AN EXTENSION OF RACHLIN'S COMMITMENT MODEL TO OBESE AND NORMAL WEIGHT ADULTS

by

Maria Zakrzewski

A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Greensboro
1977

Approved by

Rosemary O. Nelson

Dissertation Adviser

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of the Graduate School at the University of North Carolina at Greensboro.

Dissertation Adviser Rosemery O. Nelson

Committee Members P. Scott Lawrence

Donald H. Wedding

R. Soderquist

John Clinton Busch

August 25, 1977

Date of Acceptance by Committee

ZAKRZEWSKI, MARIA. An Extension of Rachlin's Commitment Model to Obese and Normal Weight Adults. (1977)
Directed by: Dr. Rosemery O. Nelson. Pp. 78.

Behavior therapists are employing self-control techniques to reduce the frequency of behavior such as overeating and smoking. Self-control becomes necessary when a person is faced with a choice between two incompatible responses. One response (lack of self-control) leads to immediate reinforcement, and the other response (self-control) is followed by delayed reinforcement. One class of techniques involved in self-control is stimulus control. Using stimulus control, a person sets up the environment to avoid the difficult choice situation and thus respond in accordance with the long term contingencies. Rachlin's term for stimulus control is "commitment strategy." Prior research on the commitment model used pigeons and children as subjects. The present study investigated the applicability of Rachlin's commitment model to normal-weight and obese adults.

Two hypotheses were tested. The first hypothesis predicted that as the choice point between a small immediate reinforcer and a larger delayed reinforcer is removed in time from delivery of the reinforcers, subjects would increasingly select the larger delayed reinforcer instead of the small immediate reinforcer. Rachlin indicated that subjects would employ the commitment strategy instead of "brute force self-control." The second hypothesis predicted differences in the way normal weight and obese subjects would respond in the

test situation. The prediction was that the normal weight subjects would exhibit self-control with shorter delays than the obese subjects and that the obese subjects would employ the commitment strategy more often than the normal weight subjects once they started exhibiting self-control.

An analog situation, similar to that used by Rachlin, was employed to test the two hypotheses. The reinforcer was listening to music that the subjects indicated they wanted to hear. The small immediate reinforcer was music lasting ten seconds followed by a thirty-second blackout before the next trial began. The larger delayed reinforcer consisted of a ten-second delay followed by thirty seconds of music. Each trial consisted of two stages. The first stage involved the subjects' responding on two buttons to set the events for the second stage. After pushing the two buttons, there was a delay, which varied as an independent variable. Three delay intervals were used: one second, fifteen seconds, and forty-five seconds. If the last response during the initial stage was on the left-hand side, only one button was operative after the initial delay. Pushing this button led to the larger delayed reinforcer. If the last response was on the right-hand side, two buttons were operative after the initial delay. One button led to the larger delayed reinforcer, and the other button produced the small immediate reinforcer. Ten female undergraduate students served as subjects. Five of the subjects were normal weight, and the other five were between forty and fifty percent overweight.

The results indicated that the normal weight subjects consistently chose the small immediate reinforcer less often than the obese subjects. As the delays increased, most subjects tended to reduce the number of times they chose the small immediate reinforcer. Only the obese subjects significantly reduced the frequency of selecting the small immediate reinforcer. Both the normal weight and obese subjects chose the commitment strategy and "brute force self-control" equally, once they started exhibiting self-control.

ACKNOWLEDGMENTS

The author gratefully acknowledges Dr. Rosemery O. Nelson, who served as chairwoman, for her help in all phases of this research. The author appreciates the suggestions of Dr. P. Scott Lawrence, Dr. David R. Soderquist, Dr. Donald G. Wildemann, and Dr. J. Chris Busch for the preparation of this dissertation.

A special debt of thanks goes to the people in the Operant Laboratory for their assistance in putting together the equipment for this dissertation.

The author wishes to thank her laboratory assistants, Robin Edwards and Pam Laughon, for their time and help in data collection.

