D., etc.
Race (Please circle one): Black  White  Oriental
       Other (specify) __________________
What job do you hold, or what profession are you in?
       __________________________
Are you right or left handed? __________________________
Marital Status (Please circle one): Single  Married  Divorced
       Widowed  Common Law  Other (specify) ______
At this moment, how emotionally upset do you feel?
(Please circle one)
       very upset  pretty well  somewhat upset  just a little calm
       very upset  upset  upset  very calm
       calm
Appendix C--Continued

At this moment, how tight or tense are you? (Please circle one)

very tense  pretty tense  somewhat tense  just a little tense  relaxed
very tense  tense  tense  tense  relaxed

At this moment, how worried are you? (Please circle one)

terrribly worried  very worried  pretty worried  somewhat worried  just a little not worried
worried worried worried worried worried at all worried

Sleep

1. Your usual number of hours of sleep per night during the last month: ___ hours & ___ minutes

2. How quickly do you fall asleep once you are ready for bed?

Please circle one: Very quickly  Fast enough to suit me
Very slowly  Slowly

3. On most nights, about how many times do you wake during the night's sleep? _______

Body Weight and Food Preferences

1. Do you find that you have a hard time keeping your weight as low as you would like it? (Please circle one)

No, not much less  less than  about more  much more  very
at all  than many  many  as  than more  very
people  people  much  many  than  hard
as  people  many  time

2. Has there very been a time in your life when other people told you that you were fat? (Please circle one) YES  NO

Has there ever been a time in your life when "you knew" that you were fat? (Please circle one)

YES  NO
Appendix C—Continued

If NO to both questions, skip to question 3.

a. If yes, when and how did you and/or other first notice that you were fat? (Giving details such as age, grade in school, job you held at the time, who told you, etc. can help in defining when this happened.)

b. How fat were you at your fattest? Describe yourself at your fattest by giving information such as dress size, height and weight at the time, problems that your weight caused you, etc. (How did you know that you were fat? What specific facts can you remember which would help someone who had not seen you at your fattest know that you were fat instead of just feeling fat? Additional space is provided on the next page for you to answer in.)

c. Circle the phrase which best describes how fat you believe that you were at your fattest.

a little  more than a  very  extremely
  fat  little fat  fat

d. How long did this period of being noticeably fat last? (Or if you still describe yourself as fat, how long have you maintained your fatness?)

________________________ (in months and/or years)

3. Do you find that you have a hard time keeping your weight as high as you would like it? (Please circle one)

not, not  much less  less than about  more
at all  than many  many  as much than
  people  people  as most many
  people

  much  very
  more  very
  than  hard
  many  time
  people
Appendix C—Continued

4. Has there ever been a time in your life when "you knew" you were skinny? (Please circle one)

YES   NO

Has there ever been a time in your life when other people told you that you were skinny? (Please circle one) YES   NO

If NO to both questions, skip to Exercise Section.

a. If yes, when and how did you and/or others first notice that you were skinny? (Giving details such as age, grade in school, job you held at the time, who told you, etc. can help in defining when this happened.)

b. How skinny were you at your skinniest? Describe yourself at your skinniest by giving information such as dress size, height, and weight at the time, problems that your lack of weight caused you, etc. (How did you know that you were skinny? What specific facts can you remember which would help someone who had not seen you at your skinniest know that you were skinny instead of just feeling skinny? Additional space is provided on the next page for you to answer in.)

c. Circle the phrase which best describes how skinny you believe that you were at your skinniest.

- a little under
- more than a
- very
- extremely
- average
- little under
- underweight
- underweight
- average
- weight

```
weight
```

d. How long did this period of being noticeably skinny last? (Or if you still describe yourself as skinny, how long have you maintained your skinniness?)

__________________________
(in months and/or years)
Appendix C—Continued

Exercise

1. How many times per week do you exercise (not counting work)

   If answer to #1 is zero, then skip #2 and #3 in this section.

