A REANALYSIS OF SCHACHTER'S EXTERNALITY THEORY: THE RELATIONSHIP BETWEEN EXTERNALITY AND OBESITY

by

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A DISSERTATION SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

DEPARTMENT OF PSYCHOLOGY
UNIVERSITY OF MANITOBA
WINNIPEG, MANITOBA

1980

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A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

ACKNOWLEDGEMENTS

The author wishes to express her sincere appreciation to Dr. Raymond P. Perry for his expert guidance and support throughout all phases of this dissertation research. Thanks are also extended to the committee members, Dr. Rod Clifton, Dr. Michael LeBow and Dr. John McIntyre, for their helpful comments on this manuscript. The author also thanks Dr. Patricia Pliner, the external examiner, for her promptness in supplying stimulating comments on the theoretical bases of this research.

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ABSTRACT

One of the most influential research topics in the social psychology of obesity is Schachter's externality theory of obesity. According to this theory, obese individuals are more responsive to external cues, both food and nonfood, than are their nonobese counterparts. Recent research has been accumulating, however, which indicates that some obese are not externally responsive while some nonobese individuals are responsive. The present research attempted to include these previous anomalies in an extension of Schachter's theory. In the resultant Weight x Externality paradigm each factor is treated as orthogonal and dichotomous. Thus, the paradigm incorporates "Schachter's groups" (High External-Obese and Low External-Nonobese) as well as the less common groups (High External-Nonobese and Low External-Obese).

A research program was developed to investigate the viability of this paradigm. In order to separate the previously confounded factors of weight and externality, each was operationally defined on separate measures. Degree of externality was determined on three nonfood tasks: time perception, emotionality ratings, and immediate recall. A median split of the summed scores was used to identify High and Low External subjects. Obesity was defined as 15%

or more overweight and nonobesity as 10% or less overweight. After prescreening on these measures, 160 introductory psychology students were selected for further experiments with 40 subjects assigned to each of the four subject groupings: Low External-Nonobese, High External-Nonobese, Low External-Obese and High External-Obese.

A replication of Ross (1974) was undertaken as the first phase of research. Ross reported that, compared to nonobese subjects, the eating behavior of obese subjects was greatly affected by cue and cognitive salience manipulations. Based on the Weight x Externality paradigm, the present replication predicted identical results for Schachter's groups, but divergent eating patterns for the two less studied groups. The design included two subject variables (weight and externality) and two nonrepeated salience factors (illumination and cognition), with the dependent measure being grams of food eaten. Cue salience was manipulated by varying illumination to make the food either obvious or less salient. Cognitive salience was either high (instructing subjects to think about the target food) or low (instructing subjects to think about a nonfood item).

Analyses of the data indicated a successful replication of Ross' experiment in that High External-Obese subjects increased consumption under increasing levels of illumination and cognitive salience. The eating behavior of Low External-Nonobese subjects was not affected by any salience manipulations. The results for the remaining two groups

were mixed. Consumption rates for the High External-Nonobese group increased under conditions of increased cognitive salience, but were not affected by the illumination manipulation. Consumption by the Low External-Obese approximated High External-Nonobese eating patterns. These results were interpreted as indicating some support for the Weight x Externality paradigm.

In order to identify other factors which may interact with weight and externality, the same 160 subjects also completed two tasks which measure another concomitant of obesity, the response inhibition deficit (RID). The card color guessing task, which measures cognitive RID, failed to show any differences among the four subject groupings. Results from the other task, mirror tracing, indicated that compared to the nonobese, both obese groups were less able to inhibit normal hand-eye coordination. This finding was interpreted as an indication that the RID may play a role in mediating the relationship between weight and externality.

The final discussion integrated the data on food intake and RID, along with questionnaire information, within the Weight x Externality paradigm. Lastly, speculations regarding the use of this paradigm for obesity research and treatment programs were explored.

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CHAPTER ONE

Introduction

The present research program investigated the relationship between obesity and externality. According to Schachter's (1968) externality theory of obesity, externality is directly related to obesity in that obese people are more responsive to external cues than are non-obese people. Initial support for externality theory was collected over a wide range of behaviors including: food intake, emotionality, distraction, time estimation, verbal learning, and pain perception. More recent research however, has been accumulating evidence which indicates that not all obese people are externally responsive, and that some nonobese people are as externally responsive as their obese counterparts. It therefore appears that externality theory cannot adequately account for obese-non-obese differences.

This introductory chapter consists of two sections. First, the history of externality theory is reviewed, including both supportive and contradictory evidence. The second section introduces a new research paradigm which extends externality theory to include previously contradictory findings. This paradigm was the basis for a series

of experiments to be presented in the following chapters.

Review of Externality Research

Schachter's (1968) report of external responsiveness in the obese was a direct extension of his research on the cognitive and physiological determinants of emotional state (e.g. Schachter, 1964). His previous experiments involved manipulating bodily state by injections of adrenaline or placebo and at the same time manipulating cognitive and situational variables. These experiments demonstrated that cognitive factors play a major role in determining how a subject interprets body states. For example, the classic study by Schachter and Singer (1962) reported that the same set of physiological symptoms (an adrenaline-induced state of sympathetic arousal) could be interpreted as euphoria or anger, depending upon the cognitive and situational cues. This line of research led Schachter to the conclusion that there is not a one-to-one relationship between physiological symptoms and the psychological label given to the symptoms. The resultant two-factor theory emphasized the importance of both physiological cues and cognitive factors.

While these studies had employed exogenous injections to manipulate physiological states, Schachter proposed that cognitive and situational cues could also play a major role in determining how a person interprets naturally occurring endogenous physiological states. For example, is there a one-to-one relationship between stomach contractions and a subject's self-report of hunger?

Schachter found support for the two-factor theory in research by Stunkard and Koch (1964) on obesity and gastric motility. In this study, subjects swallowed a gastric balloon through which stomach contractions were recorded. Subjects were asked every 15 minutes whether or not they felt hungry. Thus, the relationship between gastric motility and self-reports of hunger could be determined. The results indicated that for subjects of normal weight the two factors coincided closely, such that when the stomach contracted they were likely to report feeling hungry. For obese subjects, on the other hand, there was much less correspondence between stomach contractions and self-reports of hunger.

This indication that there are major individual differences in attention to internal cues was investigated further by Schachter, Goldman and Gordon (1968) in an experiment disguised as a study of taste. Physiological state was manipulated by two methods: pre-load and fear. The pre-load manipulation consisted of feeding roast beef sandwiches to subjects who had fasted for six hours (Full condition) or feeding them nothing (Empty condition). The fear manipulation consisted of telling subjects they would receive a painful shock (High Fear condition) or telling them they would receive a "slight tingle" electrical stimulation (Low Fear condition). The rationale for the fear manipulation was that there is evidence by Carlson (1916) and Cannon (1929) that fear inhibits gastric motility.

Thus, if the obese are insensitive to gastric motility then neither pre-load nor fear manipulations should affect their eating behavior. They should eat just as much when their stomachs are full as when their stomachs are empty, and just as much when they are frightened as when they are calm. Normal weight subjects, on the other hand, should be directly affected by the manipulations, such that they should eat less with full stomachs than when empty and should eat more when they are calm than when frightened. The dependent measure of eating was the number of crackers eaten during a "taste-test" which required subjects to rate crackers on a number of taste dimensions (salty, cheesy, garlicky, etc).

The results provided support for the predictions. For subjects of normal weight, those in the Low Fear Empty condition ate twice as much as those in the High Fear Full condition, and the remaining two conditions resulted in intermediate amounts being eaten. Thus, the eating behavior of the normal weight subjects was affected by both manipulations of internal state. The eating behavior of the obese was a marked contrast in that virtually the same amount was eaten regardless of condition. They ate as much, in fact slightly more, when their stomachs were full as when empty, and ate slightly more when fearful than when calm. It appeared therefore that the actual physiological state of the stomach has nothing to do with how much the obese eat.

Since the obese appeared to be insensitive to internal cues, the role of external food cues as determinants of their

eating was investigated. Nisbett (1968a) reasoned that if the sight of food is a potent cue, then the obese should eat only as long as food is in sight. When the available cues are gone (i.e., consumed), the obese should make no further attempt to eat. For subjects of normal weight, who presumably are more aware of internal state, the amounts eaten should depend on physiological needs, not on quantity of food in sight. Thus, this line of reasoning predicts that when normal subjects are hungry they will search for more food and perhaps eat more than obese subjects who eat only in the presence of external cues.

These predictions were tested by providing subjects, who had not eaten lunch, with either one or three roast beef sandwiches on the table in front of them. Subjects in both conditions were told that there were dozens more sandwiches in the refrigerator and were invited to help themselves. As predicted, the obese subjects ate significantly more than normals when presented with three sandwiches but ate significantly less than normals when presented with only one sandwich even though there were more sandwiches in the refrigerator. Thus, it appeared that the actual sight of food, rather than internal state, triggers the eating of obese individuals.

Nisbett (1968b) investigated another external cue, food palatability, for its effect on eating behavior of obese and normal weight subjects. If the obese are more responsive to external cues, then obese subjects should eat

more good-tasting food, but they should eat less when the food tastes bad. To test these expectations, Nisbett examined the effects of ice cream palatability on amounts eaten by subjects who varied in weight. Palatability was manipulated by providing the subject with either an expensive French vanilla ice cream (Good Ice Cream condition), or a cheap vanilla ice cream which had been mixed with 2.5 grams of quinine sulphate per quart (Bad Ice Cream condition). The results indicated a significant relationship between amount of good ice cream eaten and weight in that the heavier subjects ate more. The predicted "finickiness effect", that obese subjects would eat less bad ice cream, was not supported. This may have been due to the fact that the bad ice cream was too awful even for normals. A replication by Decke (1971) which employed a lesser amount of quinine adulteration did produce the finickiness effect for obese subjects. Thus, it again appeared that external cues would determine the eating and noneating behavior of obese humans.

A further investigation by Schachter and Gross (1968) examined the effect of time of day as an eating cue for the obese. It was reasoned that this external cue, though further removed from actual eating than pre-load or palatability, would also trigger eating for the obese but not for normal weight subjects. Time of day was manipulated by rigging a clock to run either fast or slow. If the obese rely on time as a cue for eating, their eating behavior should be greater for the fast condition which

indicated that it was "supper time" than for the slow condition. Normal weight subjects, on the other hand, would be expected to eat the same regardless of the time. The dependent measure of eating was grams of crackers eaten while filling out questionnaires. The results provided strong support for the hypotheses about obese eating behavior. Obese subjects who saw the fast clock ate almost twice as much as obese subjects who saw the slow clock. For normal subjects the effect of time manipulation was reversed, as they ate more in the slow than in the fast condition. This unexpected reversal for the normals appeared to be due to the fact that normal weight subjects reported not wanting to spoil their appetite for supper by munching on crackers. Thus, cognitive factors such as time may affect normal weight subjects, but in the opposite direction. Whereas the belief that it was suppertime inhibited eating behavior for normal weight subjects, it triggered increased eating for obese subjects.

Based on these initial experiments, the original externality hypothesis held that external food-related cues were more likely to trigger an eating response in an obese than in a normal subject. This implied that under any circumstances where a food cue is present, regardless of how remote or obscure, the obese would be more likely to eat.

Further research indicated that the hypothesis needed to be modified. For example, a survey by Schachter (1971) found that obese subjects reported eating somewhat less

frequently than did normal subjects. Given the abundance of food cues, the externality hypothesis would have predicted the opposite. Similarly, it could be predicted that obese would report more difficulty when fasting in synagogue for Yom Kippur, but Goldman, Jaffa and Schachter (1968) found just the opposite. It became apparent that for a food cue to trigger eating in the obese, the cue had to be potent or salient--literally food under the subject's nose. Thus, in an environment which is devoid of salient food cues, such as the synagogue, obese fasters would be expected to report less difficulty. But just the reverse sould be true for obese who fast outside of synagogue. In fact, Goldman et al. found trends consistent with this reinterpretation. Thus the externality hypothesis was modified because the obese's heightened responsiveness to external stimuli appeared to be confined to situations where the food cues are immediate and salient.

A typical experiment based on the modified version of externality theory was conducted by Ross (1974). Stimulus salience was manipulated in two ways: first, by varying the degree of food visibility; second, by manipulating the extent to which the subjects' attention was focused on the food cue. When the subject's attention was focused on a highly visible food cue, the obese ate almost twice as much as the normal weight subjects. When the subject's attention was diverted from an inconspicuous food cue, obese subjects ate half as much as normal weight subjects. Therefore,

obese subjects seem to be particularly sensitive to highly salient food cues. Johnson (1974) examined the impact of food-cue salience on the subject's willingness to work for food. Manipulating salience through food visibility and prior taste, Johnson found that the obese worked harder to obtain food when the cues were prominent than when they were remote. In contrast, the behavior of normal weight subjects was unaffected by cue salience.

Schachter's (1971) externality hypothesis states that: above a given salience level, the obese are more responsive to external cues than are nonobese people. The theoretical relationship between stimulus salience and subject responsiveness is diagrammed in Figure 1. At low levels of stimulus salience the obese are less responsive than nonobese, but at high stimulus salience the obese are more responsive. Stimulus salience refers to those stimulus properties which compel or attract a subject's attention. Thus, salience can refer to the physical properties, such as visibility or loudness, or to other properties such as novelty or unpredictability. Schachter admits that the specific shapes of the curves are speculative but the interaction effect is an absolute requirement for the theory.

Externality in Noneating Situations

The impact of salient food cues on the obese is only one aspect of what has been demonstrated to be a more encompassing phenomenon. The obese have also been found to

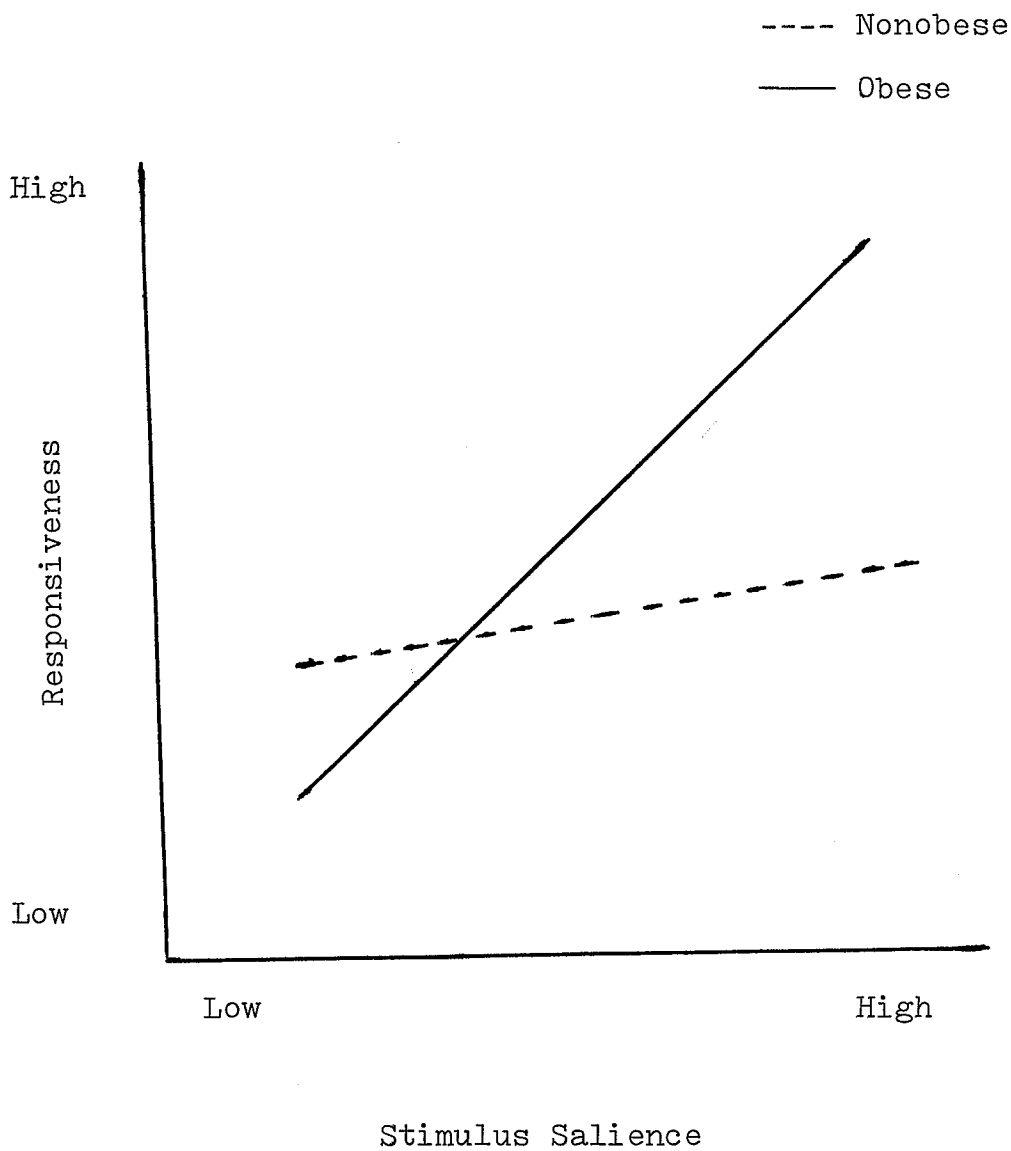

Figure 1. Theoretical relationship between stimulus salience and responsiveness.

be more responsive to salient or prominent stimuli in non-eating situations. For example, Rodin (1970) reasoned that if the externality hypothesis is correct, then distracting and irrelevant stimuli should be more disruptive for obese than for normal subjects when they are performing a task requiring concentration. This prediction was tested using taped distractions which varied in degree from no distraction to low distraction (random numbers recited) to high distraction (description of one's own death from leukemia). Subjects worked on two tasks, proof-reading and complex reaction time, while listening to one of the distractors. As predicted, the obese performed better when not distracted but their performance at both tasks decreased when distracted, especially at levels of high distraction. Thus, external cues had a greater impact on obese subjects for these non-food tasks.

