# MOTIVATIONAL EFFECTS ON TIME ESTIMATION AND DELAY OF GRATIFICATION IN OBESE AND NONOBESE BOYS

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The effects of physiological hunger and satiation and of edible and inedible incentive conditions on time estimation and delay of gratification were investigated in obese and normal boys. Physiological hunger had no significant effect on the time estimates of obese subjects, while it significantly shortened the time estimates of normal subjects, both when hunger was made relevant and irrelevant by varying the incentive conditions. It was concluded that the obese cannot respond to internal hunger cues in the same way as normals. No significant difference was found between the time estimates of obese subjects in the edible and inedible incentive conditions. This was interpreted as support for the presence of a general deficit of internal control in the obese rather than a deficit related only to eating behavior. The prediction that there is a positive correlation between time estimation and ability to delay gratification was not substantiated.

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# INTRODUCTION

Obesity is a condition in which the body contains an abnormally large amount of adipose tissue. The exact criteria for determining obesity vary widely with the culture and the authority, but most authorities agree that it is a major health hazard (Newburgh, 1942). It has been shown to be a contributing or aggravating factor in a large variety of diseases, from arteriosclerosis to varicose veins (Kaplan and Kaplan, 1967). Insurance companies have estimated that obese individuals have a higher than normal death rate in every age group, and Newburgh (1942) has demonstrated that for obese men in the 45 to 55 age range there is a 1% increase in the mortality rate for every pound that they are overweight. Even if healthy, obese individuals are caused much social discomfort in a society which places a premium on being slim. Maddox et al. (1968) have shown that, in the United States, fat individuals tend to evoke negative affect and rejection, and are considered personally responsible for their undesirable condition. Furthermore, their findings also show that fat children are considered less likable than children with gross physical disabilities. The obese, therefore, are clearly not in an enviable position.

Although endocrine and metabolic malfunction can be causal factors in obesity, it has been estimated that these disturbances account for only 3% of the incidence of obesity (Silver and Bauer, 1934). Furthermore, while a certain genetic constitutional predisposition to obesity does seem to exist, the contribution of hereditary factors is confounded by environmental factors such as family eating habits, which have been shown to be of predominant importance (Kaplan and Kaplan, 1967).

In fact, obesity in most individuals has been shown to stem directly from consuming too many calories and not expending enough energy to prevent these calories from being stored as excess fat (Mayer, 1968). Strang et al. (1930), faced with persistent protests of obese patients who claimed that they really did not eat enough to justify their excess weight, took a series of such patients and under controlled conditions fed them only what they claimed to eat; invariably, every patient lost weight.

If excess of caloric input over output is the principal cause of obesity, the obvious and crucial questions to be posed are: (1) what causes certain people to eat more than they require, and (2) how can they be helped to stop doing so?

Various attempts have been made to answer these questions. The psychoanalytic literature abounds with theories about the causes of overweight. Investigators in this area have examined specific factors in the culture, environment, family history, personality structure and unconscious of the obese patient. The hypotheses which imply that a specific type of family constellation or emotional disturbance causes obesity have never been validated experimentally (Kaplan and Kaplan, 1967). It is also noteworthy that factors proposed to account for obesity are similar to those proposed for many other psychosomatic and psychopathological conditions - from peptic ulcers to schizophrenia. Almost all conceivable psychological impulses and conflicts have been assumed to cause overeating. Many symbolic meanings have been assigned to food. Food may stand for an insatiable desire for unobtainable love, or an expression of rage and hatred; it may substitute for

sexual gratification or indicate ascetic denial; it may represent a wish to be a man and to possess a penis, or the wish to be pregnant, or the fear of pregnancy. It may help to achieve a sense of spurious power and self-aggrandizement, or serve as a defense against adulthood and responsibility. Preoccupation with food may appear as dependent clinging to parents, or as a hostile rejection of them (Bruch, 1969). Kaplan and Kaplan (1967) include a more complete list of the explanations of obesity offered in the psychoanalytic literature (see Appendix A).

In short, attempts to explain obesity on the basis of specific psychodynamic factors seem to have resulted in conceptual confusion and contradictions. It has not been proven that the conflicts discussed are the causes rather than the effects of obesity, and it has not been shown why others with similar conflicts manifest symptoms other than obesity.

In relation to the second question of treatment, the common psychoanalytic approach is to lead the patient to an understanding of the dynamics which underlie his problem. Many authors adhering to the psychoanalytic view seem to have uncritically based their theories on Freudian concepts. They explain that obese patients have remained fixated at the oral stage. Frustrated in their adult functioning, they regress to the oral level and overeat to fill the void in their adult life. An alternate Freudian interpretation may translate overeating into terms of a frustrated dependency - a wish to be loved, which is denied by external reality, causing the patient to regressively seek gratification through a wish to be fed (Kaplan and Kaplan, 1967). However, Bruch, a leading authority on obesity and an analyst herself, has conceded that "insight" is of little help to the overweight individual

(Bruch, 1969). It has been found that obese patients accept the therapist's interpretation of their problems more readily than do patients with other problems but this is seen merely as an example of their passive natures. Under these circumstances, if obese patients actually do lose weight, a relapse is almost inevitable.

In contrast to the predominant psychoanalytic view which assumes that awareness of hunger is innate and unlearned, Bruch (1969) has theorized that learning is necessary for hunger to become organized into recognizable patterns. The success of this learning depends on how appropriately and consistently an infant's needs including hunger are fulfilled, so that he can learn to perceive and distinguish different needs, to express his needs, and to take proper steps to their satisfaction. She summarizes her theory as follows:

> For such learning to take place, the infant must experience, repeatedly and consistently, a definite sequence of events: felt and expressed discomfort, recognition of this signal by the mother, appropriate response and felt relief. Deprivation of this experience, which may vary widely in its contradictory, inappropriate, or neglectful aspects, will render a child deficient in accurate guideposts to his needs. He will grow up confused in experiencing himself as a separate self-directed unit, but may feel that he lives his life in response to stimuli or demands coming from others, without the faculty of experiencing sensations, thoughts, feelings and impulses as originating within himself, or of considering them effective (Bruch, 1969, p.93).

Although critical of the failure of experimental workers to consider the importance of internal non-nutritional cues such as depression and anxiety, which seem to her to play an important role in obese patients, Bruch has recognized the merit of experimental evidence in support of her clinical observation that people show great differences in the accuracy of recognizing and conceptualizing hunger

(Bruch, 1969). One of the first of these experimental workers, Stunkard (1959), using a technique pioneered by Cannon and Washburn (1912), obtained measures of the pressure exerted by gastric motility on a balloon inserted into the stomach. He found a correspondence between reports of hunger and measures of gastric motility in women of normal weight, but no such correspondence in obese women. This lack of correspondence, which resulted from reports of no hunger in the presence of gastric motility in the obese women, was first interpreted as being due to the operation of the defense mechanism of denial. Later, a lack of correspondence was also found in obese men, but in this case it resulted from reports of hunger in the absence of gastric motility by many of the men. This discrepancy could not be explained by denial (Stunkard and Koch, 1964). Furthermore, since it was shown that the obese could develop more accurate sensitivity to gastric contractions, it seems that their initial deficiency in perceiving gastric motility was not attributable to an imperfect nervous apparatus or necessarily to denial, but was more likely due to a lack of learning (Griggs and Stunkard, 1964).

It seems, therefore, that the obese fail to make accurate use of at least one physiological correlate of hunger, that of stomach contractions. Although once assumed to be the major cause of hunger (Cannon and Washburn, 1912), sensations from the empty stomach are now known not to be a necessary condition for the existence or arousal of hunger, because there are additional complex physiological and neural mechanisms which contribute to the control of food (Quigley, 1955).

Briefly, the hypothalamus as well as the cerebral cortex have a facilitating or inhibiting effect on eating behavior, and are the main neural centres which mediate hunger, appetite, and the desire for food. The lateral area of the hypothalamus facilitates eating, while the medial area inhibits it. The hypothalamic eating centre is affected by various bodily regulatory mechanisms acting upon it. For example, hypothalamic functioning is influenced by impulses from the cortex and changes in blood glucose levels, as well as by stomach distension.

It is believed that most of the body regulatory mechanisms tend to maintain the body at a normal weight in most obese as well as normal people. However, in the obese, the influence of psychological factors, through cortical connections with the hypothalamus, very likely upsets the normal body regulatory control mechanism.