2. About how much time do you spend exercising each time you do exercise? ___ hours and ___ minutes

3. What type of exercise do you usually do? (e.g. golf, jogging, exercises, bowling, walking, ballet, swimming, belly dancing, etc.)

Medications, Alcohol, Tobacco and Stimulants

1. Has your doctor ever given you pills to help you sleep? YES NO

   (Do not count those given for 1 - 3 days after surgery)

2. Are you taking sleeping pills at this time? YES NO

3. In the past, have you ever taken "nerve pills" or other medicine to help you stay calm? YES NO

4. Are you now taking "nerve pills" or other medicine to help you stay calm? YES NO

5. Have you ever taken pills to give you energy (other than caffeine tablets; for example Dexedrine)? YES NO

6. Are you currently taking pills to give you energy? YES NO

7. Have you ever taken diet pills? YES NO

8. Are you currently taking diet pills? YES NO
Appendix C—Continued

9. How often will you usually take an alcohol containing drink, (e.g. beer, wine, mixed drink)? Please circle your choice below.

   Never Occasionally, 1 - 2 3 - 4 more than four drink at most 1 to days days days each week 2 times each each each month week week

10. Usual number of cups of coffee or tea that you drink, or the number of caffeine tablets that you take each day? (If you use more than one type then total them up for your answer. For example, 4 cups of coffee and 2 caffeine tablets equals a total of 6.) _______Total

11. If you were ever a smoker, how old were you when you started smoking? ___ years old (If never smokes, skip 11-14)

12. For how many years did you smoke, or if you still smoke for how many years have you been smoking? _______years

13. Do you smoke at this time? YES NO

14. If you smoke only a pipe or cigar please skip this question. How many cigarettes do you usually smoke each day? (Circle the answer that best describes your smoking habit.)

   Less ½ to 1 1 to 1½ 1½ to 2 2 to 2½ More than pack a packs a packs a packs a than 2½ ½ a day day day day day day pack pack pack pack

Physical Health

Please place a check by those problems you experience or body parts that you have problems with.

___ Heart (Please specify) ________________________________

___ Liver  ___ Kidneys  ___ Sinuses  ___ Lungs

___ Circulatory System (Veins)

___ Stomach or Intestines (Please specify) ____________
Appendix C--Continued

__Skin (Please specify)__

__Eyes__  __High blood pressure  __Diabetes__

__Muscles (Please specify)__

__Other (Please specify)__

If female, dates of last menstrual period?

Start:_________________________  Stop_________________________

Are you regular?  YES  NO
### APPENDIX D

**Table 2**

**Selected Subject Descriptors: Weight by Restraint Classifications**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Nonobese Unrestrained</th>
<th>Nonobese Restrained</th>
<th>Obese Unrestrained</th>
<th>Obese Restrained</th>
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</thead>
<tbody>
<tr>
<td>Age</td>
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<td>28.20</td>
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</tr>
<tr>
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<td>20.80</td>
<td>13.50</td>
<td>23.65</td>
</tr>
<tr>
<td>Post study percent overweight</td>
<td>-1.20</td>
<td>.60</td>
<td>40.56</td>
<td>77.41</td>
</tr>
<tr>
<td>Exercise frequency per week</td>
<td>1.21</td>
<td>3.20</td>
<td>1.80</td>
<td>1.87</td>
</tr>
<tr>
<td>Estimated sleep in minutes</td>
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<td>387.00</td>
<td>451.00</td>
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<tr>
<td>Estimated frequency of walking per night</td>
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<td>.90</td>
<td>1.20</td>
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<tr>
<td>Estimated cups of coffee per day</td>
<td>2.71</td>
<td>2.80</td>
<td>3.70</td>
<td>2.90</td>
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</table>

**Note:** Group ns in order are 14, 10, 10, and 23.

a Mean values
APPENDIX E

Table 3

Selected Subject Descriptors: Age at Onset of Obesity Classifications

<table>
<thead>
<tr>
<th>Variablea</th>
<th>Never Obese</th>
<th>Juvenile-Onset</th>
<th>Adult-Onset</th>
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<tbody>
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<td>Age</td>
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<td>2.00</td>
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<tr>
<td>Estimated sleep in minutes</td>
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<tr>
<td>Estimated frequency of waking per night</td>
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<tr>
<td>Estimated cups of coffee per day</td>
<td>2.75</td>
<td>2.72</td>
<td>3.67</td>
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</table>