Further studies examined other noneating situations. Rodin, Herman and Schachter (1974) reported that compared to nonobese, obese subjects performed better on complex reaction time, tachistoscopic and immediate recall tasks, when no distraction was present. Using an incidental learning paradigm, Rodin and Slochower (1976) replicated the distraction interaction reported by Rodin (1970). The obese's external responsiveness has been extended still further to time-estimation judgements, pain perception (Pliner, 1974), alcoholism (Brown & Williams, 1975) and has been adapted for the study of cigarette smoking behavior (Herman, 1974).

Schachter's research program has generated and integrated a plethora of data indicating difference between obese and normal weight subjects. Schachter and Rodin (1974) summarized the findings as follows:

1. The obese eat more good tasting food than do normals.
2. The obese eat less bad tasting food than do normals ("finickiness effect").
3. The obese eat on the average slightly, but not hugely more than normals do.
4. The obese eat fewer meals per day.
5. The obese eat more per meal than do normals.
6. The obese eat more rapidly.
7. The obese are less active than their normal counterparts.
8. The obese are more emotional than are normals.
9. The obese do better at active avoidance.
10. The obese do not regulate intake in accordance with the caloric density of a solid preload or diet. Normals do regulate.
11. Both the obese and normals do regulate intake in accordance with the caloric density of liquid preload or diet.
12. When obtaining food requires no particular effort, the obese eat more than normals do.
13. When it requires work to get at food and the food cue is remote, the obese eat less than normals do. (p. 39)

Contradictory Findings

The obese-nonobese division appeared to be clear-cut in that the obese displayed greater responsiveness to both food and nonfood salient cues. But not all of the data were consistent with externality theory. For example, Nisbett's (1968b) experiment on the effects of taste demonstrated the appropriate finding that, compared to nonobese subjects, the obese eat more good tasting ice cream. However, the data did not show the corollary "finickiness effect",

that obese should eat less bad tasting ice cream. An internal analysis using information on the subjects' weight histories uncovered the finickiness effect, but only for normal weight subjects who had once been obese. Thus currently normal weight subjects were found to behave more in the direction predicted for the obese than the obese themselves did.

Weight histories were also analyzed for subjects in Schachter and Friedman's (1974) study of the effects of work (shelling almonds) on eating behavior. The general finding, that the eating behavior of the obese was reduced by work while the normal's eating behavior was not, was in accord with the typical normal-obese differences. An analysis of currently normal subjects who had once been obese however, showed that all of these normal subjects behaved precisely as did the currently obese subjects. That is, currently normal subjects displayed the typically obese unwillingness to work for food.

In addition to normals behaving like the obese, some obese subjects have been identified as behaving more like their normal weight counter-parts. Nisbett's "super-obese" (40% or more overweight) subjects were found to behave like normal weight subjects in that they did not display finickiness toward good and bad ice cream. Similarly, Decke, Gold and Porikos (cited by Schachter & Rodin, 1974) compared immediate recall scores for normal weight, obese, and super-obese subjects. The performance of the super-

obese was not significantly different from that of the normals but both were significantly less accurate than the obese. Thus once again, while the division between obese and normal weight subjects with regards to externality seemed to exist, it was not as clear-cut as first evidenced.

More recent evidence has been accumulating which indicates that externally responsive individuals can be identified in both normal and overweight populations. Using the measures of external responsiveness which in previous studies had demonstrated the clearest differences between obese and normals, Rodin and Slochower (1976) identified externally responsive individuals in a group of normal weight summer campers. Moreover, although the scores on external responsiveness accurately predicted which campers would experience weight changes over the summer, the direction of weight change was not always the predicted increase. That is, some externally responsive individuals lost weight, which suggests that other factors, such as changes in food environment, interact with externality. Finally, Rodin, Slochower and Fleming (1977) reported finding overweight individuals who were relatively nonresponsive on the usual measures of externality. In sum, not all obese individuals are externally responsive and not all normal weight individuals are externally nonresponsive.

The contradictory evidence cited above was reported by Schachter's coworkers. Further contradictory evidence has been reported by other researchers as well. Obviously,

studies which fail to bear out differences predicted from the externality hypothesis (e.g., Milich, Anderson & Mills, 1976; Singh & Sikes, 1974) could be interpreted as demonstrating its defects. However, it would be more instructive to examine studies which indicate more specifically the areas of overlap between obese and normal weight subjects. That is, can other variables be identified which interact or covary with externality?

One such study by Herman and Polivy (1975) predicted that normal weight subjects who chronically exercised restraint with respect to eating would behave more like the obese than like their normal weight but unrestrained counterparts. This prediction was upheld in an extension of the Schachter, Goldman and Gordon (1968) study on anxiety and eating behavior. Not only did the anxious restrained normals exhibit the typical obese eating response of slightly greater intake, but they also displayed the typically obese hyperreactivity to high-anxiety manipulations. Herman and Polivy interpreted these findings as indicative of a break-down of the restrained individual's self-control behaviors, in that anxiety disinhibited their deprivation-motivated eating behavior. Disinhibition of the restrained individual's eating behavior has also been achieved by preload (Herman & Mack, 1975), depression (Polivy & Herman, 1976a) and alcohol (Polivy & Herman, 1976c).

Herman's research is an extension of a biological responsiveness, suggested by Nisbett (1972). Nisbett's

"set point" theory is based on the finding that an increased number of fat cells appears to "pre-program" some individuals to be obese. Nisbett argues that when such an individual attempts to reduce food intake, the body responds in the same manner as for a normal weight person who is starving. His review of the relevant literature indicates striking similarities between behavior patterns of dieting obese and starving organisms in that both appear to be more taste responsive, less responsive to postingestional feeding cues, more emotional, less active, and hyposexual. For example, the finickiness effect reported for obese subjects can be paralleled by the findings of Jacobs and Sharma (1969) that deprived dogs were not only relatively more accepting of good food but also rejected more bad food. These similarities suggest that chronic dieters are below set point and are, in fact, literally starving. External responsiveness is thus the result of attempts to limit food intake.

Set point theory also predicts that obese individuals who are not dieting are therefore at set point and so will <u>not</u> display the externality behaviors typical to dieting obese (and starving) organisms. If one assumes that the super-obese do not diet, it then follows that they should not behave like the obese. This is exactly what was found for the superobese in the Nisbett (1968b) study. Similarly, the studies by Herman and his colleagues discussed above can also be interpreted as supporting set point theory in that the restrained normal weight person is below set point

and therefore should behave like the obese (and starving) individual. In Nisbett's formulation then, the differences in responsiveness for normal and overweight subjects are mediated by distance from set point.

The final interacting factor to be discussed here is Singh's (1973b) response inhibition deficit (RID) theory. Singh views demonstrations of the obese's externality as part of a broader characteristic--a generalized deficit in inhibiting any ongoing response. The major postulates of Singh's RID hypothesis can be briefly summarized as: 1) In all situations where an ongoing response is to be terminated, the obese continue to respond longer than normals; 2) Because of this response inhibition deficit the obese show an exaggerated response whenever stimuli are at threshold level; and 3) Response tendencies are arranged in a hierarchy such that when more than one response is activated, the stronger response will dominate. From these postulates Singh can deduce most of the externality findings (e.g., finickiness or willingness to work for food), and in addition, can explain some findings not predicted by externality theory (e.g., passive avoidance). Singh's theory is discussed in detail later as it was the basis for Experiment 2.

Summary of Externality Evidence

To summarize, Schachter's original proposition that there are clear-cut differences in external responsiveness for normal and over-weight subjects has not been un-

equivocally supported. Even the initial findings that the obese are insensitive to gastric contractions (Stunkard, 1959; 1964), upon which Schachter based this theory, has been tempered by more recent evidence that normals also have far from perfect intake regulation (Stunkard & Fox, 1971; Wooley, Wooley & Dunham, 1972). Closer examination of differences within each weight group has indicated no one-to-one correspondence between weight and externality. This divergence is paralleled by psychiatric research which has identified "thin fat people" (Bruch, 1973) and "latent obese" (Meyer & Pudel, 1977).

A number of factors have been identified which appear to affect externality and weight, including restraint, distance from set point, and RID. A host of additional factors have also been related to obesity, such as: age of onset (Grinker & Hirsch, 1972), sex, religion-ethnicity (Burnight & Marden, 1973), social class (Stunkard, 1975), maternal weight gain during pregnancy (Weil, 1975), and body type (Mayer, 1975). One approach to the study of the obesity-externality relationship would require a priori blocking on these factors. Given the number of factors however, and the possibility that still more unidentified factors are involved, a different research strategy could be employed. By treating weight and external responsiveness as two separate factors, the previously confounded areas of overlap could be investigated. This approach is the focus of the present research program and is discussed in detail in the following section.

Weight x Externality Research Paradigm

In Schachter's research paradigm obesity was assumed to be directly related to externality. High externality was predicted for over-weight individuals and low externality was predicted for those of normal weight. Subsequently, those subjects who did not fit the paradigm were, by some post hoc analysis of weight history or superobesity, discounted as unsuitable subjects for testing externality. As more and more of these subjects are being identified it appears that a more inclusive paradigm can be generated which treats externality and obesity as two separate dimensions, with each dimension having two levels.

This Weight x Externality paradigm is presented in Figure 2. "Schachter's groups" are represented by the High External-Obese cell and the Low-External-Nonobese cell. That is, if weight were a direct function of externality, all subjects would belong to one of these two groups such that all obese individuals would be high on external responsiveness and all nonobese would be low. As demonstrated in the above review of externality research however, such is not the case. The other two cells of the present paradigm account for the previous anomalies. The Low External-Obese cell would include the super-obese subjects. As demonstrated in studies of eating behavior (Nisbett, 1968b) and immediate recall (Decke et al., 1974) the super-obese do not display external responsiveness so their classification would be in the Low External-

WEIGHT

EXTERNALITY	Obese	Nonobese
Low	Superobese	Schachter's Group
High	Schachter's Group	Restrainers

Figure 2. The Weight x Externality paradigm

Obese cell. The High External-Nonobese cell would represent those subjects who are of normal weight and yet display external responsiveness, including restrainers and those who used to be obese.

The Weight x Externality paradigm thus includes Schachter's original groups, as well as the other two groups which have been more recently identified. Use of this paradigm requires two basic steps. First, the present conceptualization must be verified by replicating results for Schachter's groups. That is, if the foregoing analysis of externality research is valid, then a replication of one of Schachter's experiments should evidence the same pattern of results for the High External-Obese and Low External-Obese groups. Experiment 1 constituted this replication procedure.

The second step in the present research program was to examine how the Weight x Externality paradigm can be used to identify other factors which may mediate the relationship between obesity and external responsiveness. That is, what other factors are involved which contribute to some high external individuals remaining nonobese while their counterparts become obese?

One such possible mediating factor is cognitive control. As previously noted, Herman and his colleagues have identified a number of factors which appear to disinhibit eating restraint in normal weight females, including fear, alcohol, depression and preload. An element common

to these various factors appears to be cognitive control. In fact, the disinhibiting effects of alcohol were found only when the "alcohol" label was supplied for subjects. An earlier study (Polivy and Herman, 1976b) which had not supplied subjects with the label, failed to produce disinhibition. These findings suggest that cognitive control may be critical in order for restrainers to maintain normal weight. Unfortunately, the research by Herman and his colleagues has been concerned with differences within a group of normal weight restrainers, therefore the role of cognitive control among the obese population is yet to be determined.

Within the proposed paradigm, restraining subjects are assumed to belong to the High External-Nonobese cell. That is, they are normal weight individuals who appear to be externally responsive, as evidenced by the Herman and Polivy (1975) finding that they exhibit typically obese behavior patterns when anxious. Thus, it could be hypothesized that one of the differences between externally responsive obese and nonobese subjects is amount of cognitive control. This possibility was tested in Experiment 1.

A noncognitive factor was also explored to determine its role in the behavior of the various groups of subjects. Specifically, Singh's theory that response habits produce typically obese behavior patterns was examined. In developing his theory, Singh has been able to explain Schachter's externality findings in terms of a more encompassing phenomenon,

the obese's response inhibition deficit (RID). Unlike the recent evidence in externality research however, RID research to date has not reported anomalies regarding obese-nonobese differences. Therefore, it may be the case that externality and RID are not the same phenomenon. The interrelationships among weight, externality and RID were investigated in Experiment 2.

Lastly, in order to identify other possible characteristics of the four subject groupings, questionnaire data were collected. Herman and Polivy's (1975) Restraint Scale was used to assess the role of weight history and concern with food.

To summarize this chapter, a review of relevant research suggested that a reanalysis of Schachter's externality hypothesis is necessary. An alternative paradigm was proposed which treats degree of externality and obesity as two separate factors. This paradigm suggested a series of experiments for both replication and extension of obesity research. The following chapters deal with each of these experiments in detail.

CHAPTER TWO

The Effects of Cognitive Salience and Cue Salience on Consumption

The first step in the present research program was to replicate a study which supported Schachter's externality theory of obesity. The Weight x Externality paradigm maintains that Schachter's typical obese-normal differences in eating behavior would be replicated only in "Schachter's groups" (High External-Obese and Low External-Nonobese) while the other two groups might display different results. These predictions were tested in a replication of Ross' study of cue and cognitive controls of eating behavior.

The choice of this particular study was determined by a number of considerations. First, Ross' study included eating behavior as the dependent measure. Since subjects were assigned to externality groups through the use of non-food measures, it would be advisable to test for generality of external responsiveness on the critical behavior of eating. Also, the Ross study is a "classic" in Schachter's research group as it was one of the first studies to indicate the importance of cue salience. Finally, it included a manipulation for cognitive salience which would enable the present study to test for the hypothesized cognitive control differences between High External-Obese and Nonobese.

In Ross' experiment food salience was manipulated by varying sheer physical cue prominence (high or low illumination of food cues) and by varying instructions of what to think about (food, non-food, or whatever they wished). The results indicated that although the effect of cue salience on eating behavior was negligible for normal weight subjects, obese subjects ate twice as much under high cue salience compared to low cue salience. The cognition manipulation was likewise effective only for obese subjects such that they ate significantly more when instructed to think about the food than when instructed to think about whatever they wished. Contrary to expectations, instructions to think about a nonfood item produced an intermediate (instead of lower) amount of eating for the obese, especially in the high cue salience condition.