There is considerable evidence that labels attached to a physiological state are a joint function of cognitive factors and the state of physiological arousal, i.e., a person's perception of his bodily state and his interpretation of it in terms of his immediate situation and his past experience determine how he will name the state he is experiencing (Schachter and Singer, 1962). Schachter (1967) has based his work on obesity on the hypothesis that the obese do not label as "hunger" the same bodily state that others recognize as such. By manipulating the state of fear, which has been shown to suppress gastric motility (Carlson, 1916) and to raise the blood sugar level (Cannon, 1915) thereby simulating the chief peripheral physiological correlates of satiation, it was demonstrated that internal signs of food deprivation are directly related to eating

behavior in normal weight subjects, but are unrelated in obese subjects (Schachter, Goldman and Gordon, 1968). Further evidence of decreased sensitivity to internal signals in the control of eating in obese subjects was the finding that ingestion of glucose did not cause the previously pleasant taste of sucrose to become unpleasant, as it did in normal subjects (Cabanac and Duclaux, 1970). Schachter and his colleagues have also shown that external or nonvisceral cues such as smell, taste, the sight of other people eating, and the time of day affect the eating behavior of obese subjects to a greater extent than that of normal subjects (Hashim and Van Itallie, 1965; Nisbett, 1968; and Schachter and Gross, 1968). Further studies in nonlaboratory settings (Goldman, Jaffa and Schachter, 1968) attest to the generality of Schachter's findings.

Moreover, in terms of treatment outcomes, the only weight-reducing programs evaluated in the literature which seem to promise long term success are those that recognize the strength of external control and the lack of internal control over eating in the obese (Stuart, 1967; Harris, 1969; Wollersheim, 1969). These programs attempt to teach the obese the antecedents and consequences of their eating behavior, to instruct them to manipulate their environment so as to restrict contact with food and food-related stimuli, and to gradually teach themselves self-control in the presence of food and food-related stimuli through the use of operant and respondent conditioning techniques.

Aside from Schachter's thesis that the obese mislabel hunger, there is another theory proposed by Kaplan and Kaplan (1967) which

seems reasonable. They have proposed that the most common type of overeating can be explained in terms of anxiety reduction. The authors argued that since eating has fear-reducing effects, a person may learn to habitually use eating to reduce anxiety over and above his use of eating to reduce hunger. They have claimed that one of the important factors predisposing individuals to choose overeating as a means of diminishing anxiety is the availability of food in their environment; the greater the availability of food, the greater the probability of a person exploiting the anxiety-reducing effects of food, should he become subject to emotional disturbance and anxiety.

Kaplan and Kaplan (1967), however, have not offered any experimental evidence in support of their theory. In fact, Schachter, Goldman and Gordon's (1968) finding that experimentally-induced fear has no effect on the amount eaten by the obese argues against the anxiety reduction theory. Nor is it likely that a general high arousal state in the obese leads to overeating. It was found that the obese do not label a state of sympathetic activation induced by adrenalin injections as hunger, nor was there any significant difference in the amounts eaten by the obese with or without adrenalin injections while nonobese subjects ate less in the high arousal state induced by adrenalin than in the low arousal state (Schachter, 1964).

Although Schachter's obesity studies seem to be basically sound, especially as compared to other theories which have received no confirmation, his work has met with several criticisms. One fault found with his experimental results is that they are open to alternate interpretations. For example, the finding that heavier airplane pilots complain less than normal weight pilots about irregular mealtimes (Goldman, Jaffa,

and Schachter, 1968) may be attributable to the known fact of greater passivity (just not bothering to complain) in obese Ss noted by Mayer (1968) rather than to the lack of responsiveness to internal hunger cues. Hashim and Van Itallie's (1965) finding that an unappetizing liquid diet leads to substantial weight loss in obese subjects may be attributed to sampling bias as their subjects were highly motivated to lose weight, indeed motivated enough to admit themselves as clinic patients. However, since many of the studies were carried out outside of the laboratory, where rigid control was impossible, criticisms are best refuted by the generality of Schachter and his colleagues' findings, and this refutation can only be strengthened by further supportive evidence from a wider range of settings. Indeed, one of the purposes of the present study was to test in yet another situation Schachter's thesis that the obese are less sensitive to the internal physiological cues than normal subjects, while they are more sensitive to external cues.

Another criticism that has been made about Schachter's work is that it has not incorporated multiple measures to show the effects of the internal hunger drive, which, in addition to exerting its influence directly on the amount eaten, may also manifest itself in other ways (Stein, 1967). Miller (1957) has shown the value of using a diversity of rigorous behavioral tests to supplement the measures of amount of food consumed. He found significant differences among four measures of hunger in a rat study investigating the effects of food deprivation. Two measures, stomach contractions and volume consumed were correlated, while two other measures, rate of bar-pressing and amount of quinine endured, took a different course. It is, therefore, important to determine whether manipulating the hunger drive can cause differences between

obese and nonobese Ss which show up in measures other than amount of food consumed.

The present study attempted to extend Schachter's findings by investigating a pertinent dependent variable other than the amount eaten - that of time estimation (a behavioral delimitation of the duration of a given time interval). The object here was to compare the effects of manipulating the internal state of hunger and incentive conditions on the time estimates of obese and nonobese subjects.

The task of time estimation was chosen because it has been found to be subject to the influence of motivational factors. Filer and Meals (1949), for example, have found that shorter time estimates were made by normal subjects in the presence of an attractive goal, than when no goal was present. Schectman (1968) has also found that anticipation of a pleasant reward shortened time estimates. It was hypothesized, therefore, that time estimates made under incentive conditions are shorter than those made in a practice situation in which no incentive is offered.

If the obese are less capable of responding to visceral signs of hunger, the effects of hunger should differ in the obese and nonobese not only in the amount eaten, but in other behaviors on which the hunger drive can exert a motivational effect. More specifically, it was hypothesized that obese subjects would show no difference between their time estimates when physiologically hungry (hungry condition), and when satiated (satiated condition), when food serves as a reward (edible incentive condition). It was also hypothesized that normal subjects would make shorter estimates in the hungry condition than in the satiated condition,

when an edible incentive renders the hunger drive relevant.

Another related but unanswered question is whether visceral components of hunger can make their presence felt when the hunger drive is irrelevant to the task at hand. Internal signs of hunger may not control food-related behavior in the obese, but it remains possible that the hunger drive will affect performance differently in the obese and the normal in a nonfood-related task. The present study attempted to test this hypothesis by manipulating the hunger drive when it was rendered irrelevant by the use of an inedible reward as an incentive and observing its effect on the time estimates of obese and normal subjects. If the visceral hunger cues exert no influence, even indirectly, on behavior in the obese, then the drive manipulation should have no effect on their time estimates. But the normals, who perceive internal cues, should be affected by the drive manipulation, insofar as the hunger drive has a nonspecific arousal effect on behavior. It was hypothesized, therefore, that the nonobese subjects would make shorter time estimates in the inedible reward condition when hungry than when satiated. For obese subjects, however, it was hypothesized that the irrelevant hunger drive would have no effect on time estimation for the inedible reward condition. If, on the other hand, internal hunger stimuli can raise the drive level in the obese and influence nonfood-related behavior, it may mean that some sort of denial mechanism or blockage at a higher cognitive level comes into existence in the obese when edible incentives are present. In this case, the obese subjects would make shorter time estimates when hungry than when satiated under the inedible incentive condition. However, the finding that not all of the inaccuracy in the reporting of gastric motility by the obese can be explained by denial (Stunkard and Koch, 1964) and

the finding that greater sensitivity to gastric contractions can be developed by the obese (Griggs and Stunkard, 1964) indicate that the learning deficiency hypothesis seems more tenable than the denial hypothesis.

Yet another question that remains unanswered is whether the obese have a specific deficit in learning to recognize internal signs of hunger which results in their being controlled by food-related external cues, or whether they have a more general problem of being unable to perceive internal cues related to other bodily states as well, which results in their being controlled by a wide range of external stimuli.

Bruch (1969) viewed the problem as being general rather than specific to eating behavior:

> If confirmation and reinforcement of his own initially rather undifferentiated needs and impulses has been absent, or has been contradictory or inaccurate, then a child will grow perplexed when trying to differentiate between disturbances in his biological field and emotional and interpersonal experiences, and he will be apt to misinterpret deformities in his self-body concept as externally induced. Thus he will become an individual deficient in his sense of separateness, with "diffuse ego boundaries", and will feel helpless under the influence of external forces (Bruch, 1969, p.99).