Note: Group ns in order are 24, 18, and 15.

aMean values.
APPENDIX F

Consent Form

I voluntarily agree to participate in a research project to study my physiological responses. This project has two parts. I understand that during the first part of the project I will be asked to fill out a Background and Behavior Questionnaire. This questionnaire asks for information on my general background (age, education, etc.), sleep patterns, weight history, exercise habits, medication intake, medical history, etc. I understand that on the basis of my answers to the Background and Behavior Questionnaire I may be asked to participate in the second part of this study. I further understand that if I am not asked to continue my participation that this is no reflection on my worth as a person, only that I do not display certain characteristics that are necessary for participation in the second half.

If I am asked to participate in the second half of the study, I understand that I will be asked to do the following:

1. Complete another questionnaire (Same Day Behavior Questionnaire) which is designed to assess my behavior (sleep, medications, diet status, etc.) on the day of my participation in the second half of the study.
Appendix F—Continued

2. Have surface sensors attached to my hands, arms and ankles so that information can be gathered about my body functions (heart rate, muscle tension and skin resistance).

3. Listen to a series of tones.

4. Imagine participating in some situations (some pleasant, some unpleasant, some inbetween) that will be described to me.

5. Complete a Post Scene Evaluation Form, Scene Rating Scales and the Personal Reaction Form which are designed to assess my feelings about the scenes and about participating in the study.

6. Have my exact height and weight recorded.

I understand that at this time my participation in the study will be complete.

I understand that this project represents a basic research study, and that at no time do the investigators intend or imply that they are providing a treatment.

I understand that the data collected in this study may appear in published form, and that my identify will remain anonymous at all times.

I also understand that if I undertake and complete both parts of the study that I will receive $3.00 in appreciation for my time, efforts, parking costs, etc.

I understand that I am participating in this study and am offering information voluntarily. Furthermore, I can withdraw at any time and will not be subject to penalty or prejudice. I understand that upon the completion of my
participation, and upon my request, I may review any information gathered about me. At that time questions that I may have about the study will also be answered.

The university of Mississippi Medical Center has no mechanism to provide compensation for subjects who may incur injuries as a result of participating in biomedical and behavioral research. This means that while all investigators will do everything possible in providing careful medical care and safeguards in conducting this experiment, there is no way in which the institutions can pay for the unlikely occurrence of injury resulting solely from the experiment itself. We will, of course, provide our best medical treatment to which you are entitled for the illness, if any, for which you consulted us whether or not you participate in this study and whether or not you decide to withdraw from the study.

I have read, understand, agree to all statements and voluntarily sign this informed consent statement this ___ day of __________ , 19___ at Jackson, Mississippi.

__________________________  ______________________
Signature of Participant     Signature of Witness
Appendix F—Continued

Principal Investigator:

Edward Marc Framer, M.A.
Department of Psychiatry
and Human Behavior
University of Mississippi
Medical Center
2500 North State Street
Jackson, Mississippi 39216
601-968-6560

Institutional Review Board:

Chairman
Institutional Review Board
University of Mississippi
Medical Center
2500 North State Street
Jackson, Mississippi 39216
APPENDIX G

Same Day Behaviors Questionnaire

Name ___________________________ Date ___________________________

The purpose of this questionnaire is to discover what you are doing today that is the same or different from when you filled out the Background and Behaviors Questionnaire. It is important that we have this information because your body is sensitive to changes in diet, medications, sleep and the like, and our equipment will be measuring some of your body functions. Please help us by being as accurate as possible.