According to the present paradigm which treats degree of externality and weight as separate factors, specific results were predicted for a replication of Ross' study. First, the former findings on the effect of cue salience should be replicated for "Schachter's groups". Specifically, compared to low salience, high cue salience was expected to increase the eating behavior of the High External-Obese group. For the Low External-Nonobese group the different levels of cue salience were expected to have no differential effect.

Predictions for the cognition manipulation followed the same general pattern. Ross' results should be replicated

for the High External-Obese group who tend to eat more when instructed to think about food and for the Low External-Nonobese who tend to eat the same amount regardless of instructions.

The predictions pertaining to the behavior of the two remaining subject groups were less specific due to the exploratory nature of the present research paradigm. If the weight factor is more powerful than the externality factor, then the Low External-Obese group should eat more under conditions of high salience, and the High External-Nonobese should be less affected by the salience manipulations. On the other hand, if the externality factor is more powerful, then the Low External-Obese group should display the typically nonobese lack of external responsiveness while the High External-Nonobese respond more like their obese counterparts. Since previous research has confounded the effects of weight and externality, a specific choice of one of these predictions would be premature. Therefore, the effects of salience on the eating behavior of these two groups was not empirically predictable but permitted a comparison between the relative potency of the weight and externality factors.

Method

Subject Classification

A total of 525 subjects were recruited from the University of Manitoba Introductory Psychology subject pool and received experimental credits for participation. These

subjects were screened on the dimensions of weight and externality. Externality scores were measured on three tasks which followed the procedure used by Rodin, Slochower and Fleming (1977): time perception, emotionality ratings, and immediate recall. Three considerations determined inclusion of these tasks. First, a fair test of Schachter's theory requires the use of identical measures used in his research. Also, these measures tap a variety of external cues without use of food-related cues. Lastly, these same measures have evidenced externality differences within a nonobese sample (Rodin et al., 1977) and therefore might be useful with the present sample of nonobese subjects. Subjects participated in groups of five with the order of the three tasks counterbalanced across groups.

Time perception. Pliner (1974) reported that external auditory stimuli had a greater effect on obese subjects' time perception estimates than on estimates made by nonobese subjects. Her data suggested that for the obese, loud and rapid stimuli produced longer time estimates, and that soft, slower stimuli produced shorter time estimates. On the pretext of testing the effects of noise on memory, subjects in the present study were asked to listen to sounds while studying a slide. The sounds were either salient (clicks produced at a rate of 60/minute at 80dB) or weak (clicks produced at a rate of 30/minute at 50dB). Subjects listened to one tape for two minutes while studying the slide and then responded to a number of questions regarding the content

of the slide and the types of clicks including the critical item: "How many minutes were the clicks playing?" Subjects then heard the second tape while studying a second slide for two minutes, and then answered the same questions. The order of the two tapes was counterbalanced across groups. The influence of external cues on time judgements was measured as the absolute difference between the time estimates for the salient and weak stimuli. For example, a subject who estimated three minutes for the salient stimulus and one minute for the weak stimulus received a score of two.

Emotionality ratings. Emotionality has also been used as an indicator of externality in that salient, affect-laden stimuli should produce more emotionality in externally responsive individuals. Previous research by Pliner (1974) reported obese-nonobese differences in ratings of both positive and negative slides. In the present experiment, subjects were asked to rate a set of three pictures on a verbally anchored nine-point scale along four dimensions (ugly-pretty, sad-happy, serious-funny, bad-good). The set included one positive picture (two children playing with a balloon), one negative picture (the body of a child who had died from a degenerative disease), and one neutral picture (an uninspiring landscape), the presentation order of which was balanced across groups. A subject's externality score for this measure was computed as the absolute difference between ratings of the neutral picture compared to ratings of the positive and negative pictures. For example, if a subject gave ratings of

7, 1 and 3 to the positive, negative and neutral pictures respectively, the positive-neutral score was 4 and the negative-neutral score was 2.

Immediate Recall. Another aspect of externality is that reliance on external cues appears to enhance immediate recall performance, as reported by Rodin, Herman and Schachter (1974). In the present study subjects were shown four slides, each of which contained 16 items. Slide 1 contained two-letter words; Slide 2 contained three-letter words; Slide 3 contained pictures of objects and Slide 4 contained four-letter words. Each slide was presented for 12 seconds, after which the subjects had 30 seconds to write down everything they remembered from that slide. Externality scores for this task consisted of the total number of items correctly recalled from the four slides.

As discussed above, these three measures of external responsiveness followed the procedure used by Rodin et al. (1977). Their method of scoring each measure was also employed, as was their technique of dividing the subjects in terms of a single, global externality score. This was computed for each subject by adding the standardized scores across the three tasks. Externality scores greater than zero were defined as High Externals and scores less than zero were defined as Low Externals.

Obesity was defined at 15% or more overweight according to the Metropolitan Life Insurance Company norms, and non-

obese as less than 10% overweight. In order to minimize subject awareness of the experiment's purpose, height and weight measurements were not directly taken in this initial session. Instead, the experimenter unobtrusively estimated and recorded percentage overweight. These estimates were used in selecting subjects and were verified (or nullified) with actual height and weight measurements at a later session.

Subject selection

From the initial pool of 525 subjects who had been screened for externality score and overweight estimate, a subgroup of 160 subjects were selected for the two experiments. Criteria for selection included: subject availability to participate in two more hours of experiments, and maintaining a balance in externality scores between the two weight groups. Within each subject grouping, the 40 subjects were randomly assigned to either high or low cognitive and illumination conditions. Subjects were tested individually according to telephone arranged appointments.

Design

The subjects were grouped according to two dichotomous factors, externality and weight resulting in four subject groupings (High External-Obese, Low External-Obese, High External-Nonobese, and Low External-Nonobese). In addition the treatment factors included two nonrepeated levels of illumination (high or low) and two nonrepeated levels of

cognition (cashews or marbles). Ross' original design had included a "free think" condition during which subjects could think about whatever they wanted. This condition was not included in the present experiment due to the limited number of obese subjects available.

Procedure

The procedure was essentially a replication of Ross (1974). To conceal the fact that eating behavior was being studied, the experiment was introduced as "a study of physiological correlates of various types of thinking or cognitive activity". Consistent with this deception, the subject was seated at a table and the experimenter fastened an elastic band containing a metal plate to the subject's right calf. Wiring from the metal plate was attached to a series of panels under the table which purportedly monitored heart rate pulses. In order to obtain a measure of the subject's hunger level, the experimenter explained that she needed to ask some questions before beginning the thinking task because "as you know, how you're feeling at the time affects your pulse rate". The experimenter verbally administered a series of four seven-point rating scales (Anxious-Relaxed, Tired-Energetic, Hungry-Full, Uncomfortable-Comfortable).

On the table were a number of items to be used in the "thinking task". Closest to the subject's right hand was a nut tray containing 200 grams of cashews. Arranged in a row to the left were a toy car, chessman, a bud vase, and, nearest the subject's left hand, three marbles. In the center of the table behind these objects was a small desk

lamp.

Instructions to the subject were as follows:

> During the thinking task there will be a tape recording telling you what to think about. The recording will be a series of instructions to think about one of the items here on the table. Subjects in different conditions get different instructions, but you will be asked to think about just one of the items. Please remain seated, facing the table and keep your eyes open. I'll be out of the room while the tape is on, so as not to distract you from your thinking task. Before I leave I'll turn on the desk lamp and shut off the overhead lights because reduced lighting tends to stabalize the heart rate. Please relax and follow the instructions, thinking about the item it tells you to concentrate on. While you're thinking you can do whatever you like. You can play with the toy car, eat the cashews, handle the marbles, or whatever, as long as you're concentrating on whatever item the tape is discussing. The tape lasts about 10 minutes, and I'll come back into the room when the tape is finished. Okay, just relax and pay attention to the tape recorder. Remember, you can eat, play or do anything else as long as you remain seated and follow the taped instructions.

During the final reminder to the subject that he/she could do other things while thinking, the experimenter picked up a cashew and ate it. Before leaving the room the experimenter turned on the desk lamp and turned off the overhead lights on the pretext that reduced lighting produces a more stable heart rate. In actuality, the lamp constituted the cue illumination manipulation. For subjects in the high illumination condition, the lamp was unshaded and contained a 40 watt bulb. For subjects in the low illumination condition, the lamp was shaded with a red filter and contained a 12 watt bulb.

The cognitive salience manipulation consisted of taped instructions telling the subject what to think about (see Appendix A). For each of the two conditions there were eight communications, each one lasting 15-20 seconds followed by 40-45 seconds of silence. One set of communications instructed the subject to think about marbles and constituted the low cognitive salience condition. The following is an example of the instructions for this condition:

> For the next few minutes we would like you to think about marbles like those on the table in front of you now. Relax and think for a while about the glass marbles, about seeing them, handling them, and playing with them. Think about this for a while until you hear the tape again.

After eight similar communications on marbles, the experimenter returned to the room, unhooked the "heart rate monitor", and verbally administered a manipulation check consisting of three questions: "What occupied your thoughts most during the thinking task?" "What else were you thinking about?" "Which objects on the table did you touch or play with?"

The major dependent measure was the number of grams of cashews eaten. At the end of the session, after the subject had left the room, the tray of cashews was weighed on a Ohaus Dialogram scale and measured to the nearest 0.5 grams. The difference between the initial weight (200 gms) and the post-session weight was recorded as the dependent measure of cashew consumption.

The same procedure was followed for subjects in the high cognitive salience condition, except that in this condition the instructions directed the subject's attention to the properties of cashews. For example, one of the communications in the high cognitive salience condition was as follows:

> For the next few minutes we would like you to think about cashew nuts like those on the table in front of you right now. Relax and think for a while about the cashews, about seeing them, think about eating them, think about this for a while until you hear the tape again.

Subjects were run individually in one-hour sessions with participation appointments generally between 10:30 A.M. and 5:30 P.M. Ideally, participation times should have all been during the same time of the day, such as midafternoon, in order to control for differential hunger states. For example, subjects in Ross' study were run at 2:30, 3:30 or 4:30 "when they presumably had finished lunch but had not yet begun to yearn for dinner" (p. 44). Such limited participation times were not possible in the present study due to conflicts in subject scheduling.

After completion of the thinking task, subjects were asked to perform the RID tasks, and then to complete the questionnaires. After completion of these tasks, each subject was interviewed regarding awareness of the experimental hypotheses, and height and weight measurements were obtained. Although these other measures were obtained during the same experimental session, they address different

theoretical issues and are discussed in the following chapters. Only the data relevant to the replication of Ross' study are presented and discussed in this chapter.

Results

Preliminary Analyses

Before considering the major dependent measure of cashew consumption, a number of preliminary analyses were undertaken to determine the equivalency of groups. The subject characteristics are presented in Table 1. Separate analyses of variance for the factors of weight and externality score within the different salience conditions indicated only main effects, in that obese group was more overweight than the nonobese group, $F(1,156) = 221.74$, $p < .0005$. and the high externals were more external than the low externals, $F(1,156) = 486.91$, $p < .00001$. These data support the subject classifications. More importantly, lack of significant interactions between subject groups and experimental conditions (all F values < 1.00) indicates equivalency of subject types across the high and low cognition and cue illumination conditions.

Moreover, an analysis of variance using hunger rating as the dependent measure evidenced no significant main effects and no significant second order interactions (highest $F = 2.46$, $p < .12$), thereby indicating that the 16 experimental conditions were equivalent in terms of hunger.

The final preliminary analysis considered the sex of subject. An analysis of variance with sex as the indep-

Table 1

Weight and Externality Scores for Subject Classification Groups

Group	n	Percentage Overweight	Externality Score
Nonobese			
Low External	40	2.1%	-1.23
High External	40	1.9%	1.45
Obese			
Low External	40	19.3%	-1.31
High External	40	19.0%	1.43

endent variable and grams of cashews consumed as the dependent variable demonstrated no significant effect ($F < 1.00$). Likewise, inclusion of the sex factor with the other major factors (weight, externality, illumination and cognition) resulted in no main effect and no significant interactions. Therefore, the data on the grams measure were combined across males and females within each experimental condition.

Grams of Cashews Consumed

The above preliminary analyses indicated that the experimental groups were equivalent in terms of subject assignment. Therefore, analyses of the major dependent measure could be performed. To review the design, subjects were classified according to weight (obese or nonobese) and externality (high or low). The experimental conditions consisted of nonrepeated levels of cue illumination (bright or dim) and cognition (cashews or marbles). The major dependent measure was grams of cashews eaten. The group means and standard deviations on this dependent measure are presented in Table 2. The grams data were analyzed according to the predictions: first, looking at Schachter's groups, and secondly, examining the other two groups.

These further analyses consisted of a priori *t*-tests, the form of which depended on the degree of theoretical support for the predictions. Thus, the predictions for the much-studied Schachter's groups were tested using one-tailed *t*-tests. The more speculative predictions for

Table 2

Group Means and Standard Deviations for Cashew Consumption Under Various Levels of Salience

Subject Group	Low Illumination				High Illumination			
	Low Cognition		High Cognition		Low Cognition		High Cognition	
	M	SD	M	SD	M	SD	M	SD
Low External-Nonobese	3.1	3.9	2.6	3.2	3.7	4.0	3.7	2.2
High External-Nonobese	4.6	7.1	11.5	10.6	1.9	2.6	7.1	8.5
Low External-Obese	1.2	2.8	8.2	6.9	2.0	4.2	4.3	5.9
High External-Obese	0.4	0.8	6.7	6.3	3.6	7.1	10.8	10.2

the other two groups which have not been previously studied were subjected to two-tailed t-tests.

Consumption Measures for High External-Obese and Low External Nonobese

In order to verify the present Weight x Externality paradigm, the results for Schachter's groups (High External-Obese and Low External-Nonobese) should replicate the findings reported by Ross. Ross found that the nonobese were not affected by the cognition and illumination manipulations, while the eating behavior of the obese increased greatly under high salience on these factors. This externality by cognition interaction was replicated in the present experiment and is represented in Figure 3.

For Low External-Nonobese subjects, food consumption was comparable under low (3.4 grams) and high 3.1 grams) cognition conditions, $t < 1.00$. For High-External Obese subjects, food consumption was significantly greater under high cognitive salience (8.8 grams) than under low cognitive salience (2.0 grams), $t(144) = 2.94$, $p < .002$. A comparison of the High External-Obese and Low External-Non-obese groups showed no significant differences in consumption at low cognitive salience, but at high cognitive salience the High External-Obese consumed significantly more than did the Low External-Nonobese. Thus, the present data regarding the effects of cognitive salience on consumption for Schachter's groups clearly support the predictions based on externality theory.

It was also predicted that the cue illumination manipulation would produce a similar interaction for Schachter's groups. Such an interaction is evident in the significant Weight x Externality x Illumination effect. The relevant data are graphed in Figure 4. Food consumption for the High External-Obese under high illumination (7.2 grams) was greater than under low illumination (3.6 grams) but this difference was not clearly significant, $t(144) = 1.59$, $p < .057$. For the Low External-Nonobese high and low illumination conditions produced comparable consumption levels of 3.7 grams and 2.9 grams respectively, $t < 1.00$.

In sum, the data on the cognition manipulation supported the hypotheses made for Schachter's groups. Under conditions of low salience the High External-Obese subjects tended to consume amounts similar to the Low External-Nonobese. However, when salience was increased through cognition instructions to think about cashews, consumption rates increased significantly for the High External-Obese. The Low External-Nonobese were not responsive to the high cognition manipulation. The data on the illumination manipulation were less clear-cut. Cashew consumption for the High External-Obese did increase under high illumination, but this increase was not clearly significant. Eating behavior for the Low External-Nonobese group was not dependent on illumination conditions. These interactions which replicate Ross' findings lend empirical support for the predictions derived from the Weight x Externality paradigm.