Karp and Pardes (1965) have conceptualized this problem in terms of Witkin's field dependence (or undifferentiation) and field independence (differentiation) continuum (Witkin et al., 1954). They have shown that obese women are significantly more field dependent than normal women on two out of three measures of field dependence. Their results, however, might have been due to sampling bias, as all the obese subjects used were those who came to a weight reduction clinic seeking help, and, thus, they might have been more field dependent than the average obese individual. Furthermore, studies in Schachter's laboratory (Schachter and Gross, 1968) have been unable to replicate these findings. Glass

et al. (1969) have found obese subjects to be more persuasible than those of normal weight, but an attempt to relate this result to a measure of field dependence was unsuccessful.

The question of general versus food-specific learning deficits in the obese still appears to be an open one. Bruch's (1969) general learning hypothesis is appealing, but it has not been fully substantiated perhaps because the field dependence tests have not been the best tools with which to test the hypothesis. This study attempted to help resolve the question by investigating the effects of manipulating the external incentive conditions on the time estimates of the obese subjects, in order to determine whether only food-related cues (the edible incentives) control the behavior of the obese, or whether cues unrelated to food (the inedible incentives) can also exert control over the behavior of the obese. Specifically, it was hypothesized that the obese would show no difference between their time estimates in the edible and inedible incentive conditions. In contrast it was hypothesized that the nonobese would make shorter time estimates in the edible than in the inedible incentive conditions as they are more responsive to internal than to external stimuli.

Another question which was investigated concerned the use of a second dependent variable - the ability to delay gratification, which has been studied extensively by Mischel (1958, 1960, 1961[a], 1961[b], 1964). This variable should prove sensitive to the ability of subjects to resist external and to rely upon internal controls, as it has been found to be positively related to social responsibility (Mischel, 1961[a]), need for achievement, "naysaying" (Mischel, 1961[b]), and realism of time perspective (Mischel and Metzner, 1962) all of which imply internal control.

As both time estimation and ability to defer gratification seem capable of measuring the influence of internal versus external control, it was hypothesized that there is a positive correlation under all combinations of the hunger and incentive conditions between the choice of delayed, larger rewards over immediate, smaller rewards, and the length of time estimation, i.e., the longer the time estimate, the greater the likelihood of the choice of a delayed reward.

Since it was unknown whether Schachter's findings hold true for younger subjects, the subjects in this study were male elementary school students, between the ages of eight and thirteen.

To summarize, the present study investigated the motivational effects of the presence or absence of physiological hunger and the effects of edible and inedible incentives on time estimation and delay of gratification in obese and normal boys. The following hypotheses were made:

(1) time estimates made under incentive conditions are shorter than those made in a practice situation in which no incentive is offered

(2) obese subjects show no difference between their time estimates in the hungry condition and the satiated condition, under the edible incentive condition (i.e., when the hunger drive is relevant)

(3) nonobese subjects make shorter estimates in the hungry condition than in the satiated condition, under the edible incentive condition (i.e., when the hunger drive is relevant)

(4) obese subjects show no difference between their time estimates in the hungry and the satiated condition, under the inedible incentive condition (i.e., when the hunger drive is irrelevant)

(5) nonobese subjects make shorter estimates in the hungry condition than in the satiated condition, under the inedible incentive condition (i.e., when the hunger drive is irrelevant)

(6) obese subjects show no difference between their time estimates in the edible and inedible incentive conditions

(7) nonobese subjects make shorter time estimates in the edible than in the inedible incentive condition

(8) the ability to delay gratification is positively correlated with the length of time estimates under all combinations of the hunger and incentive conditions.

## METHOD

### Subjects and experimental design

A total of 64 subjects participated in this experiment. The experimental group consisted of 32 obese males between the ages of 8 and 13 inclusive, mainly from four elementary schools in Cote St. Luc, a middle-class residential suburb of Montreal with a large Jewish population.[1] The criterion for obesity was set at a stringent level - at least 25% over the average weight for a particular age and body build. Such a strict criterion was used as comparison with average weight, although convenient, is not very reliable since there is an imperfect correlation between body weight and subcutaneous fat thickness (Mayer, 1968). The subjects were solicited from a list of boys judged to be at least 25% overweight by their school nurse or pediatrician. Glandular and metabolic disturbances were ruled out as causal factors of obesity in these subjects by their doctors beforehand. Permission for the obese students to participate was granted by their mothers, and almost total cooperation was received. The resultant sample comprises a majority of the obese boys attending the four schools.

The 32 obese subjects were individually matched with 32 nonobese subjects for sex, age, grade-level and socioeconomic status, since these factors have been found to influence the dependent variables (LeShan, 1952; Mischel and Metzner, 1962). In order to assess the socioeconomic status of a subject occupation of the head of the family and family income were determined. The occupations were ranked according to Blishen's (1958) scale of occupations in Canada and divided into four categories from (1) highest in status to (4) lowest in status. Family

[1] Five subjects referred by pediatricians came from equivalent neighborhoods.

income was similarly divided into four categories (see Appendix B). Both factors were equally weighted as determinants of socioeconomic level and a subjects' rating was the arithmetic mean of his level on these two factors. The control subjects were students chosen from the same schools who were not on the 25% or more overweight list and who were considered to be of normal weight. Students who seemed to be even somewhat overweight or underweight were not included. The nonobese subjects were solicited in the same manner as the obese subjects.

The subjects were divided into two groups, each of which consisted of 16 obese subjects and 16 nonobese matched controls. The first group was given the first test session before mealtime in the hungry condition and the second session after mealtime in the satiated condition, while the second group was given the first test session in the satiated condition and the second session in the hungry condition.

Each group was further divided into two subgroups, resulting in four subgroups of eight obese and nonobese subjects, comparable with respect to mean age, grade level, and socioeconomic status (see Table 1). Two of the subgroups were presented with the edible incentive condition first, followed by the inedible incentive condition, while the remaining subgroups were presented with the incentive conditions in the reversed order. One subgroup thus received the hungry and edible incentive conditions first (Group $h_1e_1$). The second subgroup received the hungry and inedible incentive conditions first (Group $h_1e_2$). The third subgroup received the satiated and edible incentive conditions first (Group $h_2e_1$). The fourth subgroup received the satiated and inedible conditions first (Group $h_2e_2$).

TABLE 1

MEAN AGE, GRADE LEVEL AND SOCIO-ECONOMIC STATUS RATING OF EACH GROUP

| Group | Mean age in years | | Mean grade | | Mean socio-economic rating | |
|---|---|---|---|---|---|---|
| | obese | nonobese | obese | nonobese | obese | nonobese |
| $h_1e_1$ | 10.875 | 10.875 | 5.625 | 5.625 | 2.125 | 2.125 |
| $h_1e_2$ | 10.500 | 10.500 | 5.125 | 5.125 | 2.000 | 2.000 |
| $h_2e_1$ | 10.875 | 10.875 | 5.375 | 5.375 | 2.000 | 2.000 |
| $h_2e_2$ | 11.000 | 11.000 | 5.375 | 5.375 | 2.063 | 2.063 |

The resulting experimental design was thus that of a 2 x 2 x 2 repeated measures factorial experiment with the order of presentation of two variables counterbalanced.

## Procedure

The subjects were tested individually in their homes, and appointments were scheduled around the particular subject's regular mid-day or evening mealtime. Groups $h_1e_1$ and $h_1e_2$ had their first session before a meal, and their second session after a meal. Groups $h_2e_1$ and $h_2e_2$ had their first session after a meal, and their second session before a meal. Most subjects were tested on the same day, but some subjects in Groups $h_2e_2$ had their second session the following day.

The subjects were told that the purpose of the study was to determine whether time goes faster before meals or after meals. Discussion of weight and eating habits or of the experimental hypotheses was avoided until the end of the experiment in order to prevent possible offense to any of the obese subjects and to ensure that awareness of the hypotheses would not influence the experimental results.

Subjects first took part in a time estimation task. The timing mechanism used was an electro-mechanical timer graduated in 100ths of a second, made by Lafayette Instrument Company, Lafayette, Indiana, which was attached to a push button mechanism at the end of a twenty-foot long cord. The subject was asked to remove his watch if he wore one, and was positioned at the end of the cord, where he could see neither the expermenter, the timing mechanism, nor any clock in the house. The production method of time estimation (Bindra and Waksberg, 1956), which requires the

subject to operatively delimit his estimate of the duration of a standard time interval by depressing a key for the duration of his estimate, was used. The subject was said to overestimate if his judgement was longer than the standard, and to underestimate if his judgement was shorter. The standard fixed for this experiment was thirty seconds, as normal subjects have been found to be relatively accurate and reliable in delimiting time estimates of this length (Wallace and Rabin, 1960; Schectman, 1968).