TABLE OF CONTENTS

Page

APPROVAL PAGE ii

ACKNOWLEDGMENTS iii

LIST OF TABLES. v

LIST OF FIGURES vi

CHAPTER

I. INTRODUCTION 1

Rachlin's "Commitment Model" 3
Characteristics of Obese Subjects. 15
Statement of Problem 23

II. METHOD 25

Experimental Design. 25
Subjects 25
Experimenters. 27
Apparatus. 27
Procedure. 30

III. RESULTS. 36

Individual Data. 36
Group Data 39
Self-Report by Subjects. 48

IV. DISCUSSION 49

BIBLIOGRAPHY. 58

APPENDICES. 63

A DESCRIPTION AND RESULTS OF PILOT WORK 63
B "IMPORTANCE OF MUSIC" RATING SCALE. 77
C AGREEMENT TO PARTICIPATE IN THE STUDY IN EXCHANGE FOR CREDIT AND A GIFT. 78

LIST OF TABLES

TABLE		Page
1	Each Subject's Height and Weight	26
2	List of Albums Recorded for Subjects' Listening. .	28
3	Mean Number of Responses Per Key For Each T Value.	42
4	Analysis of Variance Summary Table for K-1 (Commitment Key)	44
5	Analysis of Variance Summary Table for K-2 (Lack of Self-Control)	45
6	Analysis of Variance Summary Table for K-3 ("Brute Force Self-Control")	46
7	Analysis of Variance Summary Table for the Ratio of K-1/(K-1 + K-3)	47
A-1	Description of the Various Parameters Employed During Pilot Work for the Six Groups	64
A-2	Mean Percent of Responses on Each Key for Each Subject at Both T Values	68

LIST OF FIGURES

FIGURE		Page
1	Diagram of Panel Used to Explain Procedure to Subjects	29
2	Number of Times Each Key Was Chosen by Normal Weight Subjects	37
3	Number of Times Each Key Was Chosen by Obese Subjects	38
4	Mean Number of Times Each Key Was Chosen by Each Weight Group on Each Session	40
A-1	Percentage of responses on each key for both T values, pilot subject JM	70
A-2	Percentage of responses on each key for both T values, pilot subject JR	71
A-3	Percentage of responses on each key for both T values, pilot subject CA	73

CHAPTER I

INTRODUCTION

Interest in self-control has grown in recent years (Mahoney & Thoresen, 1974; Thoresen & Mahoney, 1974). In the past, self-control was assumed to be different from external control. It was felt that self-control was the exercise of willpower, in which a person was able to control his or her own actions apart from external contingencies. However, as people became more concerned with their weight, smoking habits, and other behaviors which seemed to require self-control, the social learning psychologists turned their attention to self-control in the context of external control.

Clinical psychologists have attempted many techniques to control such behaviors as overeating (Hall & Hall, 1974; Jeffrey, 1974) and smoking (Bernstein, 1969), usually with little success. Self-control procedures may prove more profitable than therapist-controlled procedures. In self-control the client is taught a technique which may be applied to any situation that occurs in the natural environment. Such a procedure may increase generalization outside the therapist's office, especially since many environments cannot be totally controlled. Self-control techniques offer the client a more active role in the therapy process and, thus, may ensure greater success than in the past.

Behaviorists interested in the area of self-control have redefined the concept of self-control. Rather than differentiating between internal and external control, both are seen to be a function of external environmental consequences. Situations in which self-control is demonstrated generally consist of two consequences: the immediate reinforcing consequence of a particular behavior, and the long term reinforcing consequence of not engaging in that behavior. An example is a person trying to lose weight. If the person is presented with a tempting piece of cake, the choice is either eating the cake or refusing it. If the cake is eaten there is the immediately reinforcing consequence of having eaten it. The alternative response, not eating the cake, would contribute to weight loss, which would be evident only in the long-run. Both of these responses are controlled by external contingencies. The first is the taste and delight of eating the cake, and the second is losing weight. The basic difference between the two alternatives is the time at which the reinforcing consequences follow the behavior. The latter response, not eating the cake, is generally viewed as self-control. Another instance in which self-control might be demonstrated is when the immediate consequence for performing the behavior is aversive, but the long-term consequence for not performing the behavior is more aversive. An example of this type of situation might be a young person exercising daily to decrease the probability of a heart

attack during middle age. The present paper will discuss a view of self-control proposed by Rachlin (Baum & Rachlin, 1969; Rachlin, 1974, 1975). Research which led to Rachlin's "commitment strategy" and some resulting research will be covered. A discussion of a popular self-control subject, overeating, will then follow. Finally, a study applying Rachlin's model to normal weight and obese adults will be presented.