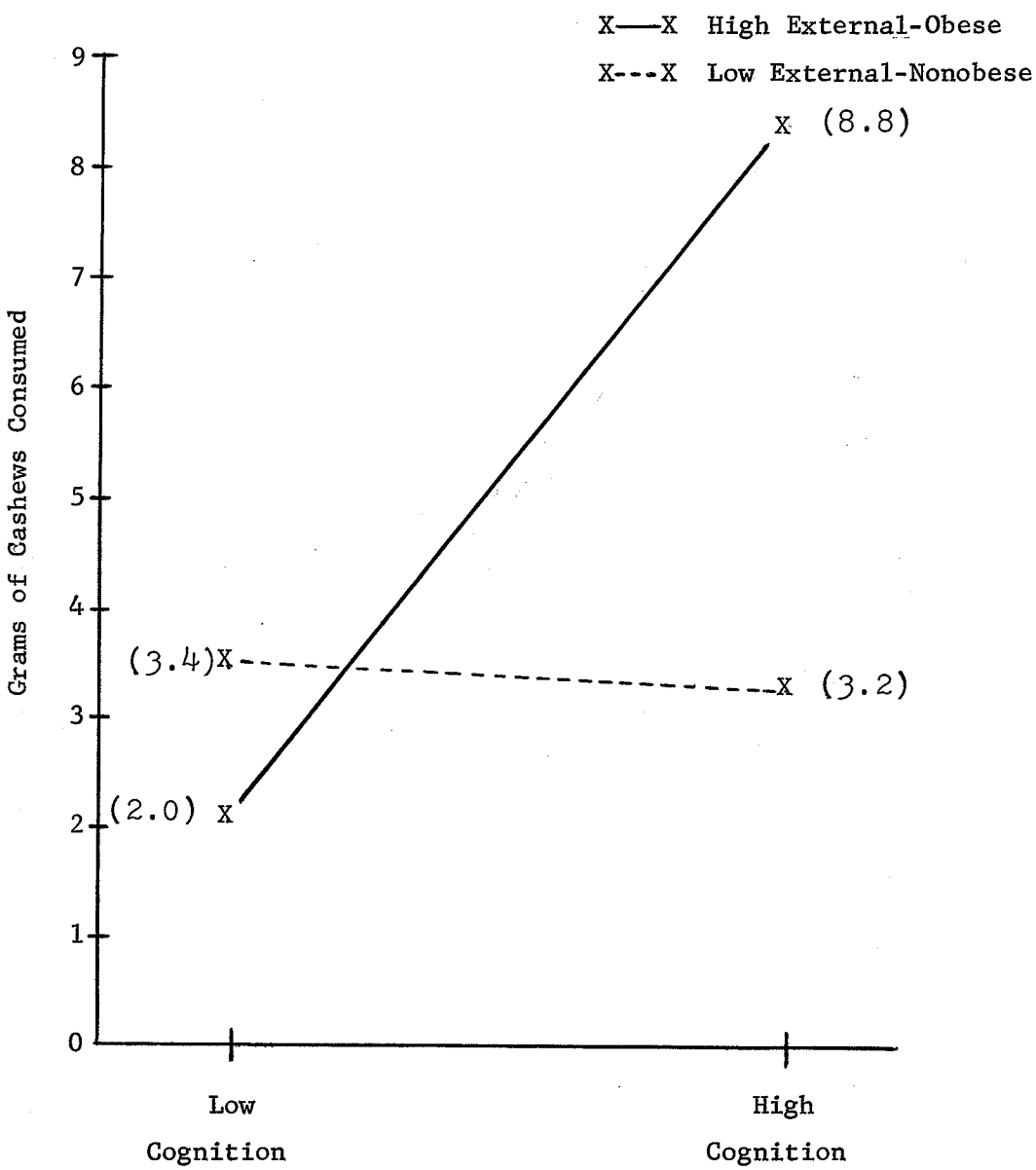

Figure 3. The effects of cognitive salience on consumption rates for Schachter's groups.

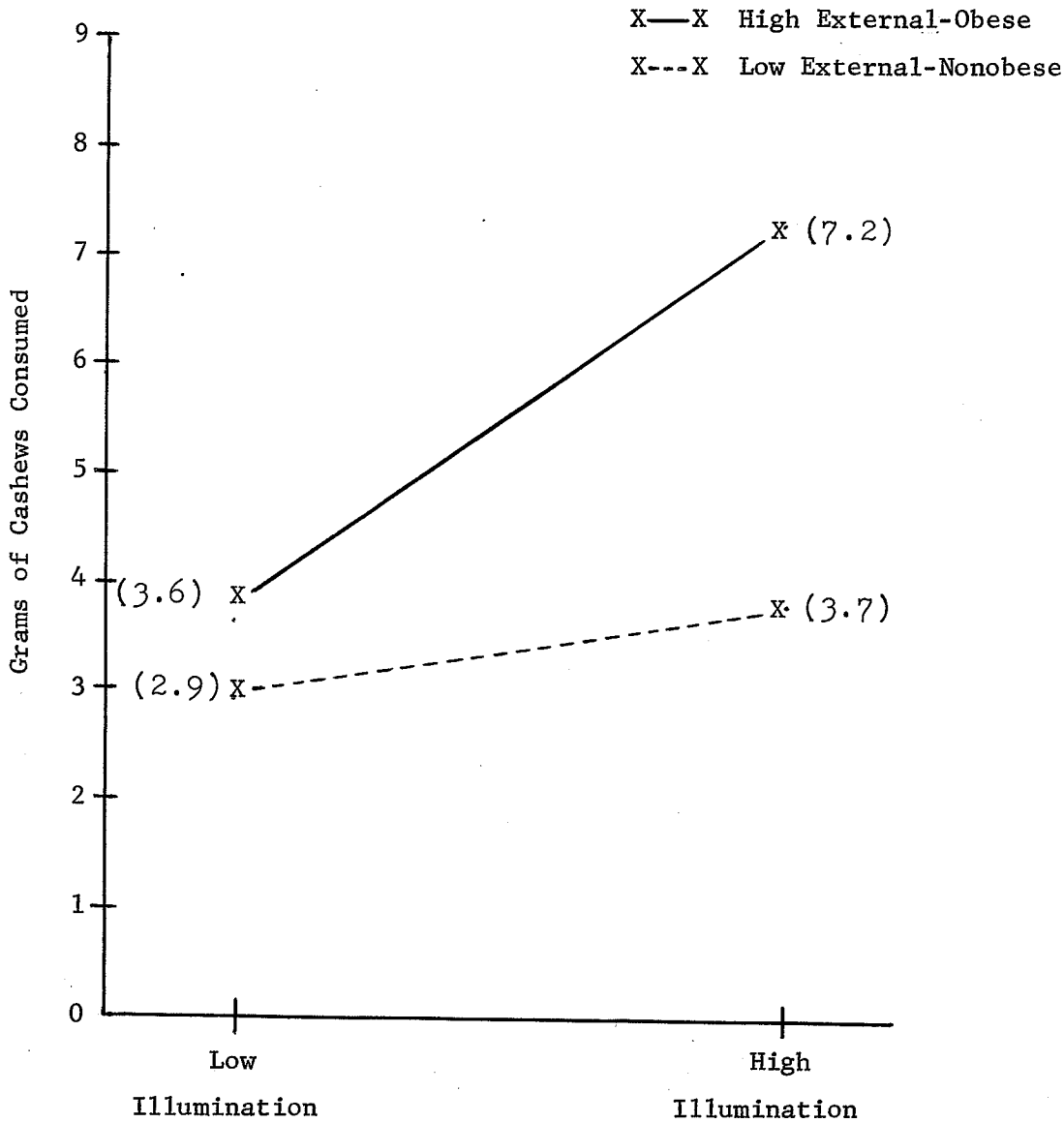

Figure 4. The effects of illumination on consumption rates for Schachter's groups.

Consumption Measures for Low External-Obese and High External-Nonobese

The predictions for the remaining two groups were less specific but attempted to compare the relative potency of the weight and externality factors. If the weight factor were more powerful, then Low External-Obese subjects should consume more under high salience conditions and the High External-Nonobese should not. If on the other hand, the externality factor were more powerful, then the Low External-Obese should be unaffected by salience manipulations while these manipulations should increase consumption in the High External-Nonobese group.

The consumption rates for these two subject groups under low and high cognitive salience are presented in Figure 5. These data indicate that the High External-Nonobese group ate significantly more when instructed to think about cashews (9.3 grams) than when instructed to think about marbles (3.3 grams), $t(144) = 2.64$, $p < .009$. The manipulation of cognitive salience produced a similar pattern in the Low External-Obese in that they also consumed significantly more under high cognitive (6.3 grams) than under low cognitive salience (1.6 grams), $t(144) = 2.03$, $p < .045$. Under conditions of both high and low cognitive salience the High External-Nonobese and Low External-Obese groups consumed similar amounts, both ts < 1.00.

Figure 6 shows the consumption rates for both subject groups under conditions of low and high illumination. The

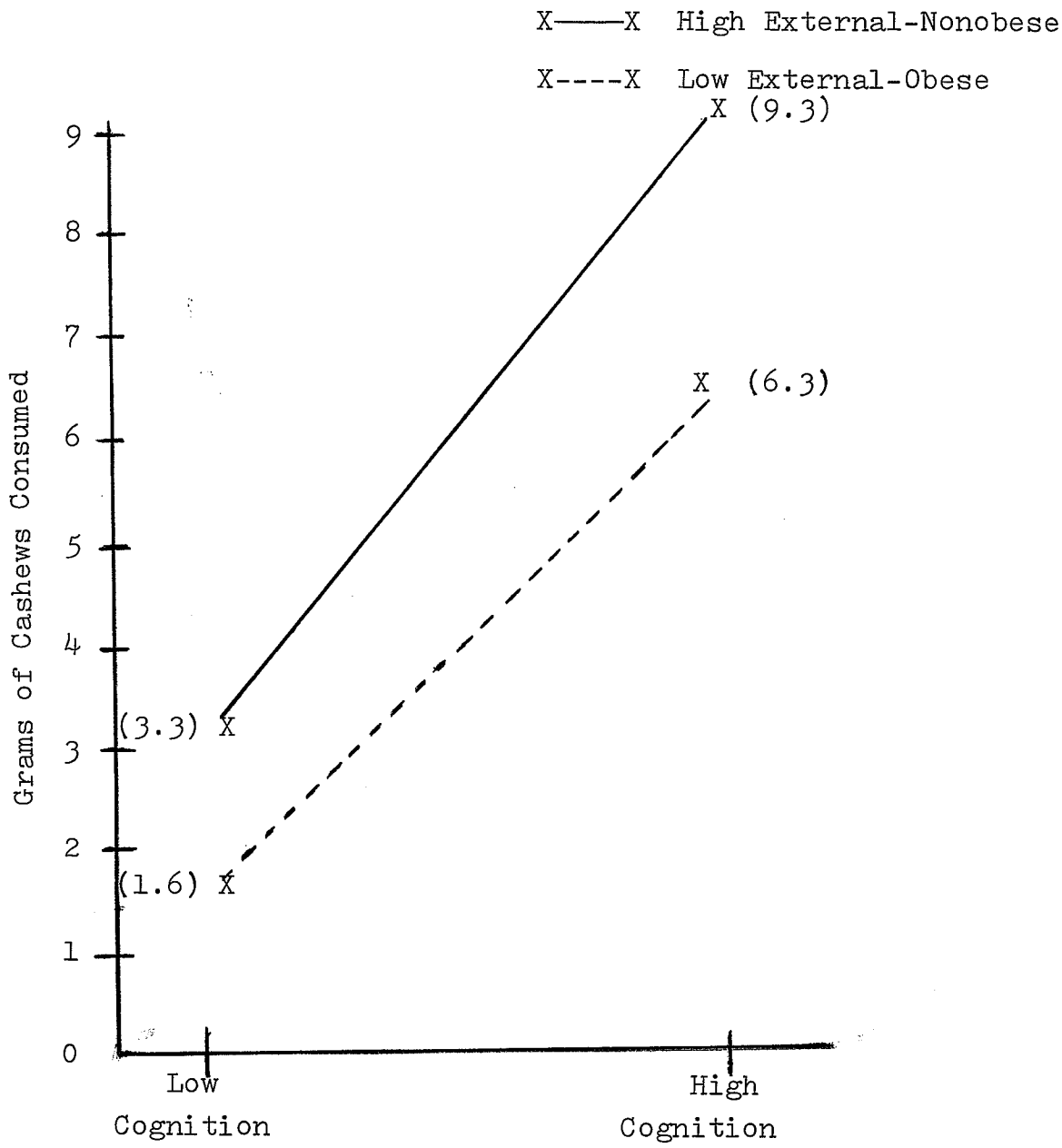

Figure 5. The effects of cognitive salience on consumption rates for High External-Nonobese and Low External-Obese

High External-Nonobese group consumed similar amounts under both low (8.1 grams) and high (4.5 grams) levels of illumination, $t(144) = 1.55$, $p < .10$. The Low External-Obese group was likewise not affected by the illumination manipulations, consuming 4.7 grams under low and 3.2 grams under high illumination levels, $t(144) < 1.00$. Consumption rates between the two subject groups did not differ significantly under either low ($t = 1.34$, $p < .10$) or high ($t < 1.00$ levels of illumination.

Taken together, these data indicate that neither of the tentative predictions was supported. High cognitive salience produced significantly increased consumption for both the High External-Nonobese and the Low External-Obese groups. The illumination manipulations, on the other hand, produced no significant differences.

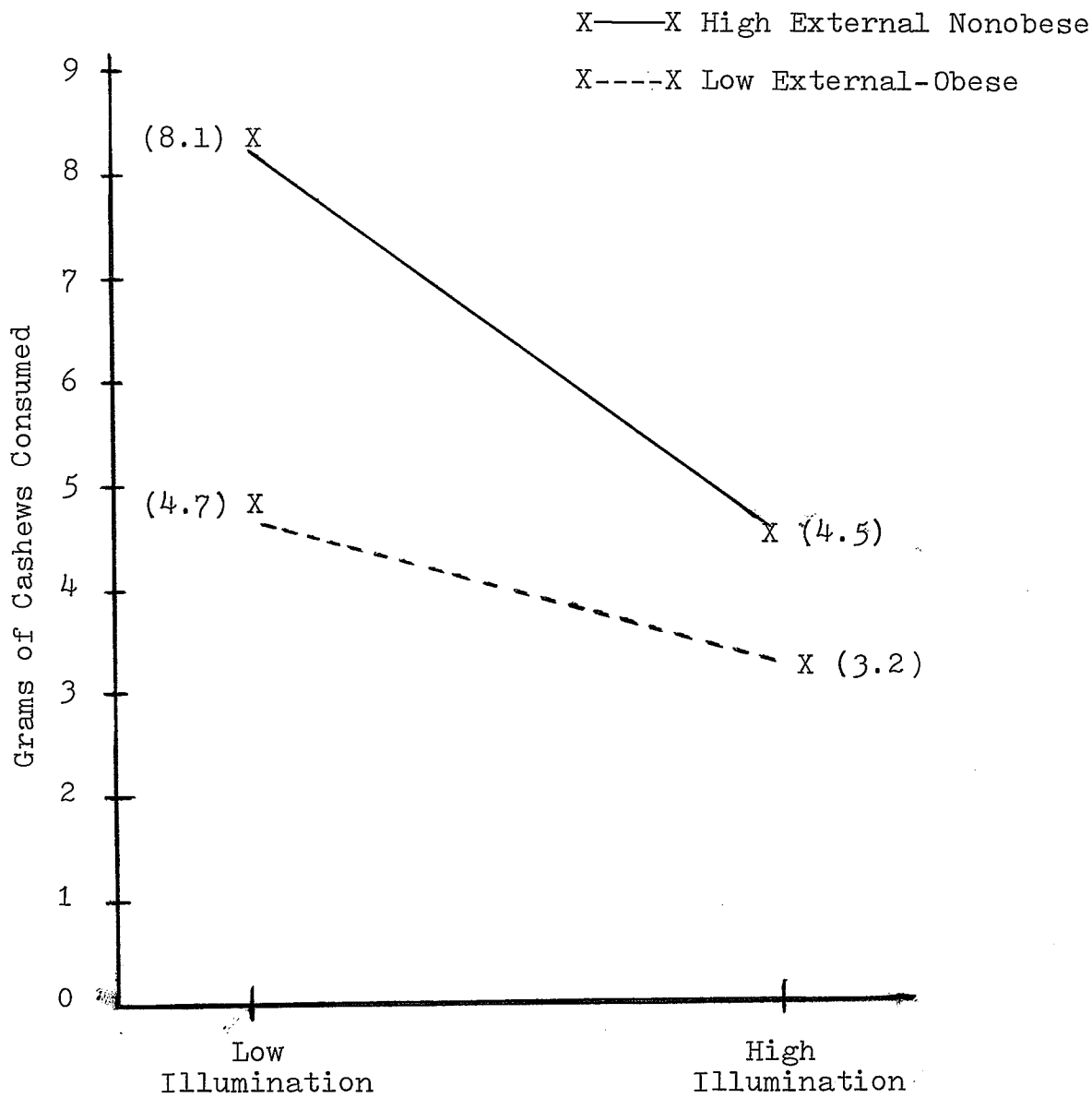

Figure 6. The effects of illumination on consumption rates for High External-Nonobese and Low External-Obese.