The subjects were told to keep the button depressed for as long as they thought 30 seconds would last. Subjects were given three practice trials with no feedback as to the accuracy of their estimates.

Subjects were then told that they would be asked to repeat the procedure, but that this time they would get a chance to play for prizes. If any of their estimates were accurate enough, i.e., within 5 seconds of the standard either way (between 25 and 35 seconds), they would win a prize. Subjects were told that they would be given an opportunity to some extent to choose their prizes, so that they might get a chance to play for prizes which they wanted to win. In order to indicate how much they wanted to win each of the prizes, the subjects were asked to rate a list of 25 edible and 25 inedible prizes on a 5-point scale, ranging from not at all to very, very much (see Appendix C). The prizes were arranged on the list in random order so that distinct categories of that which is edible and that which is inedible would not be easily formulated. The prizes had been prechosen as being relatively desirable by five judges of age and background similar to those of the subjects.

Another purpose in having the subjects rate the potential prizes was to enable the experimenter to equate the edible and inedible incentives

to be used in the subsequent test sessions for desirability. After the prizes were rated, a pair of edible and inedible prizes that were of equal attractiveness and as high in desirability as possible for the particular subject, were chosen to serve as incentives. As it was found beforehand that inedible prizes were preferred to edible prizes of the same cost the edible prizes (average cost of 30 cents) included in the list were somewhat more expensive than the inedible prizes (average cost of 20 cents).

It was ascertained by nondirective questioning that the pair of prizes selected to serve as incentives were, in fact, equally desired, and in some cases larger sizes of the edible prize had to be produced in order to equate it with the inedible prize.

The subjects were given three trials to attempt to win the first prize. Groups $h_1e_1$ and $h_2e_1$ began with the edible prize in front of them as they took their turns, while Groups $h_1e_2$ and $h_2e_2$ began with the inedible prize. The subjects were then given another three trials to attempt to win the second of the pair of prizes. Subjects were not informed as to whether or not they were successful in winning any of the prizes, and were told that they would not find out until the very end of the experiment. In order to minimize the subjects' chances of practising between the first and second session, it was not specified to them that they would have another three trials for each of the previously selected prizes during the second session when the experimenter was to return to tell them if they had won anything. In effect, each subject was to receive a total of six chances to win each prize.

The subjects were again given the opportunity to attempt

to win both prizes in the second session. Groups $h_1e_1$ and $h_1e_2$ underwent the second session after a meal, in the satiated condition, while Groups $h_2e_1$ and $h_2e_2$ underwent the second session before a meal, in the hungry condition. The two prizes were presented in the same order as in the previous session (Groups $h_1e_1$ and $h_2e_1$ receiving the edible prize first, and Groups $h_1e_2$ and $h_2e_2$ receiving the inedible prize first). Upon completion of the trials all the subjects were informed that they had indeed won the first prize, regardless of their actual performance. They were then given the choice of either accepting the prize they had won (the smaller immediate reward), or waiting one week for two of the same prizes (the greater delayed reward), a procedure similar to that outlined by Mischel (1964). Subjects were next informed that they had won the second prize and were given the same choice.

One week after the last session, the prizes were delivered to those subjects who had selected the greater delayed reward option.

## RESULTS

### Analysis of time estimates in the practice session

In order to assess whether the groups of subjects were comparable in their initial estimates, a separate analysis of variance was first carried out on the time estimates made in the practice trials. The results of this analysis are summarized in Table 2.

The effect of obesity (O) was not found to be significant, hence, correction for initial differences between the time estimates of the obese and the nonobese was not required. There was, however, an unpredicted significant difference between the hunger conditions (H) on the practice trials ($F = 4.67$, $df = 1$ and $30$, $p < .05$). Groups $h_1e_1$ and $h_1e_2$, who took their practice session in the hungry condition made significantly shorter estimates than groups $h_2e_1$ and $h_2e_2$, who took their practice session in the satiated condition, indicating that the hunger condition had an effect on both obese as well as nonobese subjects. The Obesity x Hunger interaction was not significant.

### Comparison of practice and incentive conditions

In order to test the hypothesis that time estimates made under incentive conditions are shorter than those made in a practice situation in which no incentive is offered, the average of the time estimates made in the edible and inedible incentive conditions was computed for each subject and compared with the time estimates in the practice condition. As a significant hunger effect had been found in the practice situation, separate two-tailed t-tests for the significance

TABLE 2

ANALYSIS OF VARIANCE ON TIME ESTIMATES
IN PRACTICE TRIALS

| Source | df | MS | F | p |
|---|---|---|---|---|
| O (obese, nonobese) | 1 | 99.38 | 1.52 | N.S. |
| O x H (obesity x hunger ) | 1 | 2.46 | 0.38 | N.S. |
| O x S (error within) | 30 | 65.21 | | |
| H (hungry, satiated) | 1 | 297.00 | 4.67 | $p < .05$ |
| S (error between) | 30 | 63.57 | | |

of the difference between two means for correlated samples were carried out for the two hunger conditions (see Table 3).

For Groups $h_2e_1$ and $h_2e_2$, who had taken the practice session in the satiated condition, there was no significant difference between the estimates in the incentive and practice conditions. However, Groups $h_1e_1$ and $h_1e_2$, who had taken the practice session in the hungry condition, made significantly shorter time estimates ($t = -2.52$, $df = 31$, $p < .05$) in the practice than in the incentive conditions. Both these findings were contrary to expectations.

Analysis of variance of the effects of the hunger and incentive conditions on time estimation

Table 4 summarizes the results of the analysis of variance of the effects of the hunger and incentive conditions on time estimation. No significant main effects or order effects were found.

The Obesity x Hunger interaction was the only significant interaction found ($F = 14.31$, $df = 1$ and $30$, $p < .001$), indicating that obese subjects showed no difference between their time estimates in the hunger condition and their estimates in the satiated condition, while nonobese subjects made lower estimates in the hunger condition and higher estimates in the satiated conditions (see Figure 1). The significance of the differences between these groups was separately tested for obese and nonobese subjects using orthogonal comparisons.

Orthogonal comparisons of time estimates within the Obesity x Incentive x Hunger interaction

In order to test the experimental hypotheses concerning the effects of the hunger and incentive conditions on time estimation, orthogonal comparisons were made among group means of the time estimates within the O x I x H interaction. Table 5 summarizes these findings.

TABLE 3

COMPARISON OF PRACTICE AND INCENTIVE ESTIMATES USING T-TESTS FOR THE SIGNIFICANCE OF THE DIFFERENCE BETWEEN MEANS FOR CORRELATED SAMPLES

| Groups | Mean of incentive estimates | Mean of practice estimates | t | p |
|---|---|---|---|---|
| $h_1e_2$ and $h_1e_2$ (practice in hungry condition) | 24.13 | 21.69 | -2.52 | <.05* |
| $h_2e_1$ and $h_2e_2$ (practice in satiated condition) | 26.18 | 26.00 | -0.17 | N.S. |

*based on two-tailed test

df = 31

TABLE 4

ANALYSIS OF VARIANCE ON THE EFFECTS OF THE HUNGER AND INCENTIVE CONDITIONS ON TIME ESTIMATES

| Source | df | MS | F | p |
|---|---|---|---|---|
| O (obese, nonobese) | 1 | 10.52 | .48 | N.S. |
| O x $O_h$ | 1 | 18.40 | .83 | N.S. |
| O x S | 30 | 220.99 | | |
| I (edible incentive, inedible incentive) | 1 | 26.55 | 3.01 | N.S. |
| I x $O_h$ | 1 | 1.66 | .19 | N.S. |
| I x S | 30 | 8.83 | | |
| H (hungry, satiated) | 1 | 65.03 | 3.41 | N.S. |
| H x $O_h$ | 1 | 3.43 | .18 | N.S. |
| H x S | 30 | 19.06 | | |
| $O_h$ (order hungry, satiated; order satiated, hungry) | 1 | 67.05 | .25 | N.S. |
| S | 30 | 272.60 | | |
| O x I | 1 | 27.75 | 3.45 | N.S. |
| O x I x $O_h$ | 1 | 2.75 | .34 | N.S. |

TABLE 4--Continued

| Source | df | MS | F | p |
|---|---|---|---|---|
| O x I x S | 30 | 8.06 | | |
| O x H | 1 | 226.03 | 14.31 | $p < .001$* |
| O x H x $O_h$ | 1 | 0.19 | .12 | N.S. |
| O x H x S | 30 | 15.80 | | |
| I x H | 1 | 0.43 | .50 | N.S. |
| I x H x $O_h$ | 1 | 5.26 | .61 | N.S. |
| I x H x S | 30 | 8.67 | | |
| O x I x H | 1 | 2.53 | .39 | N.S. |
| O x I x H x $O_h$ | 1 | 14.38 | 2.20 | N.S. |
| O x I x H x S | 30 | 6.54 | | |