1. How much sleep did you get last night? ______ hours and ______ min.

2. Are you making any efforts at this time to watch what you eat so that you will gain weight, lose weight, or hold your weight where it is now? (Please circle one) YES NO

   If yes, why are you watching? Gain Lose Keep weight
   (Please circle one) Weight Weight the same

3. Have you taken any medications to help you stay calm or to help your nerves today? (Please circle one) YES NO

4. Have you had any medications to give you energy or a "pick-me-up" today? (Please circle one) YES NO

5. Have you had any diet pills today? (Please circle one) YES NO

6. Have you consumed any coffee, tea, cola drinks or caffeine tablets within the 2 hours before coming to participate in this study? (Please circle one) YES NO

7. Have you had any medications other than those asked about on this page within the last 2 hours? (e.g. allergy or sinus tablets, cough medicine, heart or high blood pressure pills, epilepsy medicine, pain or headache medicine) (Please circle one) YES NO

   If yes, what medications and when did you take them?
8. How many alcoholic drinks have you had today?
   _______drinks

9. If you smoke, about how long ago did you have your last cigarette? _____ hours and _____ minutes

10. How long since you last ate? _____ hours _____ minutes
    What foods did you eat?

11. At this moment, how tight or tense are you? (Please circle one)
    very tense  pretty tense  somewhat tense  just a little tense  relaxed  very relaxed

13. At this moment, how worried are you? (Please circle one)
    terribly worried  very worried  pretty worried  somewhat worried  just a little worried  not at all worried
APPENDIX H

Post Scene Questionnaire

1. At this moment, how emotionally upset do you feel? (Please circle one)
   very upset  pretty well  somewhat upset  just a calm  very calm

2. At this moment, how tight or tense are you? (Please circle one)
   very tense  pretty tense  somewhat tense  just a relaxed tense  very relaxed tense

3. At this moment, how worried are you? (Please circle one)
   terribly worried  very worried  pretty worried  somewhat worried  just a little not at all worried
APPENDIX I

Rating Scale Series

We are now asking you to read each of the last 4 scenes that we asked you to imagine a little while ago. After you read each scene, please recall your image of it for a few seconds and then rate it by what kind of effects you remember it as having had on you. The rating scales are lines which say "not at all" on one end and "extremely" at the other. The line also has numbers from 0 to 100 running along its length. Let us look at an example:

Example:

\[
\begin{array}{cccccccccccc}
  & 0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\text{not at all} & & & & & & & & & & & \\
\end{array}
\]

Please place a circle around the set of numbers that best tells how strong your feelings were for each question that is asked. Let us go to another example. If the question were "How sleepy did the scene make you?", and you felt extremely sleepy, then the rating scale would look like the one below and you would have circled the 100.

Example:

\[
\begin{array}{cccccccccccc}
  & 0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\text{not at all} & & & & & & & & & & & \\
\text{sleepy} & & & & & & & & & & & \\
\end{array}
\]

If the question had been "How thoughtful did the scene make you?", and you felt about equally thoughtful and not thoughtful, then the rating scale would look like the one below and you would have circle the 50.

Example:

\[
\begin{array}{cccccccccccc}
  & 0 & 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\text{not at all} & & & & & & & & & & & \\
\text{thoughtful} & & & & & & & & & & & \\
\end{array}
\]
Appendix I--Continued

As the scenes and their rating scales appear, one set per page, remember to try to keep your ratings separate. Just as you were asked to try not to allow one mental picture to interfere with another when the scenes were read to you, try now not to let one rating interfere with another. Also, remember that you can choose to circle any of the numbers on the rating scale line; you are not limited to the 100 and the 50 just because the examples used them.

Okay, turn the page and start rating the scenes on the scales provided. Make sure that you read each scene completely, and get your image of the scene back in your mind before making your ratings.

In this position, above the rating scales, each of the four experimental scenes was placed on a separate rating page.