Consumption Measures for All Groups

The above comparisons were based on predicted differences which received statistical support through significant interaction effects. This last set of *t*-test comparisons was based on the 4-way interaction (weight by externality by illumination by cognition). These comparisons were also a priori because a significant 4-way interaction would be predicted by the present paradigm.

If the eating behavior of externally responsive individuals is more dependent on external food-cue salience, then the extremes of cue salience should produce the greatest consumption differences in high versus low externals. In the present experiment these cue salience extremes were the conditions of low illumination with low cognitive salience and high illumination with high cognitive salience. The consumption rates of all four subject groups in these two extreme salience conditions are presented in Figure 7.

Under conditions of extremely low salience (low cue illumination and instructions to think about marbles), the High External-Obese subjects consumed an average of 0.4 grams of cashews. High External-Obese subjects exposed to extremely high salience (high cue illumination and instructions to think about cashews), consumed significantly more (10.8 grams), $t(144) = 3.83$, $p < .005$. A comparison of Low External-Nonobese consumption rates under extremely low salience (3.1 grams)

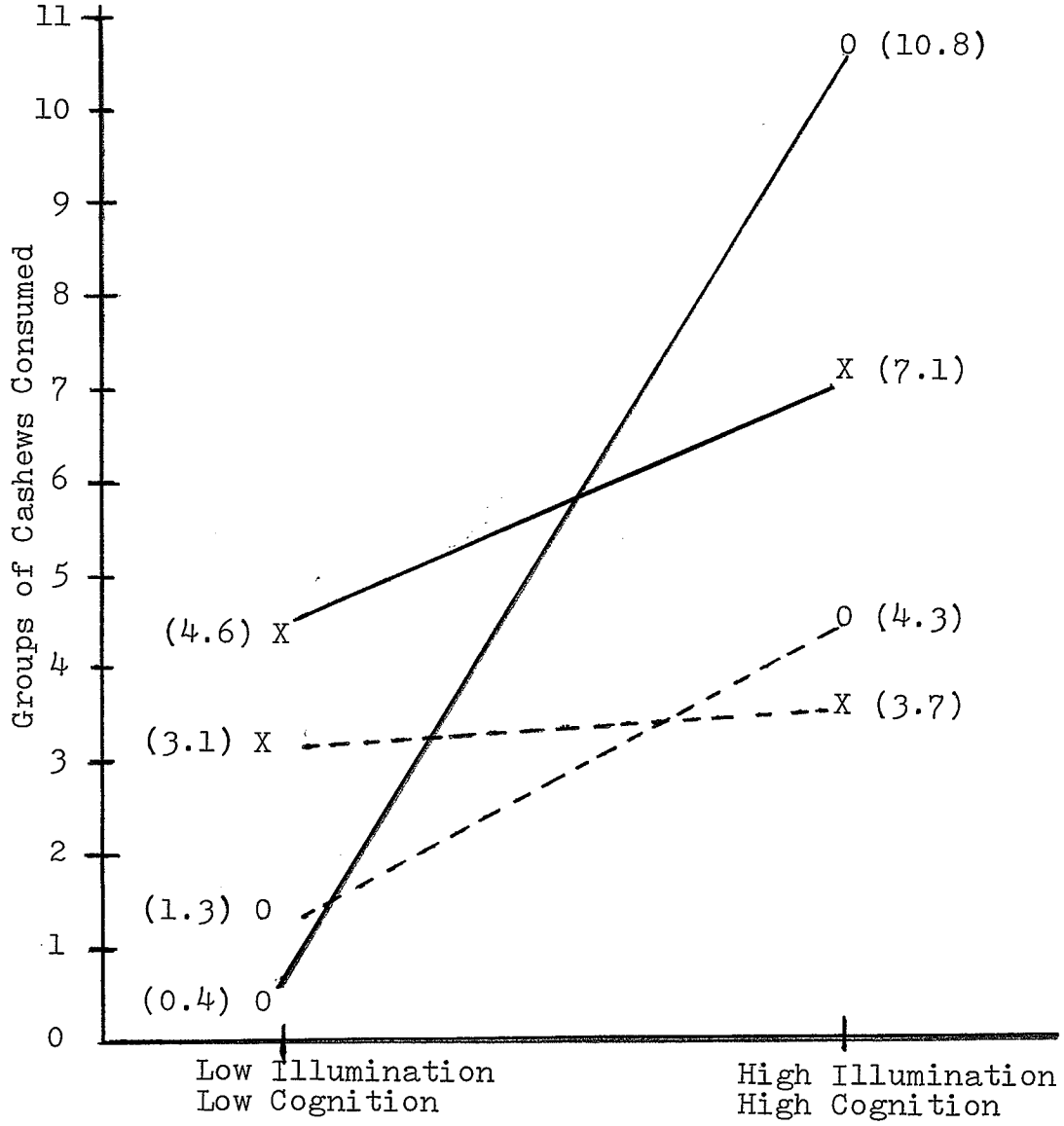

Figure 7. The effects of extreme salience on consumption rates of all subject groups.

and extremely high salience (3.7 grams) showed no significant differences, $t(144) < 1.00$. The results for these two groups are remarkably similar to Schachter's theoretical relationship between stimulus salience and external responsiveness (see Figure 1).

The consumption rates for the other two less-studied groups did not display significant increases as a result of increased salience. High External-Nonobese subjects under extremely low salience consumed 4.6 grams, compared to 7.1 grams in the extremely high salience condition, $t(144) < 1.00$. Similarly, Low External-Obese subjects did not consume significantly more under extremely high salience (4.3 grams) compared to extremely low salience (1.2 grams), $t(144) = 1.14$, $p < .10$.

Comparisons between subject groups at each extreme salience condition indicated no significant differences at extremely low salience, highest $t(144) = 1.55$, $p < .10$. At the level of extremely salience, High External-Obese subjects consumed significantly more (10.8 grams) than did the Low External-Nonobese (3.7 grams), $t(144) = 2.61$, $p < .01$. Consumption rates for the High External-Obese were also significantly greater than that of the Low External-Obese (4.3 grams) at the level of extremely high salience, $t(144) = 2.36$, $p < .02$. The High External-Nonobese consumption rates (7.1 grams) were not significantly different from High External-Obese consumption at extremely high salience, $t(144) = 1.36$, $p < .10$.

In summary, comparisons of all four subject groups at the extreme levels of low and high salience indicated three significant differences. Only the High External-Obese group increased consumption with increased salience. All groups consumed comparable amounts under extremely low salience, and the High External-Obese group consumed more than did the Low External-Nonobese and Low External-Obese under extremely high food-cue salience.

Discussion

According to the rationale on which the Weight x Externality paradigm was based, Schachter's research has been investigating differences between obese individuals who tend to be more externally responsive and nonobese individuals who tend to be less externally responsive. Therefore, the Weight x Externality paradigm was used to separate these previously confounded factors. It was predicted that the present experiment would replicate the typical obese-nonobese differences by comparing consumption rates of High External-Obese and Low External-Nonobese groups at different levels of food-cue salience. This prediction received statistical support from a number of comparisons. First, increased cognitive salience (instructions to think about cashews) produced significantly increased consumption for the High External-Obese group but did not affect consumption for the Low External-Nonobese group. Increased food-cue illumination also resulted in higher consumption for High External-Obese compared to Low External-Nonobese, but this finding was less reliable. Finally, the

comparison between the extremes of food-cue salience (low cognitive with low illumination vs. high cognitive with high illumination) again indicated more responsiveness to external cues for the High External-Obese group and very little responsiveness to external cues for the Low External-Nonobese group.

These findings closely approximate Schachter's theoretical curves of the relationship between external responsiveness and stimulus salience (see Figure 1). According to this predicted relationship, an increase in stimulus salience increases external responsiveness slightly for all individuals, but produces the highest responsiveness in obese individuals. The data collected on responsiveness of Low External-Nonobese to high cognitive salience (see Figure 3) appears to be a slight deviation from this general rule because they consumed slightly less. However, even this discrepancy coincides with previous reports of a similar "perverse phenomenon" (Schachter & Rodin, 1974, p. 65). A number of studies by Schachter and his colleagues (e.g., Nisbett, 1968a; Ross, 1974; Johnson, 1974) have also found a slightly negative relationship between cue salience and responsiveness for nonobese subjects. Therefore, the present findings appear to have replicated the exceptions as well as the general rule.

The present replication of previous findings suggests several implications. At a basic level, the data indicate that the present manipulations did in fact replicate the conditions used by Ross in the original experiment. More

importantly, it appears that the present classifications of external responsiveness were valid in terms of criterion measures. Subjects who displayed high responsiveness on the premeasures of time perception, emotionality ratings and immediate recall also were externally responsive to salient food cues. As explained previously, these premeasures were selected because they had evidenced differences in external responsiveness for a nonobese sample (Rodin & Slochower, 1976), but the present experiment was the first attempt to use these premeasures on a large sample of both obese and nonobese subjects. In short, the present data demonstrates the generality of external responsiveness on both food-related and nonfood-related tasks.

The findings discussed above can be interpreted as support for Schachter's externality theory. Obese individuals who are externally responsive consume more in the presence of salient food cues, while nonobese individuals who are less externally responsive are not dependent on food cues. These results also support the Weight x Externality paradigm which is an extension of Schachter's theory. The more crucial results are those of Schachter's previous anomalies. Predictions and results for these two groups will now be discussed.

It was predicted that comparisons between the High External-Nonobese and Low External-Obese would indicate the relative power of externality and weight in determining eating behavior. The consumption rates for the High External-Non-

obese and the Low External-Obese groups were however highly similar. Increased cognitive salience resulted in significantly more consumption for both groups, while increased illumination levels produced no significant differences. At the extreme levels of salience (both cognitive and illumination), these two groups also responded the same, in that consumption rates did not increase with increased salience. Moreover, none of the comparisons showed significant differences between these two groups at any level of salience.

This striking similarity between groups which differ in terms of both weight and externality does not coincide with either tentative prediction derived from the Weight x Externality paradigm. That is, instead of indicating which of the two factors is more powerful, the consumption rates of these two groups suggest that neither factor determines their eating behavior. Since these two groups are obviously not similar in terms of weight or externality score, further discussion of other possible factors will be postponed until the final chapter. The next chapter investigates another factor, Singh's response inhibition theory, to determine how it relates to weight and externality.

CHAPTER THREE

The Role of Response Habits in the Control of Behavior

The final phase in this research program explored further theoretical implications of the Weight x Externality paradigm. Having examined the role of cognitive factors in Chapter 2, the proposed research also considered the role of response habits in the control of behavior. Singh's (1973b) theory of the obese's response inhibition deficit (RID) was drawn upon as a possible explanation for why some externally responsive individuals become obese while others do not.

As discussed in the opening section, Singh has proposed that Schachter's demonstrations of the obese's externality are due to a more encompassing phenomenon, the obese's inability to inhibit an ongoing response. Singh cited evidence for the obese's RID from electrophysiological studies which demonstrated that the ventromedial hypothalamus (VMH) area may be involved in a somatomotor inhibitory system. Damage to the VMH area or an increase in the amount of body fat presumably reduces the effectiveness of the inhibitory system and thus produces the RID. Therefore according to Singh, in all situations where an ongoing response is to be terminated, VMH-lesioned and obese subjects will tend to

respond longer than normals. The RID theory emphasizes this slowness in changing responses as an explanation for typical obese-nonobese differences on both food-related and nonfood-related tasks.

Singh maintains that the typical eating patterns for obese individuals can be explained by RID theory. One eating pattern is that the obese do not tend to eat more meals than the nonobese. Rather, obese subjects, both human (Schachter, 1971) and rat (Teitelbaum & Campbell, 1958), appear to increase meal size rather than meal frequency. According to Singh, these data do not fit into Schachter's externality theory because if obese eating is controlled only by external cues, meal frequency should increase due to the abundance of food cues in the environment. The data do however imply that the obese are displaying an RID, in that they eat more at a given meal.

Another behavior typical of obese subjects is that, compared to normals, they are unwilling to work for food. Miller, Bailey and Stevenson (1950) noted that although lesioned rats ate more than controls when an unweighted lid covered the food dish, they ate significantly less when a 75 gram weight was fastened to the lid. Testing humans in an analogous situation, Schachter and Friedman (1974) reported that when almonds were shelled, 19 of 20 obese subjects ate, but when unshelled nuts required the work of using a nutcracker only 1 of 20 obese subjects ate. The eating behavior of normal subjects, on the other hand, was unaffected by the work involved, in that half of the normal

subjects ate, regardless of the shells or no-shells.

Singh interpreted the obese's apparent unwillingness to work in terms of their inability to suppress emotional responses. When the subject has learned to obtain a reward without much effort, a subsequent work situation would induce an emotional response which is incompatible with working. Being slower to inhibit this response due to their RID, the obese appear to be unwilling to work. Therefore, Singh reasoned that subsequent work situations would not produce the apparent unwillingness to work if prior training made working a dominant response. This reasoning was supported in a study by Singh (1973a) using rats. When trained before surgery to obtain reinforcement on a "hard work" basis (fixed ratio of 256 lever presses), VMH-lesioned obese rats did not exhibit the usual unwillingness to work for food.

An ingenious experiment by Singh and Sikes (1974) likewise demonstrated the influence of response habits with human subjects. Reasoning that unwrapping chocolates (Hershey Kisses) from aluminum foil is more common than unwrapping cashews, they predicted that the obese would eat less wrapped cashews than wrapped chocolates. That is, wrapped cashews would result in an incompatible emotional response which the obese cannot repress. For normal weight subjects the results showed no effect for wrappings as they ate the same amount whether chocolates and cashews were wrapped or unwrapped. The obese subjects, on the other hand,

ate more unwrapped cashews and less wrapped cashews. Moreover, this difference could not be attributed to a simple unwillingness to work because a similar wrapping on chocolates produced no effect and obese subjects ate as many wrapped as unwrapped chocolates. Without considering response habits and the RID, it would be difficult to explain why obese subjects are willing to unwrap chocolates but not cashews.

The obese's response inhibition deficit also has been demonstrated in non-feeding situations. When interfering training was given prior to testing, Singh (1973b) found that obese subjects performed worse than normal subjects on a timing behavior task. Conversely, when no prior training was given, obese subjects performed better than normals. Other psychophysical tasks involving reaction time (Singh, Swanson, Letz & Saunders, 1973) or signature writing (Sikes, 1974) have also demonstrated the obese's RID. Lastly, cognitive tasks which demonstrate the Einstellung effect, such as the water jar test (Singh, 1973b) or card color guessing (Sikes, 1974), have likewise shown that the obese persist longer in a mental set than do normals. Thus, Singh and his colleagues have found evidence for the obese's RID on a wide variety of tasks.

Although RID research suggests that previous training influences responsiveness to external cues, Schachter has not considered this possibility. To date, tests of the two theories (always originating from Singh's camp) have con-

sisted of generating opposing predictions and then deciding which theory is supported. In tests of externality theory stimulus salience is manipulated and response tendencies are not considered. In tests of RID theory stimulus salience is held constant while response tendencies are manipulated through prior training. Neither approach considers the "whole picture" in a complete stimulus-response context.