Rachlin's "Commitment Model"

Rachlin (Baum & Rachlin, 1969; Rachlin, 1974, 1975) has formalized a view of self-control. According to Rachlin there are three types of self-control. One is what Rachlin has termed "brute force self-control." In such a situation a person simply makes a decision to do the appropriate thing to achieve the long-term reinforcer. In the above example of the dieter, the person would simply refuse to eat the cake. A second type of self-control has been termed "self-reinforcement." In this instance, the person sets up certain reinforcing events contingent on the occurrence of the appropriate response. In a sense, the person is bringing the long-term reinforcing events closer in time to the occurrence of the desired response by administering supplementary reinforcers. In the above example, the person may be reinforced for not eating the cake by engaging in some other reinforcing activity. The third type of self-control is what Rachlin called the "commitment strategy." In a

commitment strategy the person makes the decision beforehand as to what the course of action will be. The decision is made far enough in advance so that the reinforcement value of either of the alternatives is more equal, and even in favor of the desired response, than it would be at the time of being presented with the choice. The reinforcement value is dependent on a number of factors, two of which are the amount of the reinforcer and the delay. As the delay of the reinforcer is increased, its relative value changes according to a formula derived by Rachlin. The early decision prevents the choice from being made at a later time when the reinforcement value of the piece of cake is higher than losing weight. It may be viewed as an easier choice to make, since it is removed in time from the more difficult choice (which would involve "brute force self-control"). Referring to the above example, the person would decide beforehand to either avoid places that have cake or plan a menu for the day. A group called "Overeaters Anonymous" employs a commitment strategy for its members. Every morning each member calls a sponsor and tells the sponsor what he will be eating for that day. No contingencies are specified for going off the planned menu.

Rachlin's last type of self-control as a commitment strategy grew out of the operant work on concurrent schedules. In a concurrent situation, the subject is presented with two or more alternative responses, each associated with its own

schedule of reinforcement. Herrnstein (1961) proposed the "matching law," which states that the relative rate of responding on one of two keys will match the relative rate of reinforcement for that key. The equation for this relationship is: $R_1/(R_1 + R_2) = r_1/(r_1 + r_2)$, where R_1 and R_2 are the number of responses on each key, and r_1 and r_2 are the rates of reinforcement for each key. Further studies have indicated that other variables must also be taken into account. Catania (1963) found that the relative frequency of responding matched the relative amount of reinforcement (in terms of duration of food presentation). Chung and Herrnstein (1967) found that relative frequency of responding matched the relative immediacy of reinforcement (defined as the inverse of the delay of reinforcement).

Baum and Rachlin (1969) provided an alternative form of the matching law in terms of time allocation. In the original formula, as proposed by Herrnstein, relative rates of responding were determined by relative rates of reinforcement with the assumption that the time base from which the rates were determined was the same. (The frequency of responding is defined as the product of the rate of responding times the session time.) Baum and Rachlin proposed that a time allocation model might be more appropriate. According to this model, the local time spent on each key rather than the session time was used, and the rate of responding was assumed to be equal on both keys. The new model predicted

that relative time spent, instead of relative rate of responding, was a function of relative rate of reinforcement: $T_1/(T_1 + T_2) = r_1/(r_1 + r_2)$. Expanding on this argument, Baum and Rachlin determined that the time allocation model could account for the results of Herrnstein (1961), Catania (1963), and Chung and Herrnstein (1969). A general formula, $T_1/T_2 = \prod_{j=1}^{n} \frac{x_{1j}}{x_{2j}}$ was proposed to take into account any number of reinforcement parameters possible. The formula states that the ratios of the times spent on either key is the product of the ratios of the reinforcement parameters used, such as rate, amount, and immediacy. Finally, Baum and Rachlin suggested that this product be called the "value" of a particular activity, and thus the ratio of the times spent engaging in either of two activities is equal to the ratio of the values of the two activities.