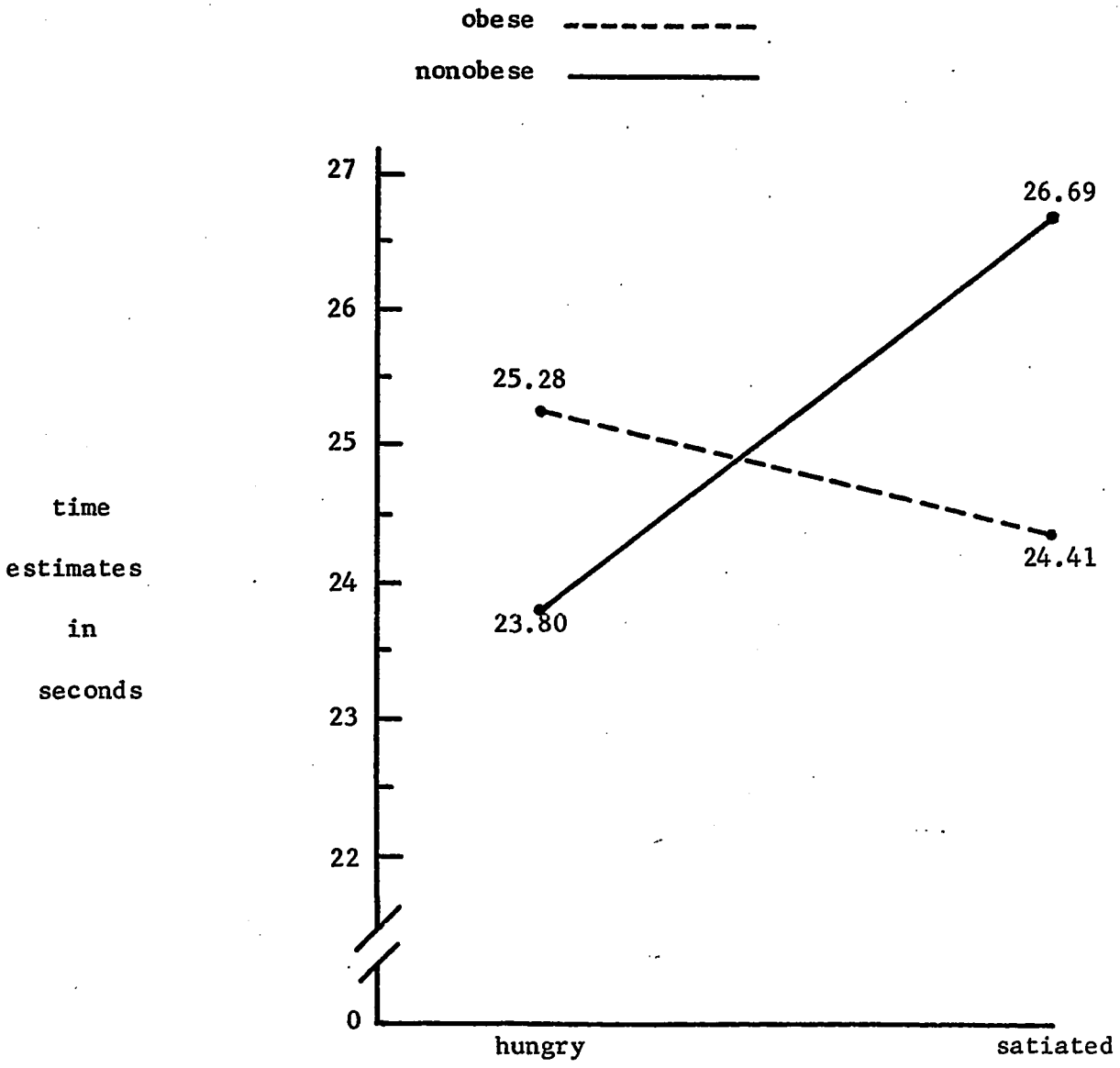


Figure 1. Means of time estimates of obese and nonobese subjects in the hungry and satiated conditions.

TABLE 5

ORTHOGONAL COMPARISONS AMONG GROUP MEANS WITHIN THE OBESITY x INCENTIVE x HUNGER INTERACTION

| Source | df | MS | F | p |
|---|---|---|---|---|
| $O_1I_1H_1$ vs $O_1I_1H_2$[a] | 1 | 11.56 | 1.77 | N.S. |
| $O_2I_1H_1$ vs $O_2I_1H_2$ | 1 | 108.67 | 16.67 | <.001* |
| $O_1I_2H_1$ vs $O_1I_2H_2$ | 1 | 15.68 | 2.40 | N.S. |
| $O_2I_2H_1$ vs $O_2I_2H_2$ | 1 | 160.78 | 24.59 | <.001* |
| $O_1I_1H_1$ & $O_1I_1H_2$ vs $O_1I_2H_1$ & $O_1I_2H_2$ | 1 | .01 | .00 | N.S. |
| $O_2I_1H_1$ & $O_2I_1H_2$ vs $O_2I_2H_1$ & $O_2I_2H_2$ | 1 | 108.16 | 16.54 | <.001* |
| Error (O x I x H x S) | 30 | 6.54 | | |

[a] $O_1$ refers to the obese subjects, $O_2$ to the nonobese subjects

$I_1$ refers to the edible incentive condition, $I_2$ to the inedible incentive condition

$H_1$ refers to the hunger condition, $H_2$ refers to the satiated condition.

The hypothesis that obese subjects ($O_1$) show no difference between their time estimates in the hungry condition ($H_1$) and the satiated condition ($H_2$) under the edible incentive condition ($I_1$), (i.e., when the hunger drive is relevant), was upheld, since the $O_1I_1H_1$ versus $O_1I_1H_2$ comparison was not significant. The hypothesis that nonobese subjects make shorter time estimates in the hungry condition than in the satiated condition, under the edible incentive condition, (i.e., when the hunger drive is relevant), was confirmed, since the $O_2I_1H_1$ versus $O_2I_1H_2$ comparison yielded significant results ($F = 16.67$, $df = 1$ and $30$, $p < .001$).

The hypothesis that obese subjects show no difference between their time estimates in the hungry and the satiated conditions, under the inedible incentive condition ($I_2$), i.e., when the hunger drive is irrelevant, was also upheld, since the $O_1I_2H_1$ versus $O_1I_2H_2$ comparison was not significant. The hypothesis that nonobese subjects make shorter estimates in the hungry condition than in the satiated condition, under the inedible incentive condition, (i.e., when the hunger drive is irrelevant) was confirmed, since the $O_2I_2H_1$ versus $O_2I_2H_2$ comparison was significant ($F = 24.59$, $df = 1$ and $30$, $p < .001$).

The hypothesis that obese subjects show no difference between their time estimates in the edible and inedible incentive conditions was upheld, since the $O_1I_1H_1$ and $O_1I_1H_2$ versus $O_1I_2H_1$ and $O_1I_2H_2$ comparison was not significant. The hypothesis that nonobese subjects make shorter time estimates in the edible than in the inedible incentive condition was confirmed, since the $O_2I_1H_1$ and $O_2I_1H_2$ versus $O_2I_2H_1$ and $O_2I_2H_2$ comparison was significant ($F = 16.54$, $df = 1$ and $30$, $p < .001$).

Correlation of time estimates and choice of reward

Point biserial correlations were computed between time estimates and choice of immediate over delayed rewards for each combination of the hunger and incentive conditions (see Table 6). The last hypothesis, that the ability to delay gratification is positively correlated with the length of time estimates under all combinations of the hunger and incentive conditions, was not confirmed, since none of the correlations were significant.

Post hoc analyses were done on the choice of immediate over delayed reward data in order to help explain the lack of correlation between the two dependent variables.

In order to determine whether the choices of the matched obese and the nonobese subjects differed, a McNemar test for the significance of changes (Siegel, 1956) was performed on the choice of immediate over delayed reward data combined over all the hunger and incentive conditions. When the data was thus combined, it was found that the obese subjects chose the immediate reward significantly more often than nonobese subjects ($X^2 = 6.32$, $df = 1$, $p < .02$). In contrast, no difference was found between the time estimates of obese and normal subjects in the time estimation task (i.e., the obesity main effect was not significant).