The perspective taken by the present research was more able to focus on the "whole picture". First of all, subjects had already been assessed on the typical externality measures to determine their reactivity to stimulus salience. Their externality scores could then be directly compared to response tendencies on RID tasks. In addition, the present paradigm had the advantage of separating the previously confounded factors of weight and externality.

No specific predictions of the interrelationships were made because previous research has confounded the weight and externality factors. Only one study by Aves (1977) reported data on two RID tasks which could be interpreted within the Weight x Externality paradigm. Aves found that obese subjects displayed the typical RID on a card color task but nonobese and fluctuating-weight subjects did not. Following the rationale presented in Chapter 1, the fluctuating-weight subjects would probably belong to the High External-Nonobese group along with the restrainers and those who used to be obese. Therefore, since Aves found fluctuators (i.e., High External-Nonobese) to be more

similar to the nonobese, it might be predicted the High External-Nonobese group would not exhibit the RID. However, the other RID task used by Aves, a paired associates transfer paradigm, did not produce RID differences between any of the subject groups. Lack of consistent empirical support therefore precluded any specific hypotheses in the present experiment. As stated above, the general purpose of this experiment was to determine the interrelationships among external responsiveness, RID and weight.

In order to maximize the chances for producing RID effects, two tasks were used: card color guessing and mirror tracing. The card color guessing task, as used in the Aves study, measures how well a person can adjust to a shift in card colors after previous training with a reverse expectancy. The mirror tracing task (Singh, Swanson, Letz & Sanders, 1973) requires inhibition of normal hand-eye coordination while tracing a six-pointed star which is visible in a mirror. On both tasks a RID would interfere with learning the new response and result in more errors. Use of these two particular tasks had the advantage of tapping two distinct response systems: cognitive set and motor performance.

Method

Subjects

The same 160 subjects who participated in Experiment 1, also participated in the RID tasks which were explained

as "tests of problem solving abilities". As in Experiment 1, there were 40 subjects in each of the four externality-weight groups. Subjects were tested individually after completing the Experiment 1 task and the order of the two RID tasks was counterbalanced among the four subject groups.

Apparatus

The stimulus materials for the card color guessing task consisted of a stack of 120 regular playing cards. The first 90 cards contained 80% (72) black cards which were randomly shuffled with 20% (18) red cards. The last 30 cards were all red. The order of the cards remained constant across subjects.

The mirror-tracing task was performed on a Lafayette Automatic Scoring Mirror Tracer (model 58024). The base of the apparatus consisted of a metal plate on which there was a path in the shape of a six-pointed star, 20 cm in diameter. The width of the path was 0.5 cm. The subject was required to trace the star path with a stylus which was connected to an electrical power supply. Whenever the stylus deviated from the path, the electrical circuit was completed and an error counter was activated. An adjustable mirror, 26 x 20 cm, was attached vertically to the rear of the base. A moveable metal blinder, 27 x 21 cm was positioned either vertically in front of the mirror (for positive trials) or horizontally 15 cm above the base (for negative and reversal trials). When the

blinder was in the horizontal position, the base was hidden from the subject's view and the star path was visible only in the mirror. When viewing by the mirror the subject's forward and backward hand movements were reversed, but left and right movements remained the same.

Procedure

During the card color guessing task the subject was seated across from the experimenter with the stack of 120 cards on the table between them. Instructions to the subject were as follows:

> We are going to go through this stack of 120 cards one-by-one. They are regular playing cards, black or red, but not an equal number of black and red cards. For each card, I'd like you to guess what color it is. After you guess I'll record your answer on this sheet, show you the card and then we'll go on to the next card. You can use whatever strategy you want for guessing, but remember that this is not a standard deck of equal black and red cards.

On each of the 120 trials the subject guessed black or red, the experimenter recorded the guess, showed the subject that card, placed it face up on the table and continued with the subject's guess for the next card.

The procedure for the mirror-tracing task was basically the same as used by Singh et al. (1973). Before each session the blinder was positioned vertically, exposing the base and star path to direct view. Instructions to the subject were as follows, accompanied by a demonstration:

> This is called a mirror-tracing apparatus. Have you ever played with one of these before? What I'd like you to do is to trace the star using this stylus. Start at this point and go in this direction. If you go off the star path, the recorder will click and record an error. See? If you go off the path, come back on at the same place you went off, like this. Don't take any short-cuts across the points like this. Continue on the path until you get back to the starting point and then stop. I'll be timing you and recording errors so go as quickly as possible with a minimum of errors. For the first couple of trials you can trace the star just looking at it normally. After that I'll ask you to trace the star while looking at it in the mirror. Here is the stylus. Use your dominant hand for these first trials. You can position the stylus at the starting point.

Testing consisted of three sequential phases: positive, negative and reversal. The positive phase consisted of three massed trials while viewing the star path directly. During the negative phase the blinder was positioned horizontally over the base, and the subject had five massed trials using the dominant hand while viewing the star path in the mirror. The blinder was also in position during the reversal phase which consisted of three massed trials with the nondominant hand.

After each trial the experimenter recorded time (in seconds) and number of errors. The upper time limit for a given trial was 240 seconds after which the trial was terminated. Data were also collected on handedness of each subject and whether the subject had previously experienced a mirror trace apparatus.

Results

The results from the card color guessing task were analyzed by the same procedure used by Sikes. The dependent measure on this task was the number of errors made on the last set of 30 cards. The error means and standard deviations for the four subject groups are presented in Table 3. These data were analyzed with planned comparison *t*-tests. None of these comparisons indicated a significant difference between subject groups, all $ts(40) < 1.00$.

There were two major dependent measures for the mirror tracing task: time and errors. A repeated measures analysis of variance revealed no significant main effects or interactions for handedness and previous mirror tracing experience so the data were combined across these variables. Figures 8 and 9 present the mean time and errors for the four subject groups during the positive, negative and reversal phases of testing.

The data analysis for each dependent measure consisted of a repeated measures analysis of variance across the 11 trials with two nonrepeated subject factors (weight and externality). The results of the time measure are presented in Table 4. There was a significant main effect for weight, $F(1,156) = 8.10$, $p < .005$. Planned comparison *t*-tests indicated that both obese groups took significantly more time to complete the negative and reversal trials, $p < .05$, and that all groups were identical on the positive trials, all $ts < 1.00$. This later finding rules out the

Table 3

Means and Standard Deviations of Card Color Guessing Errors by Subject Groups

Group	n	Mean Errors	Standard Deviation
Nonobese			
Low External	40	6.23	3.08
High External	40	6.30	2.84
Obese			
Low External	40	6.28	3.48
High External	40	7.35	4.25

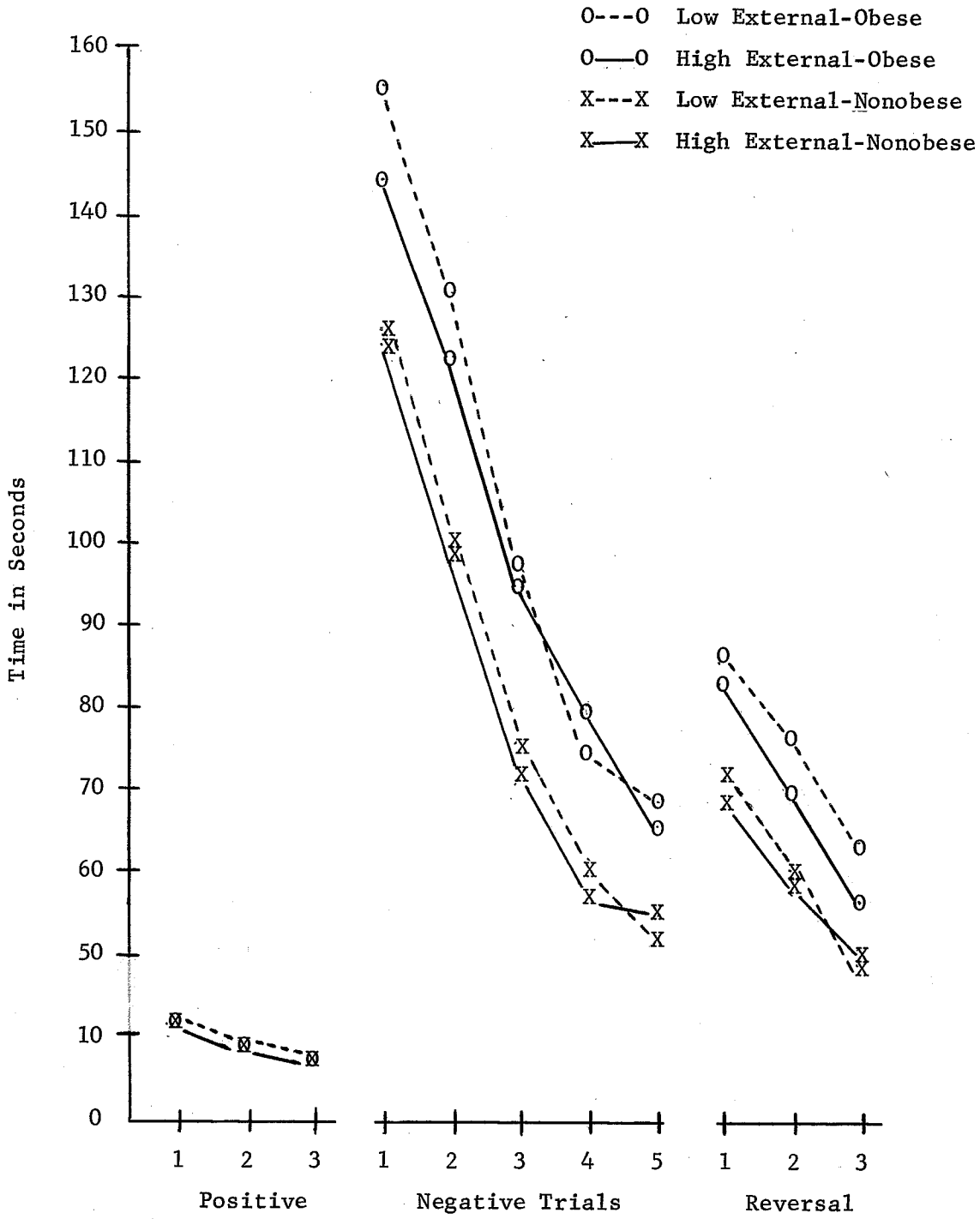

Figure 8. Time scores on mirror tracing task during successive phases of testing.

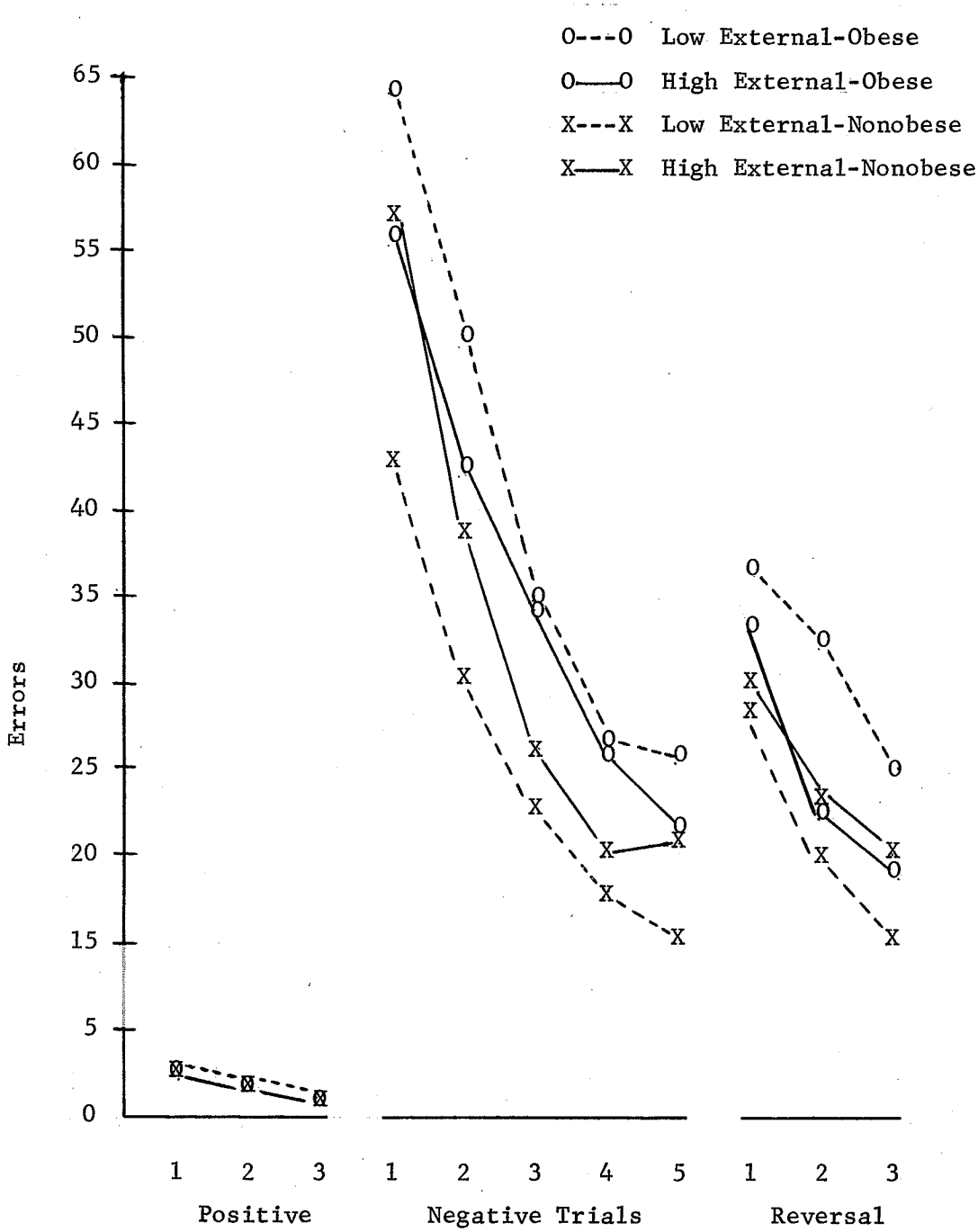

Figure 9. Mean number of errors on mirror tracing task during successive phases of testing.

possibility that differential baseline performance was responsible for group differences in subsequent phases of testing. No significant main effects were found for the externality factor or for the weight by externality interaction, both Fs <1.00. The significant main effect across trials, $F(10,1560) = 224.11$, $p < .00005$, is typical of the mirror trace task in that most subjects improve with practice. However, the significant trial by weight interaction, $F(10,1560)$, $p < .0006$, showed that both obese groups were consistently slower in this improvement.

Even though both obese groups were significantly slower on the time measure, this increased time to complete each trial did not produce fewer errors. Table 5 presents the summary of the error analysis. Both obese groups made more errors across the test trials, $F(1,156) = 6.22$, $p < .01$, and again there was no significant main effect for the externality factor, $F < 1.00$. All groups improved across test trials, $F(10,1560) = 141.86$, $p < .00005$, but the obese again were slower in this improvement, $F(10,1560) = 2.07$, $p < .02$.

In summary, data analyses of the RID tasks evidenced no significant differences between groups on the card color guessing task. Group performance on the mirror trace task was found to be significantly worse for both obese groups in terms of completion time and number of errors. Neither dependent measure on the mirror trace task indicated a significant effect for the externality factor.