1. How clearly were you able to picture this scene in your mind?

   not at 0 10 20 30 40 50 60 70 80 90 100 extremely all clearly

2. How much were you upset by this scene?

   not at 0 10 20 30 40 50 60 70 80 90 100 extremely all upset

3. How anxious did this scene make you feel?

   not at 0 10 20 30 40 50 60 70 80 90 100 extremely all anxious

4. How happy did this scene make you?

   not at 0 10 20 30 40 50 60 70 80 90 100 extremely all happy
Appendix I—Continued

5. How emotionally aroused did you become to this scene?

<table>
<thead>
<tr>
<th>not at 0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>all emotionally aroused</td>
<td>extremely emotionally aroused</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. How safe did this scene make you feel?

<table>
<thead>
<tr>
<th>not at 0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>all safe</td>
<td>extremely safe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. How involved did you become with this scene?

<table>
<thead>
<tr>
<th>not at 0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>all involved</td>
<td>extremely involved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX J

Scenes

**Practice**

**First.** Imagine a sunlit spring morning. You feel a soft cool breeze. The sounds and smells of spring surround you. Tiny yellow-green buds are beginning to appear on the tips of branches. You hear birds in the distance. It feels good to be alive. Let yourself experience the scene completely. Remember to press the button when you have a clear, vivid picture in your imagination. (30 seconds)

**Second.** Imagine yourself talking with a close girlfriend whom you have not seen for some time. How does your friend look? Can you see yourself? What are you saying to each other? Get a clear picture of the conversation and your feelings. You have a talking photograph in your mind's eye; you and your friend are in that photograph. Remember to press the button when you have a clear, vivid picture in your imagination. (30 seconds)

**Experimental**

**Neutral.** Imagine yourself putting a new plant into a clay pot. The pebbles you place in the bottom are hard, smoothly round and cool. The soil is dry, loose and warm. You ease the plant down onto scattered, warm soil. Then you place extra soil around the roots. Next, you water the plant, then stand back to look at it. (25 seconds)
Appendix J--Continued

**Positive.** Imagine that it is your birthday. You are out for an intimate dinner with a person who means a great deal to you. The restaurant at which you are dining is charming. There are flowers and candle tapers on each table. You look and feel wonderful—smiling, witty, full of energy. Your friend clearly enjoys being with you, and tells you. This is a perfect evening. (26 seconds)

**Neutral.** Imagine yourself walking along the beach looking for seashells. You can hear waves wooshing onto the shore. The sand feels damp and warm beneath your bare feet. The breeze from the sea is brisk and tastes of salt. You feel the warm sun on your shoulders. The day takes on a dream like quality as you walk along, stopping now and then to gather another shell. (26 seconds)

**Negative.** Try to imagine your thoughts and feelings if the person upon whom you most depend for love and support, died suddenly. You are at the final, graveside service. The sky is overcast. The air feels slightly damp. All the speeches have been made. All the prayers have been said. The casket is being slowly lowered into the ground. (30 seconds)
APPENDIX K

Data: Definitions and Transformations

Range Correction

Physiological change scores can be transformed to adjust the recorded values for individual differences in range; this reduces error variance (Lykken, 1975; Lykken, Rose, Luther, & Maley, 1966; Lykken & Venables, 1975). For phasic data the transformation to range corrected proportions is:

\[
\frac{\text{current base-to-peak response}}{\text{maximum base-to-peak response}}
\]

Lykken and his associates note that this range correction procedure obviates the need for an analysis of covariance to free the final values from an inverse dependence on initial values (Benjamin, 1963, 1967; Wilder, 1967). The range correction procedure also avoids the problems associated with floating baselines and unequal slopes in covariance analyses. In this study, range corrected proportions were used wherever change scores had originally been generated.

Latency

Log latency (Mueller, 1949; Winer, 1971) scores were formed by transformation from time, in seconds. For the tones latency was defined as the time from tone onset until first skin conductance response. For the scenes, latency was the time from scene offset until a subject signaled that
APPENDIX K

Data: Definitions and Transformations

Range Correction

Physiological change scores can be transformed to adjust the recorded values for individual differences in range; this reduces error variance (Lykken, Rose, Luther & Mahley, 1966; Lykken & Venables, 1971; Lykken, 1974, 1975). For phasic data the transformation to range corrected proportions is:

\[
\frac{\text{current base-to-peak response}}{\text{maximum base-to-peak response}}
\] (1)

Lykken and his associates note that this range correction procedure obviates the need for an analysis of covariance to free the final values from an inverse dependence on initial values (Benjamin, 1963, 1967; Wilder, 1967). The range correction procedure also avoids the problems associated with floating baselines and unequal slopes in covariance analyses. In this study, range corrected proportions were used wherever change scores had originally been generated.