Ainslie (1970) conducted an experiment in self-control with pigeons. The pigeons were initially presented with a red key. If they pecked the red key, food was made available for 1.5 seconds. If they did not peck the key for 2.5 seconds, they then received four seconds access to food. The pigeons always pecked the red key. Ainslie then introduced another contingency. A white key light was presented several seconds before the red key was due to go on. If the pigeons pecked the white key, it cancelled the red key, and after a short delay, food was made available for the four-second duration. However, if the pigeons did not peck the

white key, the red key came on, leading to the 1.5 second access to food. The data indicated that the pigeons pecked the white key, and thus prevented the later choice on the red key. Rachlin (1970) discussed this study in terms of self-control. As the choice point (between a smaller, immediate reinforcer and a larger delayed reinforcer) is removed in time from access to the immediate reinforcer, self-control (choosing the larger delayed reinforcer) is more likely to be demonstrated.

Rachlin and Green (1972) studied the Baum and Rachlin (1969) model of choice behavior and suggested it as a model for a commitment strategy of self-control. According to these authors, when presented with a choice of responses, an organism will engage in the behavior which at the time has the highest relative value. As mentioned earlier, self-control occurs in situations in which two choices of responding are available. One course of action leads to immediate reinforcement and the other leads to reinforcement at a later time. Rachlin and Green examined this model by changing reinforcement values of the two activities over a period of time also using pigeons as subjects. Two white keys were illuminated during the first stage of a two stage design. After twenty-five responses on the keys, there was a blackout period of varying length. The last response on the white keys determined the events of the second stage of the study. If the last response on the white keys was on

the right side (choice side), two different keys were lit at the end of the blackout. This time one key was red and the other was green. One peck on the red key led to immediate access to food for two seconds, followed by another blackout. A peck on the green key led to a 4-second blackout, followed by 4 seconds access to food. However, if the bird had last pecked the white key on the left side (commitment side) during the first stage, only the green key was lit after the first blackout, and thus only the larger delayed reinforcer was available. The formula used to predict the birds' responding was: $V_1/V_2 = A_1/A_2 \times D_2/D_1$, where A_1 and A_2 were the reinforcement durations and D_1 and D_2 were the delay times (the blackout following the last response on the white keys). This formula predicted that when the initial blackout was less than four seconds, the birds would choose the choice side, and then the smaller, immediate reward. When the initial blackout was longer than four seconds, the birds would choose the commitment side. The data indicate that the commitment model was appropriate for the pigeons in this situation; as the delay was increased, the pigeons showed a change in preference by more often selecting the larger, delayed reinforcer.

As the research by Herrnstein (1961) and Rachlin and Green (1972) has shown, pigeons when presented with a choice between a small, immediate reinforcer and a larger, delayed reinforcer, will most often select the smaller, immediate

reinforcer. Although the question of ability to delay reinforcement in humans has received theoretical consideration in terms of ego development and socialization, very little experimental work has been conducted using human subjects. The basic paradigm of the few studies that have been conducted has been to present the subjects with a choice between an immediate reward and a delayed reward, and then have the subjects indicate a preference. Most of these studies have employed children as subjects.

Irwin, Armitt, and Simon (1943) conducted a study in which children expressed a preference for either of two toys which were of equal value. Each child was told that he would receive one of the toys immediately and the other toy in one week. He was then asked which toy he would like to play with for a while. Each toy was presented to different children as either the immediate or delayed reward an equal number of times. The results indicated that the children preferred the immediate toy over the delayed toy significantly more often.

Grusec (1968) extended this idea and varied the value of the delayed reinforcer. The value of the delayed reward varied from being equal to the immediate reward to being of much greater value than the immediate reward (e.g., 25¢ now versus 25¢, 30¢, 45¢, or 50¢ in two weeks). Four sets of rewards were used. The results showed that as the value of the delayed reward increased in relation to the value of the

immediate reward the children tended to choose the delayed reward more often.

Both of the above studies used a constant delay time. Mischel and Grusec (1967) and Mischel, Grusec, and Masters (1969) varied the delay time to determine the effect of delay of the subjects' evaluations of the reward. The immediate and delayed rewards were of equal value and the delay time varied from one to thirty days. The results of these two studies indicated that as the delay increased, the subjective values of the delayed rewards decreased.