In order to determine whether manipulating hunger and incentive conditions had the same effect on the choice of immediate over delayed reward variable as it did on time estimation, each of the hypotheses made concerning the effects of the hunger and incentive conditions on time estimation data was tested out on the choice of immediate over

TABLE 6

POINT BISERIAL CORRELATIONS OF TIME ESTIMATES AND CHOICE OF IMMEDIATE OVER DELAYED REWARDS FOR ALL COMBINATIONS OF HUNGER AND INCENTIVE CONDITIONS

| Condition | r | t | p |
|---|---|---|---|
| $H_1I_1$ (hungry, edible incentive) | -.05 | -.28 | N.S.* |
| $H_1I_2$ (hungry, inedible incentive) | -.14 | -.77 | N.S. |
| $H_2I_1$ (satiated, edible incentive) | .27 | 1.53 | N.S. |
| $H_2I_2$ (satiated, inedible incentive) | .28 | 1.60 | N.S. |

*based on two-tailed test

df = 30

delayed reward data. In the cases of comparisons between unmatched groups, $X^2$ tests for two independent samples (Siegel, 1956), and Fisher's exact method test for small expected frequencies (Bradley, 1968) were used. In the cases of measures taken on the same subjects and where the expected cell frequencies were too small for the McNemar test, the binomial test was used[1] (Siegel, 1956).

Table 7 compares the results of the tests of the degree of association between choice of immediate over delayed reward and the pertinent hunger and incentive conditions with the results of the orthogonal comparisons among the same hunger and incentive conditions on the time estimation data.

It can be seen from the table that the hunger and incentive conditions did not affect time estimation and ability to delay gratification in nonobese subjects in the same manner. The hunger drive when it was both relevant and irrelevant served to shorten the time estimates of nonobese subjects, while it had no effect on their choice behavior. Nonobese subjects made shorter time estimates in the edible incentive condition than in the inedible incentive condition, while the incentive condition had no effect on their choice behavior.

To summarize, an unexpected significant hunger effect was found in the time estimates in the practice session. Contrary to the first hypothesis, time estimates were not found to be shorter in the incentive than in the practice conditions. The hypotheses concerning the effects

[1]These tests were actually illegitimate, as some of the observations have already been used in testing for the overall difference in choice of immediate over delayed reward between obese and nonobese subjects. The overlap of observations would result in greater ease of obtaining significant differences where none exist. However, no significant differences were found on any of the tests made.

TABLE 7

DEGREE OF ASSOCIATION BETWEEN HUNGER AND INCENTIVE CONDITIONS AND CHOICE OF IMMEDIATE REWARD AS COMPARED WITH THE RESULTS OF THE ORTHOGONAL COMPARISONS AMONG THE SAME HUNGER AND INCENTIVE CONDITIONS ON THE TIME ESTIMATION DATA

| Comparison | Time estimation | | Reward choice | | | |
|---|---|---|---|---|---|---|
| | F | p | $X^2$ | Fisher's exact probability | Binomial test probability | p |
| $O_1I_1H_1$ vs $O_1I_1H_2$ | 1.77 | N.S. | .502 | | | N.S. |
| $O_2I_1H_1$ vs $O_2I_1H_2$ | 16.67 | $<.001$ | | $<.05$ | | N.S. |
| $O_1I_2H_1$ vs $O_1I_2H_2$ | 2.40 | N.S. | .127 | | | N.S. |
| $O_2I_2H_1$ vs $O_2I_2H_2$ | 24.59 | $<.001$ | | $<.05$ | | N.S. |
| $O_1I_1H_1$ & $O_1I_1H_2$ vs $O_1I_2H_1$ & $O_1I_2H_2$ | .00 | N.S. | | | .508 | N.S. |
| $O_2I_1H_1$ & $O_2I_1H_2$ vs $O_2I_2H_1$ & $O_2I_2H_2$ | 16.54 | $<.001$ | | | .344 | N.S. |

of the hunger and incentive conditions on time estimation were upheld. Time estimation and ability to delay gratification were not found to be significantly correlated, since the ability to delay gratification was not influenced by the manipulation of the hunger and incentive conditions, while the length of time estimates were influenced by these manipulations.

# DISCUSSION

The major hypotheses connected with the thesis that the obese are less sensitive to internal hunger cues than the nonobese were borne out by the results of this study. However, before discussing the positive findings and their implications it is necessary to explain the unexpected results which occurred, that is, the unpredicted significant hunger effect in the practice situation, the lack of confirmation for the hypothesis that time estimates are shorter in the incentive than in the practice condition and the lack of correlation between time estimation and ability to delay gratification.

First, a significant hunger effect was found in the practice situation, indicating that both obese and nonobese subjects made shorter time estimates when hungry than when satiated in this situation. According to one of the major hypotheses in this study, the hunger condition, while it should have an effect on nonobese subjects should have no effect on obese subjects, and indeed, in the incentive situation hunger did not affect the time estimates of obese subjects. The discrepancy between the effect of hunger on obese subjects in the practice and incentive situations, can perhaps be explained by the fact that all the subjects were very much aware of what time it was as the practice session took place immediately upon the arrival of the experimenter who had made a fixed appointment. Since eating in the obese has been found to be influenced by the manipulation of clock-time (Schachter and Gross, 1968), the obese subjects might have rushed through the practice session knowing that it was soon time to eat. Later, in the incentive condition, it is likely the time became less salient for them especially as they realized

that the task was of short duration and would allow them sufficient time to eat and return to school. In fact, some subjects at the outset sought reassurance that they would not be late for school; however, at the end of the session, some forgot about the time and wanted to stay and play with the clock.

The second surprising finding was that, contrary to the initial hypothesis, time estimates made in the incentive condition were not shorter than those in the practice situation. For those subjects who took the practice session in the satiated condition there was no difference between the length of time estimates made in the practice and the incentive situations, while those subjects who took the practice session in the hungry condition made significantly shorter time estimates in the practice situation than in the incentive situation. However, this does not necessarily mean that the incentive conditions did not have a motivational effect. What may have occurred was that the greater motivation of the subjects in the incentive situation was reflected in the greater accuracy of the time estimates rather than in shorter duration as had been expected i.e.,time estimates made in the incentive condition were closer to the thirty second standard on the average in the incentive than in the practice situation. Subjects were perhaps less intent upon making accurate estimates in the practice situation wanting to complete it quickly to get on with the "for real part". Schectman (1968) also found that time estimates were more accurate when subjects anticipated a reward than when a control "filling" task was employed. In his study, however, the more accurate time estimates made in anticipation of a reward were shorter rather than longer, since the control "filling" task he used produced estimates larger than the standard.

The third unexpected finding was that, contrary to the last hypothesis, no correlation was found between time estimation and the ability to delay gratification. As shown by the post hoc analyses, the hunger and incentive conditions which affected time estimation did not affect the choice of immediate over delayed reward. It may be that time estimation is easily susceptible to the manipulation of visceral and external variables while the ability to delay gratification is not as easily controlled by these motivational variables and requires instead for a subject to have reached a certain degree of cognitive maturity - a stage in his thinking in which he is able to defer immediate gratification for greater reward later. The time estimation task is perhaps more reliant upon the internal bodily state since the subject never gets any information or feedback on which to base his estimates and therefore would use any internal cues available to him. While in the delay of reward task the subject has full knowledge of the possible outcomes and needs only to make a decision based on this information. It may be that although the deprivation and incentive levels used in this experiment were too weak to produce an effect on the choice of reward it might still be possible that longer periods of food deprivation and/or more valuable incentives would have produced an effect on the choice of reward. In fact, Mischel and Metzner (1962), have found that varying the prizes offered effects the choice of reward.

On the other hand, it may be that the lack of correlation between the two measures was due to the choice of reward being affected by uncontrolled variables which could not affect the time estimation task. The subjects' trust in the experimenter is an important factor in delay of gratification (Mischel and Metzner, 1962), while it has little bearing

on the time estimation task. An experimenter who had not given his subjects any feedback during the time estimation trials and had not told them that they had to take more turns in the second session before they could win a prize might not be trusted to return with the prizes one week later, while in the time estimation task the prize was already in full view of the subject.

With less suspicious subjects, the extraneous factor of politeness might have come into play. Explaining the reasons for their choice, three nonobese subjects in the satiated condition were frank enough to state that, although they would have liked twice as many prizes, they did not wish the experimenter to take the trouble to return one week later. Unfortunately, it is not known whether such consideration is more prevalent in the satiated condition and in nonobese subjects. Another confounding factor in the choice of reward task was that it is possible that some subjects might not have wanted two of the same prizes, since several subjects who chose to wait asked if they would be allowed to trade one of the prizes for something else. Furthermore, for some subjects with dental problems, the dilema of accepting large quantities of sweets arose, as the subjects who had not worried about the effects of one bag of candy as an occasional treat, were faced with the prospect of having their added winnings confiscated by their mothers.