Latency

Log latency (Mueller, 1949; Winer, 1971) scores were formed by transformation from time, in seconds. For the tones latency was defined as the time from tone onset until first skin conductance response. For the scenes, latency was the time from scene offset until a subject signaled that
she had formed a clear visual image. The latency scores were determined from the polygraph recordings.

**Magnitude-duration**

Magnitude-duration is a proportion score. It represents the proportion of a maximum skin conductance response maintained 1 minute after a clear scene visualization was reported.

**Emotional Arousal Score**

The emotional arousal score is a ranked sum of ranks. This measure was obtained by ranking responses to the positive and negative scenes, summing the rank scores and then ranking the sums. The component scores included the skin conductance, frontalis muscle activity and heart rate range corrected proportions for the positive and negative scenes. The measurement interval from which the range corrected proportions were derived was scene offset until the time a clear image was signaled. Additionally, the magnitude-duration proportions from the positive and negative scenes were included.
General Experimental Instructions

I will be studying your reactions to sounds and scenes which will be presented at irregular times. After I leave this room you will have about 10 minutes to relax and adjust to the electrodes which have been placed on you. Please close your eyes and keep them closed for the whole study; this helps our recording. You will hear sounds, or pure tones as we call them, first. Following each tone there will be rest periods, just relax during them. Also, please do not talk, and try not to fidget since this would introduce errors. After all the tones, a new set of instructions will be read to you. The time you will spend being recorded varies between 60 and 90 minutes. If you have no questions, we will begin. Oh yes, before the tones I will ask you to tense your forehead, squeeze your eyes and to tell me if you can hear me; it is allright to move or talk at this times.
APPENDIX M

Scene Instructions

At this time the situations that I would like you to picture in your imagination will be described. Some scenes will be warm and happy, others somewhat unpleasant, and the rest in between. Try to give each of them your full attention. Each of the situations, or scenes, will be described by several sentences. After I have completely finished describing it, you should try to get a clear, vivid picture of that scene in your mind. Experience each scene as completely as possible. When you have a clear, vivid picture of it, please press the button on the control that you are holding. Press it for a second or so and then let go. Pressing the button means that you have a strong, clear image in your imagination, and breaks your concentration less than having to tell me out loud. Please keep the image as sharp and strong as possible until I ask you to relax and forget that scene. The time that you are asked to hold a scene in your imagination will vary, but it could be as long as several minutes. During that time, concentrate on the scene and your reactions to it. Live the scene to the best of your ability. Use your senses to see, hear, touch, taste, smell and become involved with the picture that you have
Appendix M—Continued

created. There will be rest period of one to five minutes between scenes.

For the first scene or two I will give you additional instructions after the scene is described. For example, I will remind you to push the button when the image is strong and clear. After the first two scenes I will stop telling you to do so, but please remember to give the scenes your full attention and imagination. Also remember to press the button even though you are no longer being reminded. Please try to react to each scene separately. They are not related to each other in any way.

This finishes the instructions for the scenes part of the study. Remember, each scene is presented separately. There will be a number of scenes, but try to respond to each one by itself. When you have a clear image of a scene, signal with the pushbutton by pressing, and then quickly releasing it. Even after signaling with the pushbutton, please continue to hold the clear, vivid image of the scene in your mind until asked to relax and forget the scene. After each scene there will be a rest period of about one to five minutes. During that time please continue to sit still, but relax and let the one scene fade away. If you must move or rearrange your position, please do so during this interval as it will disrupt the study less than would movements at
other times. Now, just sit back and relax, the first scene will be described to you in about one minute.
APPENDIX N