Rotter (1973) has suggested that there are two aspects of reinforcement which determine the occurrence of a response. One aspect is the value of the reinforcer. Rachlin's formula is concerned with determinants of the reinforcement value in a choice situation. The second facet is expectancy, which Rotter defines as

> The probability held by the individual that a particular reinforcement will occur as a function of a specific behavior on his part in a specific situation or situations. Expectancy is independent of the value or importance of the reinforcement. (p. 107)

Two studies have investigated the role of expectancy in a choice situation involving delayed reward. Mahrer (1956) trained his subjects to different degrees of expectancy. The children came to the lab five consecutive days. Each day they were promised that they would receive a balloon the next day. Expectancy levels were varied by following through with

the promise either four, two, or zero times over the five days. After training was completed, the children were tested on delay of reinforcement. The immediate reward was of lower value than the delayed reward. The children were then asked which reward they wanted. The results showed that as the expectancy for the delayed reinforcement decreased, the children were more likely to select the immediate reinforcer. Expectancy was also varied in the previously discussed study by Mischel and Grusec (1967). The children were to select between a small immediate reward and a larger delayed reward. The children were told the probability of receiving the delayed reward. The delay was held constant at seven days for the three expectancy levels. The findings of this study supported those of Mahrer: as the expectancy of getting the delayed reinforcer decreased the children chose the immediate reinforcer more often.

Rachlin (1975) described ongoing research with children to study the commitment model. A laboratory analog was used so that the children were exposed to the same situation as the pigeons, except that five different keys were employed and the reinforcer was music instead of grain. The preliminary findings, based on one subject, suggested that the child did not respond in the same way as the birds in this situation. A shaping procedure was employed to introduce the children to the response panel. Only the "choice side" was presented for the first four days. After some initial

random responding, the girl started indicating a preference for the small, immediate reinforcer. She was then presented only the "commitment side." When this learning period ended, all of the response buttons were made available. Up to this point, the child's responding paralleled the pigeons'. When all of the buttons were available, the child's responding was different from the pigeons' pattern of responding. The girl picked the choice side about as often as the commitment side. However, when presented with the choice side, the child still selected the larger, delayed reinforcer (demonstrated "brute force self-control"). Rachlin suggested that the reason for this might have been that the pigeons responded in a one to one relationship to the individual reinforcers: each trial was a discrete unit, totally separate from the other trials. For the child, responding may have been over the session rather than trial by trial. Thus, one may speak of the meaningful rate of reinforcement for the child as being different from the meaningful rate of reinforcement for the birds. For the birds, there was a one to one relationship between responses and reinforcers. For the child, there was not this one to one relationship; rather the times involved were somewhat longer: "the rewards and the responses happen to be integrated over a longer period" (Rachlin, 1975). If this were the case, then the time intervals specified in the design of the study may not have been the same as the intervals to which the girl was responding.

Burns and Powers (1975) tested the commitment model using two children. Again, the procedure was similar to that used by Rachlin and Green (1972), except that the reinforcers were two or four tokens. The results of this study did not support the commitment model either. As the delay was increased, the children increasingly selected the choice side, and then the smaller, immediate reinforcer. They did not employ either the commitment strategy or "brute force self-control." Another type of data reported by Burns and Powers was the number of tokens earned and the percent of tokens spent daily. (Each token was worth five cents and could be exchanged daily or at the end of the week.) The mean number of tokens earned decreased with the increasing delays (the children choosing the smaller, immediate reinforcer), but the percentage of tokens spent daily increased directly with the increasing delays. The main difficulty with this study was the use of tokens. The previous work done in this area employed reinforcers which had to be used immediately rather than stored as tokens could be. The Burns and Powers study introduced an additional delay in reinforcement which may not be accounted for by Rachlin's formula.

Only two studies have been conducted in which adults served as subjects to investigate delay of reinforcement. Irwin, Orchinik, and Weiss (1946) asked undergraduates which of two pictures they preferred after telling them that they would receive one of the pictures immediately and the other

picture in one week as a thank you for participating in a bogus study. Various replicas of famous paintings were used, and each picture served as the immediate reward and the delayed reward for different subjects. The subjects said that they liked the picture they would be getting immediately significantly more often than the delayed picture. Mischel, Grusec, and Masters (1969) also used undergraduates to investigate the effects of delays on the subjective value of rewards. As with the children in this study, the adults' subjective value of the delayed reinforcer decreased as the delay increased.