Table 4

Analysis of Variance for Time on Mirror-Trace

Source	Sum of Squares	df	Mean Square	F
Mean	6858385.05	1	6858385.05	793.02
Weight	70018.30	1	70018.30	8.10*
Externality	1463.65	1	1463.65	0.17
W x E	399.96	1	399.96	0.05
Error	1349148.23	156	8648.39	
Trials	2765871.71	10	276587.17	224.11***
T x W	38268.71	10	3826.87	3.10**
T x E	2532.06	10	253.21	0.21
T x W x E	3401.15	10	340.12	0.28
Error	1925324.20	1560	1234.18	

* p .005

** p .0006

*** p .00005

Table 5

Analysis of Variance for Errors on Mirror-Trace

Source	Sum of Squares	df	Mean Square	F
Mean	873001.82	1	873001.82	451.57
Weight	12033.18	1	12033.18	6.22**
Externality	0.11	1	0.11	0.00
W x E	6330.82	1	6330.82	3.27
Error	301584.97	156	1933.24	
Trials	451807.45	10	45180.75	141.86***
T x W	6598.07	10	659.81	2.07*
T x E	1054.71	10	105.47	0.33
T x W x E	5231.88	10	523.19	1.64
Error	496854.98	1560	318.50	

* p .02

** p .01

*** p .00005

Discussion

If the RID and externality produce similar behavior patterns, as Singh claims, the analyses should have shown a significant effect for the externality factor. That is, the High External-Obese who are extreme in terms of both weight and externality should have been the slowest in inhibiting responses. Neither the card color guessing not the mirror tracing data displayed such an effect. The significant main effect for weight on the mirror tracing task replicated the findings of Singh et al. (1973) that the obese have lower performance scores. Mirror tracing requires that the subject inhibit the normal hand-eye coordination and develop a new hand-eye coordination in which forward and backward movements are reversed while left and right movements remain the same. A deficit in the ability to inhibit normal coordination therefore produces more errors. If externality produced the same effect as the RID, the High External-Obese subjects should have made more errors. This was not the case as the Low External-Obese made the most errors on every trial in the negative and reversal phases. It appears therefore that externality and RID are not related, at least on the mirror tracing task.

On the other hand, the card color guessing data did not evidence an effect for weight or for externality factors. The RID prediction that obese subjects would make more guessing errors is based on the assumption that they are less able to inhibit a well-learned response. There-

fore, in order for the RID to be evident, the response must be well-learned. This was apparently not the case for the "black" response which was to be induced by the first 90 cards. An indicator of the lack of sufficient manipulation is that the error scores for subjects in the present study are higher than those reported by Aves. In Aves' study the nonobese, fluctuators and obese error scores were 4.05, 4.05 and 5.85 respectively. Mean error scores in the present study (presented previously in Table 4) ranged from 6.23 to 7.35. A similar problem in inducing the "black" response was noted by Sikes (1974) who reported that only 15% of the subjects learned the "black" response on the first 90 cards. Therefore, it appears that an unsuccessful manipulation of previous learning in the present study negated the possibility of an RID effect on this cognitive task.

The mirror tracing task, which utilizes a more strongly established motor response, did evidence the RID for obese subjects regardless of externality score. This finding suggests that the RID and external responsiveness do not produce identical behavior patterns. Further support for this suggestion comes from Singh's own research. In contrast to Schachter's reports of obese individuals who are not externally responsive, Singh and his colleagues have never reported a similar anomalie in their RID research. If the RID were the same as external responsiveness, similar anomalies should have occurred. As previously stated, the present experiment is the first to include independent measures of

externality and RID, and the present results suggest that these two factors do not produce identical behavior patterns.

The present data also suggest that the RID may be a critical factor involved in discriminating between the High External-Obese and High External-Nonobese. The original position taken by Schachter was that individuals become obese because they are more externally responsive to food cues. However, since not all externally responsive people are obese, another factor must be involved. It is possible that the RID is this factor.

This possibility, along with other speculations are discussed further in Chapter 5. One final factor which may interact with weight and externality was examined in the present research program. The role of eating restraint is discussed in Chapter 4.

CHAPTER FOUR

Externality, Obesity and Eating Restraint

As was discussed in Chapter 1, research by Herman and his colleagues has suggested that dieting (or "eating restraint") can produce typically "obese" external responsiveness in non-obese subjects. Herman and Polivy (1975) developed the Restraint Scale, an 11-item questionnaire which assesses an individual's dieting history and general concern with food. Research employing the Restraint Scale generally uses a median split to identify restrainers and nonrestrainers in the non-obese population. Initial studies which employed this basic format demonstrated that the Restraint Scale has considerable predictive validity in that nonobese restrainers behaved much like the obese in terms of insensitivity to preload (Herman & Mack, 1975), and overeating in response to anxiety (Herman & Polivy, 1975) or depression (Polivy & Herman, 1976).

Although eating restraint appears to be related to externality on food-intake measures, it is not clear how eating restraint relates to externality in non-eating situations. The present research program, which had already assessed externality on the non-food tasks of time perception, emotionality ratings and immediate recall, assessed this relationship.

In addition, to date there has been only minimal research on Restraint Scale scores for obese subjects. The Herman and Polivy (1975) study inadvertently included five obese subjects, all of whom appeared to be restrained eaters. Herman and Mack (1975) reported that 12 obese subjects scored slightly, but not significantly higher on the Restraint Scale. Therefore, the more substantial sample of obese subjects in the present research provided a testing ground for the relationships among obesity, externality, and Restraint Scale scores.

Besides amplifying on restraint research per se, the present study included the Restraint Scale as another factor which may differentiate between High External-Obese and -Nonobese groups. As discussed in Chapter 1, it was reasoned that some high external individuals may avoid becoming obese by cognitive restraint. Therefore, if restraint is the critical factor, the High External-Nonobese should score higher on the Restraint Scale than do their obese counterparts.

Method

Subjects

The same 160 subjects who participated in the first two experiments completed the Restraint Scale. Included in this sample were 40 Low External-Nonobese, 40 Low External-Obese, 40 High External-Nonobese and 40 High External-Obese.

Procedure

After completing the cue salience experiment (see Chapter 2) and the RID tasks (see Chapter 3), each subject was asked to complete the Restraint Scale (Herman & Polivy, 1975). This questionnaire assesses an individual's dieting history and general concern with food. The Restraint Scale and its scoring key are presented in Appendix B.

Results

Each subject received an overall Restraint Scale score. Group means and standard deviations are present in the last column of Table 6. Planned comparison t-tests indicated that overall Restraint Scale scores were significantly higher for the obese than the nonobese, $t(79) = 4.15$, $p < .0005$. Moreover, the High External-Obese group scored significantly higher than did the Low External Obese, $t(39) = 2.46$, $p < .01$, while the difference between the nonobese groups was not significant, $t < 1.0$. In sum, these analyses of overall Restraint Scale scores indicated that the High External-Obese group scored the highest (22.30), followed by the Low External-Obese (19.10), and the two nonobese groups which did not differ from each other (9.75 and 10.11) The prediction that the High External-Nonobese would display the most restraint was obviously not supported, as this group scored significantly lower than both obese groups.

The Restraint Scale scores were analyzed further

Table 6

Average Restraint Scale Scores and Standard Deviations for Subjects Differing in Weight and Externality

Subject Group	Dieting History		Concern with Food		Overall Restraint	
	Mean	SD	Mean	SD	Mean	SD
Low External-Nonobese	4.87	(3.08)	4.88	(2.23)	9.75	(4.27)
High External-Nonobese	5.16	(2.85)	4.95	(2.40)	10.11	(4.51)
Low External-Obese	12.97	(5.28)	6.13	(2.19	19.10	(6.19)
High External-Obese	14.85	(5.48)	7.45	(2.83)	22.30	(6.86)

according to the two subscales: dieting history and concern with food. Since the history subscale contains items regarding pounds overweight, obese subjects might have scored higher on overall restraint simply because they weigh more. However, further *t*-tests using scores from the two subscales (first two columns of Table 6) produced the same pattern which was found using the overall Restraint Scale score. Compared to the nonobese groups, the obese groups displayed greater concern with food, as well as greater weight, with the High External-Obese again scoring the highest on both subscales, $t(39) = 2.44$, $p < .01$.

Thus, in all the analyses, the pattern of results remained the same. The obese subjects scored higher than the nonobese, High External-Obese scored higher than Low External-Obese, and the two nonobese groups were significantly lower but were not significantly different from each other.

Discussion

The prediction that eating restraint, as measured on the Restraint Scale, might account for High External-Obese and -Nonobese differences in weight was not supported by the present results. In fact, instead of being more restrained, the High External-Nonobese scored significantly lower than did the High External-Obese.

One explanation for these contradictory findings is that the Restraint Scale measures restraint attempts, not necessarily successful attempts. The Restraint Scale

has demonstrated predictive validity within the nonobese population, but it has been assessing restraint for these obviously successful restrainers. The results for the present obese sample suggest that more restraint, as measured by the Restraint Scale, does not necessarily result in successful weight control.

The significant main effect for weight is at least consistent with the incidental findings reported by previous restraint research. This consistency lends support to the above explanation, in that obese subjects in other samples have also demonstrated more, if not successful, attempts at restraint. In short, the obese apparently do attempt to restrain eating even more than their nonobese counterparts, but simply are less successful.

In the present sample of obese subjects, a significant difference in restraint scores was found between High External- and Low External-Obese groups. This finding suggests that external responsiveness, as defined by the premeasures of nonfood-related tasks, generalizes to self-reports of everyday eating-restraint attempts. That is, it appears that High External-Obese individuals may have to cope with more food cues because they are more responsive than are the Low External-Obese. This tentative suggestion is consistent with the results of the extreme salience manipulation in Experiment 1. Increased salience (both cognitive and illumination) produced increased consumption in the High External-Obese but did not affect the Low External-

Obese. Similarly on the Restraint Scale, High External-Obese subjects reported significantly more restraint attempts than did Low External-Obese.

This tentative suggestion, along with the other suggestions generated in the two experiments, are examined further in the following final chapter. Chapter Five presents a summary and analysis of the present research paradigm findings and their implications for behavioral control of obesity.

CHAPTER FIVE

Summary and Implications of Weight x Externality Research

Analyses of the various factors of the Weight x Externality paradigm were presented in the previous chapters. This final chapter attempts to synthesize and evaluate the research findings. The Weight x Externality paradigm was based on accumulating data which indicate that externality is not a direct function of weight. This paradigm was developed to include the groups typically studied in Schachter's research (High External-Obese and Low External-Nonobese), as well as those groups which have previously received less attention (Low External-Obese and High External-Nonobese). Since not all externally responsive individuals are obese, it was assumed that some other factor must interact with weight and externality. Two such factors were investigated in Experiments 1 and 2: cognitive control and the response inhibition deficit (RID). Data regarding eating restraint were also collected.

The Role of Cognitive Control

The role of cognitive control was investigated in a replication of Ross (1974). If cognitive control keeps some externally responsive individuals from becoming obese,

then increased cognitive salience should have produced a reduction in consumption for the High External-Nonobese group. The results of Experiment 1 indicated that increased cognitive salience produced higher, instead of lower consumption rates for this subject group. In fact, high cognitive salience of the food cues produced significantly higher consumption rates for all subject groups, except the Low External-Nonobese. These findings can be interpreted in two different ways. First, it could be argued that these data show no differences in cognitive control between High External-Obese and -Nonobese.

On the other hand, a less parsimonious interpretation is that high cognitive salience (instructions to concentrate on cashews) resulted in a break-down of any cognitive control the High External-Nonobese might have had. Therefore, perhaps results from illumination manipulation would be a better indicator of intact cognitive control. Increased illumination produced increased consumption for the High External-Obese, but the High External-Nonobese ate the same amount (in fact, slightly less) under high illumination levels. Perhaps these results suggest that increased food cue salience in terms of physical intensity (illumination) increases the High External-Nonobese's cognitive control, while increased cognitive salience breaks down their cognitive control. This second interpretation would be consistent with the research by Herman and his colleagues regarding a break-down in cognitive restraint (Herman & Mack, 1975; Herman & Polivy, 1975).

The present study did however collect data with Herman's measure of restraint. The results from the Restraint Scale clearly indicated that the High External-Obese reported significantly more eating restraint than did the High External-Nonobese. Therefore, this second interpretation of the cognitive factor findings does not have much empirical support. The former interpretation, that the High External-Nonobese do not exercise more cognitive control than do the High External-Obese, is both parsimonious and empirically supported. In short, cognitive control does not appear to be the crucial variable which prevents some externally responsive individuals from becoming obese.

The Role of Response Inhibition Deficits

Singh's RID theory was also explored as a possibly crucial factor in determining which externally responsive individuals become obese. On the mirror tracing task High External-Obese subjects displayed greater difficulty in inhibiting normal hand-eye coordination, while High External-Nonobese showed less RID. Therefore, RID may be a crucial factor in the Weight x Externality paradigm.

Although these data are exploratory in that this research program was the first to investigate differences between High External-Obese and -Nonobese, a tentative scheme can be proposed to integrate the findings. Externality, as defined by Schachter and his colleagues, appears to be related to the initiation of eating behavior. In Schachter's

words, "for any cue, a prominent stimulus is more likely to trigger an appropriate response from an obese than from a normal subject" (Schachter & Rodin, 1974, p. 65). It is this response triggering or initiation which is affected by externality. Thus, in externality research stimulus salience is manipulated with the prediction being that higher levels initiate the appropriate response.

Singh's RID theory, on the other hand, emphasizes the termination of an ongoing response. The basic tenet of this theory is that obese individuals "exhibit a generalized deficit in inhibiting responses, and hence in all those situations where an ongoing response is to be terminated, they respond longer than normal persons" (Singh, Swanson, Letz, & Sanders, 1973, p. 240).

The results of the present study can be interpreted in terms of this schema which distinguises between initiation and termination of eating behavior. Both High External-Obese and -Nonobese subjects appeared to be equally responsive to salient cognitive cues for the initiation of eating responses. The High External-Obese, however, displayed the RID. Therefore, it may be that some highly responsive individuals remain obese because they are less able to inhibit an ongoing eating response.

Consider, for the sake of exposition, a party situation with two main characters: a High External-Nonobese person and a High External-Obese person. Both party-goers are approached by the host who offers them some hors d'oeuvres.

This salient cue initiates an eating response in both externally responsive people. The High External-Obese person however, persists in eating longer, and consumes more than the High External-Nonobese person. Thus, although both were equally responsive to cues for eating initiation, they differ in ability to terminate the eating response.

This schema which considers externality to be the major factor in initiation and RID as the major factor in termination of eating behavior is consistent with the present results. Both High External groups responded to the cognitive salience increase but only the High External-Obese displayed the RID. There is however an important qualification. The present data regarding the RID were collected on a task involving motor performance. Although Singh's theory assumes that RID is a generalized characteristic which affects all response modes, the present study did not test for RID directly on a food intake task. Given this qualification, coupled with the fact that these data are preliminary findings from a recently developed paradigm, the above schema should be considered tenuous.

Even though tenuous, this schema suggests caution in designing externality or RID experiments. Many previous externality experiments have employed the "taste-test" cover-story which forces subjects to initiate eating, and then uses amount consumed as a measure of externality. Reinterpreted in terms of the above schema which differentiates between initiation and termination of eating behavior, these experiments

may have been measuring RID instead of externality.

The validity of this schema is, of course, an empirical question. At present, it is consistent with the otherwise contradictory findings that not all externally responsive individuals display the RID. In addition, this admittedly post hoc schema is at least consistent with Singh's own results. Both studies which produced evidence of the obese's RID on eating tasks (Singh, 1973; Singh & Sikes, 1974) used the "taste-test" cover story to get subjects to initiate the eating response. According to the present schema, this type of research design only serves to confuse the theoretical issues by combining initiation and termination of eating behaviors in the same task. The present hypothesis, that initiation of eating behaviors depends on externality and termination depends on RID, is readily testable and may help to resolve the theoretical debate.

The Present Anomoly

The major goal of the present research program was to account for the anomolies of past externality research, the High External-Nonobese and the Low External-Obese. As discussed above, it appears that the High External-Nonobese differ from their equally external but obese counterparts in terms of the RID. The discussion now considers the remaining group, the Low External-Obese.

The results of Experiment 1 indicated that consumption rates for the Low External-Obese group closely paralleled

those of the High External-Nonobese group. Both groups increased consumption with increased cognitive salience, and both groups failed to respond to the illumination manipulation. This similarity of results for groups which differed in terms of both weight and externality ran counter to both tentative predictions generated from the Weight x Externality paradigm.

On the RID task, the performance of the Low External-Obese group approximated the High External-Obese's performance. Both obese groups displayed more difficulty in inhibiting normal hand-eye coordination. The responses of the Low External-Obese to the Restraint Scale were unique in that they scored significantly below the High External-Obese and significantly above the two nonobese groups. In short, the only group that the Low External-Obese did not resemble was the Low External-Nonobese group.