Nevertheless, these extraneous variables should not invalidate the finding that obese subjects make more immediate reward choices than nonobese subjects, as there is no reason to assume that the effect of these variables should not be randomly distributed. However, the chances of these extraneous factors being randomly distributed among the subjects

in each combination of hunger and incentive conditions is much smaller, as there are fewer subjects at these levels. These extraneous factors might, thus, explain the lack of correlation between time estimation and the ability to delay gratification.

Another study should be done in order to clarify the relationship between time estimation and ability to delay gratification. The ability of obese and nonobese subjects to delay gratification should be examined by one experimenter as though it were a separate study, while time estimates both under incentive and non incentive conditions should be obtained from the same subjects by a different experimenter as though in an unrelated study in order to obviate the effects of distrust of the initial experimenter. Longer lists of prizes, ability to substitute in the case of two of the same prizes and delivery of prizes by mail one week later would be necessary improvements over the present methods. By limiting the interference of extraneous variables in this way it should be possible to determine whether or not time estimation and ability to delay gratification are positively correlated.

The remaining and major hypotheses in this experiment were confirmed and the results of the present study were consistent with Schachter's findings that the obese are less responsive to internal hunger stimuli than the nonobese and are, thus, more under the control of external cues. This was shown to be true not only when the dependent variable was the amount eaten as Schachter has found, but the impaired sensitivity to hunger cues in the obese also reflected itself in the length of time estimates made by the obese subjects. Furthermore, the internal hunger cues had no effect on behavior unrelated to eating in the

obese, whereas in the nonobese the hunger drive exerted some sort of disruptive arousal effect that produced shorter and less accurate time estimates.

As evidence exists that there is no mechanical impairment in the hunger detection apparatus of most of the obese and that the obese can learn greater sensitivity to hunger cues (Griggs and Stunkard, 1964), it would be theoretically interesting to see whether the hunger drive can exert a nonspecific arousal effect which would shorten time estimates in obese subjects who have learned greater responsivity to hunger cues. If obese subjects can be taught greater sensitivity to hunger cues and can be influenced by the hunger drive in the same manner as nonobese subjects, it would provide good evidence that a deficit in learning to recognize hunger cues is a possible cause of obesity.

Furthermore, teaching the obese greater sensitivity to internal hunger cues might have important implications for treatment. In Griggs and Stunkard's (1964) experiment, a subject was taught greater sensitivity to stomach contractions by using a payoff matrix which maximized rewards for correctly reporting the presence of contractions. However, a balloon had to be inserted into the stomach with a Levin tube and a complex recording mechanism was required. If it can be shown that this method results in the acquisition of greater internal control over eating behavior and consequent substantial and permanent weight loss, then steps should be taken to find a more convenient and economically feasible method. Perhaps a transistorized component which could measure stomach contractions or some other physiological correlate of hunger could be used in teaching awareness of hunger.

The results of this study also supported the hypothesis of a

general rather than a food related deficit in the learning of the obese to respond to internal cues (and to consequently fall under the control of the external stimulus situation) as there were no differences in the time estimates of the obese in the edible and inedible conditions while the nonobese made shorter time estimates in the edible condition than in the inedible condition. Bruch's (1969) theory can explain the development of such a general deficit. Inappropriate responses to a child's needs may result in the child being unable to recognize his internal state on the basis of internal cues and his becoming consequently dependent upon external control. The finding that only children have a greater likelihood of being overweight (Bruch, 1957; Atkinson and Ringuette, 1967) is noteworthy, as it is the overprotective mother who would be more likely to respond inappropriately to a baby's needs, imposing her control over the child rather than letting him learn to become aware of and dependent upon his own internal states. In this way, the obese probably have failed to establish internal control over eating and over other activities which are under greater internal control in the nonobese.

However, the problem of a deficit in internal control over behavior in the obese is probably not as straightforward as this discussion implies. Although the results of this study have been interpreted to mean that obese individuals show a general deficit, it is important to note that not all obese subjects chose immediate rewards. In another study, moreover, although obese subjects were shown to be more persuasible than those of normal weight, no correlation was found between persuasibility and a general measure of field dependence (Glass et al., 1969). Furthermore, there are individuals who are highly field dependent

and extremely deficient in internal control and yet are of normal weight. How can all this be reconciled? The explanation probably lies in the fact that individual learning histories differ; one mother may have responded appropriately to a child's hunger needs but not to his other needs, another mother may have responded inappropriately to all of a child's needs.

In planning treatment for the obese it would seem worthwhile, therefore, to determine whether lower sensitivity to internal cues is general or specific in the particular individual. Perhaps a simple task such as time estimation or delay of gratification may eventually prove useful in determining this; perhaps a complex battery of tests will be necessary. If the deficit is found to be general, steps should be taken in the treatment to teach and reinforce internal control in many behaviors besides eating. Some behaviors may prove easier to work with than eating behavior and perhaps internal control over eating will result through generalization or transfer of training. Patients in whom lower sensitivity to internal cues is specific to eating behavior would of course benefit more quickly from a behavior therapy program which would decrease the power of external food related stimuli and increase the power of internal stimuli in controlling eating.

What causes certain people to eat more than they require? How can they be helped to stop doing so? These two questions, which were originally posed at the outset of the study are by no means fully answered. However, it does seem highly probable that the obese eat more than they require because of a faulty learning history. The exact mechanism by which learning acts to make the obese less sensitive to internal hunger cues and more sensitive to external hunger cues than those of normal weight

is as yet unknown. It is still conceivable that it is some sort of faulty wiring in the obese, which has hitherto gone undetected, rather than faulty learning that is at the root of the problem. At this stage of speculation, however, the learning deficit hypothesis seems quite reasonable. Certainly, with regard to treatment the learning theory approach has been the most profitable to date.

## SUMMARY

This study attempted to determine whether recent findings on the lower responsivity of obese subjects to internal hunger cues could be reflected in dependent variables other than amount eaten and also to discover whether the hunger drive when irrelevant could have the same effect on obese and nonobese subjects. Another question investigated was whether the lower sensitivity to internal cues and the consequently greater influence of external cues is a general deficit or only a specific deficit related to hunger.

In order to answer these questions the effects of physiological hunger and satiation and of edible and inedible incentive conditions on time estimation and delay of gratification were studied in obese and normal boys. Hunger was found to have no effect on the time estimates of obese subjects, while normal subjects made significantly shorter time estimates both when the hunger state was made relevant and irrelevant by varying the incentive conditions. It was concluded that the obese cannot respond to internal cues in the same way as the nonobese. No significant difference was found between the time estimates of obese subjects in the edible and inedible incentive conditions. This was interpreted as support for the presence of a general deficit of internal

control in the obese. The prediction that there is a positive correlation between time estimation and ability to delay gratification was not substantiated. This was possibly due to the intervention of extraneous variables. Implications of the findings for the treatment of obesity were discussed.

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## APPENDIX A

## MEANINGS OF OBESITY IN THE PSYCHOANALYTIC LITERATURE

## (KAPLAN & KAPLAN, 1969)

a. Overeating may be:

a means of diminishing anxiety, insecurity, tension, worry, indecision.

a means of achieving pleasure, gratification, success.

a diversion from monotony and an empty life.

a means of achieving social success and acceptance.

a means of relieving frustration, deprivation and discouragement.

a means of expressing hostility, which hostility may be conscious, unconscious, denied, or repressed. Repressing the hostility produces anxiety and even more hostility.

a means of diminishing feelings of insecurity and inferiority.

a means of self-indulgence.

a means of rewarding oneself for some task accomplished.

a type of defiance, rebellion against authority and control, an attempt at independence.

a means of submitting, e.g., to parental authority.

a means of self-punishment and self-degradation oft-times in response to guilt.

a means of diminishing guilt, which guilt may itself be due to overeating.

a means of exhibitionism.

a means of attaining attention and care.

a means of justifying failure in life.

a means of counteracting a feeling of being unloved.

a means of distorting reality.

a means of identifying with a fat parent usually an obese mother.

a means of sedating oneself.

a means of avoiding competition in life.

a means of avoiding the change in the status quo.

a means of proving inferiority and justifying self-depreciation.

a means of avoiding maturity.

a means of diminishing fear of starvation particularly in poor people.

a means of consciously fulfilling the desire to become fat, for being fat may equal health, or being fat may please the parent.

a means of handing anxiety from infantile oral frustration.

b. Overeating may serve:

as a substitute for love, affection and friendliness (food = love).

as a substitute for showing love and affection.

as a substitute for pregnancy.

as a substitute for a heterosexual existence, i.e., protection against men and marriage.

c. Obesity may mean:

1. Obesity achieves the closing of the gap between

achievement and reality, i.e. very often obese people are failures who have no success except at eating and gaining weight. A big body to them means strength, a type of greatness and bigness achieved by becoming more special and stronger than others. They have a megalomanic image of themselves. Loss of weight will disturb this patient because loss of weight means a loss of special power (11).