The present status of the commitment model is ambiguous. Research involving pigeons has indicated that the commitment model is appropriate. However, current research with human subjects is more contradictory. As Rachlin (1975) has suggested, human subjects may be responding over the session and thus might exhibit what appears to be "brute force self-control." The only other study in this area, conducted by Burns and Powers (1975), indicated that neither the commitment strategy nor "brute force self-control" was used by the children. One question which the present study investigated was how do adult humans respond in the situation described by Rachlin. Given the difficulty with the Burns and Powers study, it was predicted that adults would respond over the session and exhibit "brute force self-control" as often, if not more often, than the commitment strategy. Attention will now be turned to the research on obesity.

Characteristics of Obese Subjects

Obesity is one of the major health problems facing Americans (Stuart & Davis, 1972). As such, clinical psychologists are searching for and trying new methods to control overeating. Obesity results from a higher level of caloric intake than is expended in daily activity. Various treatment methods have been tried from psychoanalysis to the use of aversive consequences for overeating. In attempting to determine an appropriate treatment technique to use with obese clients, many psychologists have attempted to define certain characteristics which may differentiate obese and normal weight people.

In a behavioral analysis there are three types of events which may be changed: antecedents, responses, and consequences. Research on obesity has generally concentrated on the first two events. Stanley Schachter and his associates have done research on the general characteristics of obese individuals and the effects of food related cues on the eating response of obese subjects. Schachter's work has concentrated on a differential sensitivity to external cues as distinguishing between obese and normal weight subjects. This dichotomy is part of Schachter's theory of emotion in which an emotion is a label attached to a state of physiological arousal (internal cues) and appropriate to the situation (external cues) (Schachter, 1971; Schachter & Rodin, 1974). As a result of research, Schachter has argued for a view

that the obese subject responds more to external cues than to internal cues.

Numerous studies have been conducted to determine which factors might influence the eating behavior of obese subjects. Most of these studies have had similar designs. Food was made available, and a cover story was employed concerning the study and de-emphasizing the role of food, per se, in the setting. Within this context, the various factors affecting the obese subjects' eating behavior have been studied. Schachter and Gross (1968) told subjects that they were in a study to determine the relationship between physiological reactions and psychological characteristics. While having heartrate, GSR, or sweat gland activity measured, the actual manipulation was going on. For half the subjects the clock on the wall ran fast, and for the other half the clock ran slow. When the experimenter returned to conduct the psychological part of the study he had a box of crackers with him and invited the subject to partake. The number of crackers eaten by the subjects was compared for the obese and normal weight subjects. The obese subjects in the fast condition ate almost twice as many crackers as the obese subjects in the slow condition. Apparently, they thought it was closer to dinner time and as a result "felt" more hungry. The results for the normal weight subjects were the opposite. Schachter and Gross interpreted this finding as an indication that the normal weight subjects did not want to spoil their

appetites so close to dinner. A study using naturalistic observations supported this finding (Goldman, Jaffa, & Schachter, 1968). Schachter and Friedman (1974) used shelled and unshelled nuts to determine the effects of amount of work involved in eating. Obese subjects ate fewer nuts when they had to be shelled than when they were already shelled, but normal weight subjects ate about the same amount in both conditions. Again, a study employing naturalistic observations supported these findings (Schachter, Friedman, & Handler, 1974). The taste of food was altered (Decke, 1971; Johnson, 1974; Nisbett, 1968); and it was found that obese subjects ate or drank significantly more when the taste was pleasant than when it was unpleasant, but that for normal weight subjects the change was not significant. Salience and visibility of food related cues, in terms of the number of sandwiches (Nisbett, 1968), level of illumination for visibility (Ross, 1974), and fasting and availability of food (Goldman, Jaffa, & Schachter, 1968) have all been found to have differential effects on the eating behavior of obese and normal weight subjects.