Table 6
Tests of Equality and Symmetry of the Variance-Covariance Matrices for Hypothesis Two

<table>
<thead>
<tr>
<th>Factors</th>
<th>Equality</th>
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<th>Symmetry</th>
<th></th>
<th></th>
<th>Epsilon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$x^2$</td>
<td>df</td>
<td>$p$</td>
<td>$x^2$</td>
<td>df</td>
<td>$p$</td>
<td></td>
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<tr>
<td>Skin Conductance</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Weight x restraint x tone</td>
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<td>.005</td>
<td>.5943</td>
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<tr>
<td>Weight x tone</td>
<td>9.52</td>
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<td>.250</td>
<td>185.15</td>
<td>8</td>
<td>.005</td>
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<td>Restraint x tone</td>
<td>3.95</td>
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<td>.500</td>
<td>184.66</td>
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<td>.005</td>
<td>.6011</td>
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<tr>
<td>Frontalis Activity</td>
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</tr>
<tr>
<td>Weight x restraint x tone</td>
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<td>.005</td>
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<td>Heart Rate</td>
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<td>Weight x restraint x tone</td>
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<td>Restraint x tone</td>
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<td>.250</td>
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<td>.005</td>
<td>.8360</td>
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</table>

Note: Tests with alpha $\leq .01$ are considered significant.
# APPENDIX O

## Table 7

Tests of Equality and Symmetry of the Variance-Covariance Matrices for Hypothesis Three

<table>
<thead>
<tr>
<th>Factors</th>
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<td>df</td>
</tr>
<tr>
<td><strong>Skin Conductance</strong></td>
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</tr>
<tr>
<td>Weight x restraint x scene</td>
<td>52.78</td>
<td>18</td>
</tr>
<tr>
<td>Weight x scene</td>
<td>14.31</td>
<td>6</td>
</tr>
<tr>
<td>Restraint x scene</td>
<td>17.22</td>
<td>6</td>
</tr>
<tr>
<td><strong>Frontalis Muscle Activity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight x restraint x scene</td>
<td>14.95</td>
<td>18</td>
</tr>
<tr>
<td>Weight x scene</td>
<td>3.76</td>
<td>6</td>
</tr>
<tr>
<td>Restraint x scene</td>
<td>9.00</td>
<td>6</td>
</tr>
<tr>
<td><strong>Heart Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight x restraint x scene</td>
<td>16.13</td>
<td>18</td>
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<tr>
<td>Weight x scene</td>
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<td>6</td>
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<tr>
<td>Restraint x scene</td>
<td>9.43</td>
<td>6</td>
</tr>
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*Note: Tests with alpha ≤ .01 are considered significant.*
APPENDIX P

Table 8
Tests of Equality and Symmetry of the Weight x Restraint x Scene
Variance-Covariance Matrices for Hypothesis Four

<table>
<thead>
<tr>
<th>Rating</th>
<th>Equality</th>
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<td></td>
<td>( \chi^2 )</td>
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<td>( p )</td>
<td>( \chi^2 )</td>
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<td>Happiness</td>
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</table>

Note: Tests with \( p \leq .01 \) are considered significant.

\(^a\) Sum of emotion, anxiety, upset, safety, and happiness.
### APPENDIX Q

Table 9

Tests of Equality and Symmetry of the Variance-Covariance Matricies for Hypothesis Five