These data suggest that some other factor may be needed to account for the behavior of the Low External-Obese group. From the viewpoint of the present research program, the most interesting comparison is between the High External-Obese and Low External-Obese. That is, given that both groups are equally obese, what other factor might account for the differences on the externality factor? Obviously, the RID factor does not discriminate between the two groups because they displayed similar levels of RID. The Restraint Scale scores did show a significant difference between the two groups, therefore the theoretical rationale for this

questionnaire will be examined further.

The Restraint Scale was based on Nisbett's "set point" theory which was discussed in Chapter 1. According to this theory, external responsiveness will occur for any organism which is below its biologically dictated set point for weight. As discussed earlier, Herman and Polivy (1975) developed the Restraint Scale as a measure of distance from set point for the nonobese population. Therefore, if it can be assumed that this measure also holds for the obese population, then the present results support Nisbett's theory. That is, obese individuals who were highly responsive on the premeasures of externality, scored significantly higher on the Restraint Scale. The other obese group who were less responsive on externality premeasures had significantly lower Restraint Scale scores. This correspondence between externality and Restraint Scale scores suggests that perhaps the two obese groups differed in terms of biological set point for weight.

Since the Restraint Scale was developed using non-obese samples, the above suggestion is extremely tenuous. It could be bolstered through a second independent measure of the obese's distance from set point. In the medical literature, a direct measure of adipose tissue set point is taken by a needle biopsy (Penick & Stunkard, 1973). This measure was obviously not included in the present research. Nisbett (1972) suggested the indirect measure of percentage overweight. His rationale for this operational measure was that individuals who are extremely overweight (40% or more)

would be closer to set point. Rodin (1975), on the other hand, argued that closeness to set point could be more accurately inferred from long-term weight stability. She reasoned that obese individuals whose weight had been stable for two years would be closer to set point than would individuals whose weight fluctuated.

Unfortunately, neither of these two operational definitions of distance from set point were appropriate for the present post hoc comparison of High and Low External-Obese. The groups were equivalent in terms of percentage overweight (see Table 1) and data were not collected on weight stability. Although the Restraint Scale scores suggest that the High and Low External-Obese differ in terms of set point, the present research did not include any other data which would validate this suggestion. Therefore, the above suggestion remains extremely tenuous and requires further research.

In summary, the results of Experiment 1 indicated that High and Low External-Obese groups responded differently to external food cues. This difference might be due to a difference in set point because increased externality has been associated with increased distance from set point. In the present study distance from set point was measured on the Restraint Scale and this measure indicated a significant difference between the two groups. However, further data is required in order to determine the construct validity of Restraint Scale scores for obese subjects.

Implications for Behavioral Control of Obesity

The major focus of the present research program was theoretical in examining the viability of an extension of Schachter's externality theory. But the results obtained for the two obese groups do suggest certain implications for the behavioral control of obesity. Although obesity treatment programs have developed some successful techniques, it is becoming increasingly evident that not all techniques are equally successful for all obese individuals. For example, Jeffery and Coates (1978) have recently pointed out that "needed may be a conceptual framework which can incorporate other critical variables and useful techniques" (p. 858). The present Weight x Externality paradigm, if tested further, may serve to fill this need. This section examines the possible (albeit tentative) applications of the present research results to the behavioral control of obesity.

In order to maximize the effectiveness of behavioral control of obesity, a recent trend has been towards identifying person characteristics which interact with different treatment techniques. Bellack (1975) developed a strategy for assigning subjects to optimal obesity treatments. His procedure includes identifying characteristics necessary for a specific treatment, and then evaluation of the treatment with clients who are either high or low on these characteristics. Bellack reported that this strategy proved to be effective for matching obese clients with high self-reinforcement style to self-monitoring treatment.

The person characteristic of external responsiveness has not been explicitly used in obesity treatment programs, but it does appear to be related to stimulus control techniques which reduce available food cues. The results of the present cue illumination manipulation are relevant to stimulus control techniques. As reported earlier, the High External-Obese subjects increased consumption under increased cue illumination, while consumption rates for the Low External-Obese remained the same. Based on these results, it might be speculated that High External-Obese subjects would benefit more from techniques which reduce food stimulus saliency. This prediction could be investigated using Bellack's strategy: identify High and Low External-Obese groups and then evaluate the relative efficacy of stimulus control techniques. Again, these speculations are based on preliminary data and therefore require more supportive evidence before implementing a client-treatment strategy based on external responsiveness.

The data collected on the Restraint Scale are at least consistent with the assumption that differences exist within the obese population. The finding that High External-Obese subjects report more eating restraint than do the Low External-Obese suggests that they have more food cues with which to contend. Therefore, reduction of these cues may be a more effective strategy with High rather than with Low External-Obese.

The previous post hoc suggestion that High External-Obese may have a higher biological set point for weight is

relevant to the issue of early intervention in obesity control. Research by Hirsch and his colleagues (Hirsch & Knittle, 1969; Salons, Knittle & Hirsch, 1968) indicated that the number of fat cells is determined early in life. Since increased number of fat cells increases the body's set point for weight, it is essential that childhood obesity be treated as early as possible.

Since both obese groups appear to exhibit the RID, treatment programs might focus on techniques which assist in terminating an eating response. Having smaller portions or preparing only one portion at a time may be useful if seeing a clean plate is necessary to terminate the response. Also, increased control over the act of eating, for example by introducing pauses, may be effective in reducing the RID. Again, early intervention during childhood would be recommended in order to develop the proper responses. If obese individuals are slower to inhibit a dominant response, then it is imperative that proper eating habits be developed early in life.

Discussing the need for a new conceptual framework, Jeffery & Coates suggested that the new model should be able to incorporate the critical factor of cognitions (e.g. Mahoney & Mahoney, 1976). The present results of Experiment 1 likewise pointed out the major role of cognitions in eating behavior. If cognitions can increase eating behavior, then cognitions should also be able to decrease eating behavior. Although studies demonstrating the former effect

(e.g., Herman & Mack, 1975; Polivy & Herman, 1976a) outnumber the latter effect, one recent study attempted to decrease eating behavior by increasing attention to eating.

Pliner and Iuppa (1978) hypothesized that increased attention to eating, induced by having subjects observe themselves in a mirror, would decrease food intake for obese subjects. It was further hypothesized that nonobese subjects would be less responsive to the attention manipulation. Their results indicated a significant effect for increased attention. Compared to obese subjects who did not view themselves in a mirror, obese subjects who ate while facing a mirror consumed significantly less. In fact, increased attention also produced significantly lower consumption for nonobese subjects. These findings are encouraging because they indicate that cognitive control can increase eating restraint.

These findings can also be interpreted in terms of the Weight x Externality paradigm. Pliner and Iuppa's hypotheses were derived from Schachter's externality theory, and therefore predicted obese-nonobese differences in response to the external cue provided by the mirror. However, Pliner and Iuppa also reported that the subject groups were comparable on a number of premeasures which included the Restraint Scale. Therefore, if Restraint Scale scores reflect external responsiveness, it appears that obese and nonobese subjects were identical in terms of externality. Thus, the Weight x Externality paradigm would have predicted the lack

of obese-nonobese differences in responsiveness to the external cue. This is an empirical question, which the present author is pursuing (Buser, Note 1), and therefore will be answered at a later date. At present, the Weight x Externality paradigm suggests that some obese individuals (i.e., the Low External-Obese) may not be as responsive to certain treatments which attempt to increase cognitive control.

The above suggestions for applying the Weight x Externality paradigm to treatment programs are tentative, and depend upon further experimentation to determine their viability. In the meantime, this paradigm appears to meet some of the model requirements put forward by Jeffery and Coates. Whether this appearance is more than face validity remains an empirical issue.

Conclusions

This final chapter has dealt with theoretical and treatment-oriented speculations which the present data appear to suggest. Being the initial investigation of the Weight x Externality paradigm, however, these speculations must be taken as extremely tenuous. Instead of extrapolating too much from the data, the viability of the paradigm itself must be established by further experimentation.

The rationale underlying the paradigm itself has received some support. Externality, as measured on cognitive tasks, was found to affect food intake. Schachter's groups

behaved in accordance with the externality theory of obesity while the other two groups behaved differently. Weight, per se, is not the major determinant of food intake. Rather, the interaction between weight and externality appears to determine reactions to food salience.

In addition, the paradigm displayed some usefulness in identifying the RID as a possibly critical factor in differentiating between High External-Obese and -Nonobese groups. Similarly, the Restraint Scale appeared to differentiate between High and Low External-Obese, although the underlying factor for this difference could not be determined.

The Weight x Externality paradigm is far from a panacea for behavioral treatments of obesity. In fact, although the conceptual model is appealing, it appears to have raised more issues than could be answered by the present data. On the other hand, each of the issues is open to investigation thereby indicating at least heuristic value.

Similarly on a theoretical level, the Weight x Externality paradigm did not resolve all the issues. On the positive side, Schachter's externality theory was supported when considering the more typical High External-Obese and Low External-Nonobese. However, many of the questions which plagued Schachter's theory are still unanswered. For example, how does external responsiveness develop? A recent report by Isbitsky and White (Note 2) found that obese and nonobese children both displayed external responsiveness on food- and nonfood-related tasks. Therefore, is externality a charact-

eristic that all people have during childhood, but which some people "grow out of"? Another question which is unresolved has been raised by Herman, Polivy, Pliner, Threlkeld and Munic (1978). They interpret externality in terms of heightened arousal or arousability, so is externality a reversable state and not an enduring trait?

The list of unanswered questions could continue indefinitely. In closing, the author agrees with Rodin's (1977) statement that the literature on obesity reads like the blind men describing an elephant, each touching a different part of the elephant's body. The intent of the Weight x Externality paradigm was to bring these described parts a bit closer.

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Appendix A

Verbatim Account of Taped Instructions for Cognitive Manipulations

(adapted from Ross, 1974)

Below are the taped instructions which were identical for all groups up to the crucial point at which the manipulation of cognitive salience occurs.

> The instructions you are receiving now are pre-taped for three reasons: First, and most important, it allows us to coordinate each thinking task and instructions with the physiological record we obtain from you. Secondly, it removes the possibly distracting influence of the experimenter. Thirdly, it guarantees that all experimental subjects will be exposed to identical stimuli.
>
> As the experimenter has explained, we want you to be relaxed and to react naturally. Ignore the recording electrodes as much as you possibly can. The only restriction we wish you to observe is that you refrain from smoking. Please remain seated facing the table throughout the experiment. Please pay close attention to the instructions. Do not keep your eyes closed when you are asked to think, keep them open naturally.

One half of the obese subjects and one half of the nonobese subjects received one of the following sets of eight communications designed to manipulate the cognitive salience of the cashews. Each communication lasted between 15 and 20 seconds followed by 40 to 45 seconds of silence.

High Cognitive Salience Communications

For the next few minutes we would like you to think about cashew nuts like those on the table in front of you right now. Relax, and think about the cashews; think about seeing them; think about eating them. Think about this for a while until you hear the tape again. Remember not to keep your eyes shut.

Now think about the taste of the cashews. Sit back and think about the light salty taste, the rich toasted quality and the taste of really fine cashews. What other adjectives describe that rich, yet elusive taste? Can you think of any? Try to, as you continue to think about cashews for the next little while.

Are you finding it difficult to keep thinking about cashews? Relax and consider for a while their texture and the way it feels when you eat cashews. They are firm and crunchy as they resist your bite. Think about the texture, the sensation you get as you crunch them between your teeth. Remember you can do what you wish. Only your thinking is being directed now.

Are you having difficulty thinking about cashew nuts continually or do you find it easy to relax and savor the thought of their salty toasted taste and their texture and how they feel as you crunch and grind them in your mouth?

Consider the aroma of the cashews when they are warm and just freshly roasted. Is there a good adjective to accurately describe the aroma? Can you think of one? Can you manage to keep thinking about the taste, texture and aroma of fine fresh cashews for a little while longer?

Are you enjoying sitting there relaxing, savoring the thought of cashew nuts, musing perhaps for the first time about the details of their taste, feel and aroma, and how they contribute to the sensations of taste and touch. Please keep thinking about cashews.

Perhaps you are finding it difficult to keep your attention on cashew nuts. It's amazing how difficult it is sometimes to keep your mind on one topic even one as pleasurable as cashew nuts. Can you find some other aspect of the nuts besides their satisfying toasted, salted taste which will hold your attention? Please try now.

Alright, we are nearly finished. Just a little

while longer. Keep thinking about the golden cashews--firm, satisfying, warm, rich aroma, delicate toasted taste. A little while longer please. Relax and keep thinking about the cashews.

Fine, that concludes our thinking session. The experimenter will be with you in a minute.

Low Cognitive Salience Communications

Alright, for the next few minutes we would like you to think about marbles like those on the table in front of you right now. Relax and think about the glass marbles, about seeing them, handling them, playing with them. Think about this for a while until you hear the tape again. Remember not to keep your eyes shut.

Now think about the way the different marbles look. Think of the colors, about the clear rich quality in the colors of really fine marbles. What other adjectives describe that rich glistening quality of the glass marbles? Can you think of any? Try to, as you continue to think about marbles for the next little while.

Are you finding it difficult to keep thinking about the marbles? Relax and consider for a while the hard smooth way they feel when you hold them, or play with them. They are shiny and hard and sort of crack if you grind them together in your hand. Think about this sensation. Remember you can do as you wish. Only your thinking is being directed.

Are you having difficulty thinking about marbles continually or do you find it easy to relax and enjoy the thought of the delicate colors, their gleaming hard finish, the quiet satisfaction associated with handling them and playing with them? Try your best to keep thinking about this.

Consider the games you used to play with marbles. Think of holding one in the crook of your finger as you aim and prepare to knock another one out of the circle. Think of the other games that you played. What are they? How do you play them? Can you manage to keep thinking about this for a while longer?

Are you sitting there relaxing, savoring the variety of marbles--associations they provide,

musing perhaps for the first time about the details of their various colors and designs and how it feels to handle them and play with them? Please try to keep thinking about marbles.

Perhaps you are finding it difficult to keep your attention on marbles. It is amazing how difficult it is sometimes to keep your mind on a single topic even one as pleasurable and rich in associations as marbles. Can you find some other aspect of the marbles besides their appearance to hold your attention a while longer. Please try.

Alright, we are nearly finished. Just a little while longer. Keep thinking about the multi-colored marbles--creamy whites, lustrous rich reds, greens, blues, shining clear hard glass. A little while longer please. Relax and keep thinking about marbles.

Fine, that concludes our thinking session. The experimenter will be with you in a minute.

Appendix B:

Restraint Scale
(adapted from Herman & Polivy, 1975)

Diet and Weight History

1. How many pounds over your desired weight were you at your maximum weight? (score: 1 point/5 pounds)

2. How often are you dieting?
   Rarely
   Sometimes
   Usually
   Always
   (score 1-4)

3. Which of the below best describes your behavior after you have eaten a "not allowed" food while on your diet?
   Return to diet.
   Stop eating for an extended period of time in order to make up for the extra calories.
   Continue on a splurge.
   Eat other "not allowed" foods.
   (score: 0-3)

4. What is the maximum amount of weight that you have ever lost within 1 month? (score: 1 point/5 pounds)

5. What is the maximum amount of weight that you have ever gained within a week? (score: 1 point/3 pounds)

6. In a typical week, how much does your weight fluctuate? (score: 1 point/3 pounds)

Concern with Food and Eating

7. Would a weight fluctuation of 5 pounds affect the way you live your life?
   Not at all
   Slightly
   Moderately
   Very Much
   (Score: 0-3)

8. Do you eat sensibly before others and then make up for it when you are alone?
   Never
   Rarely
   Often
   Always
   (score: 0-3)

9. Do you give too much time and thought to food?
   Never
   Rarely
   Often
   Always
   (score: 0-3)

10. Do you have feelings of guilt after eating too much?
    Never
    Rarely
    Often
    Always
    (score: 0-3)

11. How conscious are you of what you are eating?
    Not at all
    Slightly
    Moderately
    Extremely
    (score: 0-3)