As an extension of this research, Schachter (1974), has suggested that the eating behavior of obese individuals may be a special case of a general stimulus sensitivity of obese people. Research by several authors (Gormanous & Lowe, 1975; Karp & Pardes, 1965; Karpowitz & Zeis, 1975; McArthur & Burstein, 1975; Pliner, 1974; Rodin, 1974; Rodin,

Herman & Schachter, 1974; Schachter, 1971) has led to contradictory findings concerning a general increased sensitivity to external stimuli in obese subjects. In these studies two groups of subjects (obese and nonobese) were tested on a number of "externality" measures. Gormanous and Lowe (1975) and Karpowitz and Zeis (1975) found no differences on locus of control. Degree of field dependence, as measured by the rod-and-frame and embedded figures tests, has been used as an indication of responsivity to external cues. Karp and Pardes (1965) employed female subjects and found that the obese subjects were more field dependent than the normal weight subjects on both the rod-and-frame and embedded figures tests. Schachter (1971) reported a study in which male and female college undergraduates were tested on the embedded figures test and resulted in no differences between obese and nonobese subjects. McArthur and Burstein (1975) conducted a study to reconcile the differences between the Karp and Pardes and Schachter studies. McArthur and Burstein argued that females are generally more field dependent than males and that the embedded figures test is correlated with I.Q. score. The subjects in this study were males and females who were paid to participate, and they were tested only on the rod-and-frame. The results indicated that females were more field dependent than males and that obese subjects were more field dependent than nonobese subjects. These authors also found that only for the females did degree of

overweight correlate significantly with degree of field dependence. Pliner (1974) found obese subjects to be more responsive to the salience of various stimuli (auditory tones, a visual scene, and positive and negative affective stimuli). Rodin (1974) found that obese subjects were more distractable than normal weight subjects. The results of the study conducted by Rodin, Herman, and Schachter (1974) also supported the view of a generalized stimulus sensitivity in obese subjects. Further research is being conducted to determine the reasons for the different findings and to find out if this view may still be plausible.

Recently, work has been conducted on the eating response of obese and nonobese subjects. Mahoney (1975a, 1975b) has argued that much of what is believed about the way obese people eat may not be true. Reviewing several behavioral treatment strategies used to reduce weight, Mahoney has determined that there is implicit within these treatments a distinctive "obese eating style." This eating style is characterized by a few large bites, rapid eating pace, and short meal duration. Only three studies have been conducted to date to show that the eating response of obese people may be the opposite of what has generally been assumed to be true. Meyer and Pudel (1972) conducted a study comparing the speed of eating in normal weight and obese subjects. Their findings indicated that obese subjects may eat more slowly than nonobese subjects. The results of a study by Gaul, Craighead,

and Mahoney (1975) indicated that obese subjects took more bites, performed fewer chews per bite, and spent less time chewing than normal weight people. Mahoney (1975b) reported the results of several studies in which degree of obesity was correlated with a few eating response measures. None of the studies reported by Mahoney indicated significant differences for total number of bites, meal duration, or eating rate (the number of bites per minute). The results of these studies tended to disagree with the assumption held implicit in many behavioral management techniques for controlling weight.

Rachlin (1974, 1975) has suggested that there may be such a thing as an "addictive personality." A person with an "addictive personality" might show consistent behavior across situations in which certain salient cues are present. Extending this possibility, Rachlin suggested that in attempting to control the eating behavior of an obese person, the commitment strategy could be taught and applied to other less difficult responses, such as nail biting and smoking, and then applied to the eating response itself. A further implication of the "addictive personality" would be that in difficult choice situations involving immediate versus delayed rewards, those persons labeled as "addictive" would be more likely to select the immediate reinforcer. Only one study has investigated the possibility of a difference between obese and nonobese subjects in their ability to delay reinforcement. Sigal and Adler (1976) had boys between the ages of eight and

thirteen serve as subjects and varied the degree of hunger and the edibility of the reinforcer. Neither degree of hunger nor edibility affected the ability of the boys to delay reinforcement. However, the obese boys chose the immediate reinforcers more often than the normal weight boys.