<table>
<thead>
<tr>
<th>Factors</th>
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<tr>
<td>Skin conductance</td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Weight x restraint x scene</td>
<td>16.36</td>
<td>18</td>
<td>.500</td>
<td>15.53</td>
<td>4</td>
<td>.005</td>
<td>.9354</td>
<td></td>
</tr>
<tr>
<td>Weight x scene</td>
<td>6.43</td>
<td>6</td>
<td>.250</td>
<td>16.33</td>
<td>4</td>
<td>.005</td>
<td>.9334</td>
<td></td>
</tr>
<tr>
<td>Restraint x scene</td>
<td>1.94</td>
<td>6</td>
<td>.500</td>
<td>14.67</td>
<td>4</td>
<td>.005</td>
<td>.9274</td>
<td></td>
</tr>
<tr>
<td>Heart rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight x restraint x scene</td>
<td>11.41</td>
<td>18</td>
<td>.500</td>
<td>14.36</td>
<td>4</td>
<td>.010</td>
<td>.9189</td>
<td></td>
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<tr>
<td>Weight x scene</td>
<td>6.92</td>
<td>6</td>
<td>.250</td>
<td>16.67</td>
<td>4</td>
<td>.005</td>
<td>.9344</td>
<td></td>
</tr>
<tr>
<td>Restraint x scene</td>
<td>3.06</td>
<td>6</td>
<td>.500</td>
<td>15.91</td>
<td>4</td>
<td>.005</td>
<td>.9368</td>
<td></td>
</tr>
</tbody>
</table>

Note: Tests with alpha ≤ .01 are considered significant.
APPENDIX R

Table 10
Selected Tests of Equality and Symmetry of the Variance-Covariance Matrices for Hypotheses 1, 6, 7 and 10

<table>
<thead>
<tr>
<th>Factor</th>
<th>Equality</th>
<th></th>
<th></th>
<th>Symmetry</th>
<th></th>
<th></th>
<th>Epsilon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$x^2$</td>
<td>df</td>
<td>p</td>
<td>$x^2$</td>
<td>df</td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>Hypothesis one</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight x restraint x tone</td>
<td>26.99</td>
<td>30</td>
<td>.500</td>
<td>24.18</td>
<td>8</td>
<td>.005</td>
<td>.8325</td>
</tr>
<tr>
<td>Hypothesis six</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight x restraint x scene</td>
<td>15.05</td>
<td>18</td>
<td>.500</td>
<td>18.98</td>
<td>4</td>
<td>.005</td>
<td>.9115</td>
</tr>
<tr>
<td>Hypothesis seven</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight x restraint x scene</td>
<td>32.44</td>
<td>18</td>
<td>.010</td>
<td>9.59</td>
<td>4</td>
<td>.025</td>
<td>.9364</td>
</tr>
<tr>
<td>Hypothesis ten</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at onset x scene</td>
<td>13.29</td>
<td>6</td>
<td>.025</td>
<td>5.05</td>
<td>4</td>
<td>.250</td>
<td>.9679</td>
</tr>
</tbody>
</table>

Note: Tests with $p \leq .01$ are considered significant.
APPENDIX S

Table 11

Summary of Most Complex Usable and Necessary ANOVAs for Tests on Stated Hypotheses

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Analytic Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>2</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>Skin</td>
<td>Tone, weight x restraint</td>
</tr>
<tr>
<td>Frontalis</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>Heart</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>3</td>
<td>Weight x tone, tone, weight x restraint</td>
</tr>
<tr>
<td>Skin</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>Frontalis</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>Heart</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>4</td>
<td>Weight x restraint x tone,</td>
</tr>
<tr>
<td></td>
<td>Restraint x tone, weight x tone</td>
</tr>
<tr>
<td>5</td>
<td>Weight x tone</td>
</tr>
<tr>
<td>Skin</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>Frontalis</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>Heart</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>6</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>7</td>
<td>Weight x restraint x tone</td>
</tr>
<tr>
<td>10</td>
<td>Onset x tone</td>
</tr>
</tbody>
</table>

Note: The presence of additional analyses for any hypothesis indicates that they were also necessary for complete interpretation.
APPENDIX T

START
Rest
Prestimulation
Baseline

Tones
1. Baseline
2. Latency
3. Response

Two Practice Scenes
1. Baseline
2. Presentation
3. Visualization
4. Maintain Image
5. Recovery

Rest
Postpractice

Four Experimental Scenes
1. Baseline
2. Presentation
3. Visualization
4. Maintain Image
5. Recovery

Rest
Postexperimental Recovery

END

TIME

Figure 4. The temporal progression of stimulus conditions and physiological measurement intervals over the course of the experiment.
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