2. Obesity results in feelings of inferiority, inadequacy and shame. These feelings and the obesity associated with them then can be used to justify all the failures in interpersonal relationships which the obese patient has. They may be used as a rationalization to avoid any further contact with people and threatning situations.

d. Overeating or food may be symbolically:

representative of pre-Oedipal mother conflict.

a type of an alimentary orgasm.

expression of an unsatisfied sexual craving.

expression of destructive sadistic impulses.

expression of penis envy and a wish to deprive the male of his penis, i.e. an unconscious association between food and phallus.

expression of a fantasy where overeating results in impregnation.

expression of pregnancy whereby abdominal fat = pregnant figure.

pathologically strong oral libido being gratified in an

unsublimated way.

a means of possessing a "part-object" like a penis or breast.

a seed or impregnating agent.

devouring an ambivalently loved object.

a defense against threatening unconscious feminine or masculine wishes.

an expression of exhibitionistic impulses.

the mother, with eating being an attempt to orally incorporate the mother.

a desire to feed at the breast.

an attempt to modify an underlying depression.

an indication of an early disturbed mother-child relationship.

## APPENDIX B

## SOCIO-ECONOMIC RATINGS

Occupation:

(1) Professional (executives, owners of large businesses, doctors, lawyers, professors, bankers, etc.)

(2) Managerial (supervisors, managers, sales agents, salesmen, teachers, reporters, owners of small businesses, etc.)

(3) Skilled workers (industrial workers, craftsmen, tailors, mechanics, etc.)

(4) Unskilled workers (assembly line, labourers, drivers, janitors, etc.)

Family Income:

(1) $20,000 and above per year

(2) $12,000 - $20,000

(3) $6,000 - $12,000

(4) $6,000 and under yearly

## APPENDIX C

NAME_____ AGE_____ GRADE_____

### PRIZE QUESTIONNAIRE

This is a list of the prizes. I would like you to let me know how much you like each of these prizes so that you can get a chance to win something that you really like. You actually can win as many as two of these prizes so tell me how you really feel. This is not a test, there are no right or wrong answers.

Let us say for example that the prize is a COLOURING BOOK.
If you don't want to win a COLOURING BOOK, circle "No" like this
COLOURING BOOK No Don't care Yes Very much Very very much
If you don't care especially to win a COLOURING BOOK circle "Don't care" like this
COLOURING BOOK No Don't care Yes Very much Very very much
If you would like to win a COLOURING BOOK very much circle "very much" like this
COLOURING BOOK No Don't care Yes Very much Very very much
If you would like to win a COLOURING BOOK very very much circle "very very much" like this
COLOURING BOOK No Don't care Yes Very much Very very much

| | | | | | |
|---|---|---|---|---|---|
| 1. HOCKEY PUCK | No | Don't care | Yes | Very much | Very very much |
| 2. OH HENRY BARS | No | Don't care | Yes | Very much | Very very much |
| 3. FRITOS CORN CHIPS | No | Don't care | Yes | Very much | Very very much |
| 4. SCOTCH TAPE | No | Don't care | Yes | Very much | Very very much |
| 5. FELT PEN | No | Don't care | Yes | Very much | Very very much |
| 6. LIFE SAVERS (5 flavours) | No | Don't care | Yes | Very much | Very very much |
| 7. BAG OF MARBLES | No | Don't care | Yes | Very much | Very very much |
| 8. PACKAGE OF CHICKLETS | No | Don't care | Yes | Very much | Very very much |
| 9. AERO CHOCOLATE BARS | No | Don't care | Yes | Very much | Very very much |
| 10. MARVEL COMIC BOOK | No | Don't care | Yes | Very much | Very very much |
| 11. LOWNEYS GLOSETTE PEANUTS | No | Don't care | Yes | Very much | Very very much |
| 12. SLING SHOT | No | Don't care | Yes | Very much | Very very much |
| 13. RULER | No | Don't care | Yes | Very much | Very very much |
| 14. LICORICE TWISTERS | No | Don't care | Yes | Very much | Very very much |
| 15. APOLLO 11 MEDAL | No | Don't care | Yes | Very much | Very very much |
| 16. PING PONG BALL | No | Don't care | Yes | Very much | Very very much |
| 17. BAG OF POTATO CHIPS | No | Don't care | Yes | Very much | Very very much |
| 18. TURTLES CHOCOLATE BAR | No | Don't care | Yes | Very much | Very very much |
| 19. PACKAGE OF SMARTIES | No | Don't care | Yes | Very much | Very very much |

| | | | | | |
|---|---|---|---|---|---|
| 20. PACKAGE OF ERASERS | No | Don't care | Yes | Very much | Very very much |
| 21. STAMPS FROM MANY COUNTRIES | No | Don't care | Yes | Very much | Very very much |
| 22. MARS CANDY BAR | No | Don't care | Yes | Very much | Very very much |
| 23. COLOURED PENCILS | No | Don't care | Yes | Very much | Very very much |
| 24. BAG OF PLANTERS PEANUTS | No | Don't care | Yes | Very much | Very very much |
| 25. BAG OF JELLY BEANS | No | Don't care | Yes | Very much | Very very much |
| 26. CADBURY DAIRY MILK CHOCOLATES | No | Don't care | Yes | Very much | Very very much |
| 27. NOTEBOOK | No | Don't care | Yes | Very much | Very very much |
| 28. FANCY PENCIL SHARPENER | No | Don't care | Yes | Very much | Very very much |
| 29. WRIGLEY'S JUICY FRUIT | No | Don't care | Yes | Very much | Very very much |
| 30. NUMBER "15" PUZZLE | No | Don't care | Yes | Very much | Very very much |
| 31. KEY CHAIN | No | Don't care | Yes | Very much | Very very much |
| 32. MAY WEST | No | Don't care | Yes | Very much | Very very much |
| 33. KRAFT CARAMELS | No | Don't care | Yes | Very much | Very very much |
| 34. MINIATURE STAMP ALBUM | No | Don't care | Yes | Very much | Very very much |
| 35. TOOTSIE ROOLS | No | Don't care | Yes | Very much | Very very much |
| 36. RUBBER BALL | No | Don't care | Yes | Very much | Very very much |

| | | | | | | |
|---|---|---|---|---|---|---|
| 37. | BAG OF POPCORN | No | Don't care | Yes | Very much | Very very much |
| 38. | PACKAGE OF SPARKLERS | No | Don't care | Yes | Very much | Very very much |
| 39. | HOCKEY STICK TAPE | No | Don't care | Yes | Very much | Very very much |
| 40. | HERSHEY BAR | No | Don't care | Yes | Very much | Very very much |
| 41. | MACKINTOSH TOFFEE BAR | No | Don't care | Yes | Very much | Very very much |
| 42. | SCREW DRIVER | No | Don't care | Yes | Very much | Very very much |
| 43. | PAINT BOX | No | Don't care | Yes | Very much | Very very much |
| 44. | BOTTLE OF PAPER GLUE | No | Don't care | Yes | Very much | Very very much |
| 45. | CRISPY CRUNCH BAR | No | Don't care | Yes | Very much | Very very much |
| 46. | ADDRESS BOOK | No | Don't care | Yes | Very much | Very very much |
| 47. | PACKAGE OF JUJUBES | No | Don't care | Yes | Very much | Very very much |
| 48. | CHOCOLATE PEPPERMINT ROLLS | No | Don't care | Yes | Very much | Very very much |
| 49. | WATER PISTOL | No | Don't care | Yes | Very much | Very very much |
| 50. | CANDY CIGARETTES | No | Don't care | Yes | Very much | Very very much |

1. Now you have won this_____. I am going to give you a choice of taking this one_____now or getting two of them if you wait until one week from now.

   You have also won this_____. I am going to give you a choice of taking this one_____now or getting two of them if you wait until one week from now.

Name_____

Choice a.

b.

Group