One point should be made here. Several authors (Grinker, 1973; Silverstein, 1959; Stunkard & Burt, 1967) have indicated that there are important differences between early-onset obese people and adult-onset obese people, which may affect the generalizability of the previously mentioned studies. It has been estimated that 70% of obese adults became obese in adulthood, rather than childhood. The majority of the studies discussed in this paper employed children or college students as subjects. The average age of the subjects was twenty years old. The subjects were probably early-onset obese, and thus the generalizability of such studies is in question. One study (Grinker, Glucksman, Hirsch, & Viseltear, 1973) found that early-onset obese subjects differed from adult-onset obese subjects in time perception while losing weight. Hall, Hall, Hanson and Borden (1974) did not find differences between college subjects (median age of 20.8 years) and subjects from the community (median age of 42.0 years) in the effects of two self-management techniques for weight loss. At the present time this question of age of onset is still open, and researchers would do well to specify the population from which samples are drawn and limit

discussion of results to these populations (Hall & Hall, 1974).

Each of the three research approaches (Schachter and his associates, Mahoney and his associates, and Rachlin) discussed in this paper has implications for therapy. Schachter's research would imply a line of treatment in which obese clients are taught to become more aware of internal cues for hunger, and thus less responsive to external cues which may have led to overeating. Mahoney's approach would indicate changing the eating response itself in a manner different from that currently being employed by behavior therapists. Finally, Rachlin's approach would concentrate more on the stimulus control aspects of the program proposed by Stuart and Davis (1972). These authors suggested methods by which obese clients put "temptation out of reach" (p. 79), by such procedures as not buying problematic foods and putting table scraps into the garbage immediately after finishing a meal. Such procedures are employed to help clients stay on their diets by avoiding the difficult choice of either eating incorrectly (immediate reward) or losing weight (delayed reward). According to Rachlin the client might first be taught a general commitment strategy through which the client would learn to respond to long-term consequences, to be applied to less difficult behaviors before attempting to control overeating. In addition to the first purpose of this study to determine whether or not Rachlin's commitment model is

applicable to adults, the second purpose was to determine if there was a difference in the way obese and normal weight subjects respond in Rachlin's design.

Statement of Problem

The study investigated the commitment model of self-control. An analog situation was employed, matching as closely as possible the Rachlin and Green (1972) design. Pilot work was conducted to determine the delays and reinforcement intervals. (For a description of the pilot work see Appendix A.) College undergraduates served as subjects. The study also investigated the possibility of a difference between obese and nonobese subjects on this task. Since this was a new area of research, the predictions were very tentative.

The first hypothesis stated that as the initial delay was increased, subjects would be more likely to avoid the small, immediate reinforcer. This hypothesis was based on the preliminary findings reported by Rachlin (1975) and the pilot work conducted for this study. Whereas pigeons change from the small, immediate reinforcer to the commitment strategy with increasing delays, it was expected that subjects in this study would simply avoid the small immediate reinforcer and possibly select the "brute force self-control" side and the commitment side equally.

The second hypothesis stated that there would be a difference between the obese and normal weight subjects

with the longer delays. This hypothesis was based on the study by Sigal and Adler (1976) and on the one obese subject included in the pilot work for this study. Two predictions were involved in the difference between the obese and the normal weight subjects. First, both groups would exhibit self-control, but a longer delay would be required before the obese subjects demonstrated self-control. Second, the obese subjects would be more likely to employ the commitment strategy than would the nonobese subjects. The normal weight subjects were expected to exhibit self-control by selecting the commitment side and "brute force self-control" an equal number of times. The obese subjects were expected to employ the commitment strategy more often than "brute force self-control," if and when they did exhibit self-control.

CHAPTER II

METHOD

Experimental Design

The present study employed one between-factor (weight group) and three within-factors (delay times, session within delay times, and twenty trials/per session). The dependent variable was the mean number of times each of the three response keys (described below) was selected during each session.

Subjects

The subjects in this study were ten female undergraduates at the University of North Carolina at Greensboro. Five of the subjects were of normal weight (Metropolitan Life Insurance Co., 1959), and the other five subjects were between 40 and 50 percent overweight. The subjects' heights and weights were measured by the author at the end of the subjects' participation in the study in order to determine the subjects' weight qualifications for each group. These data are presented in Table 1 along with each subject's age and race.

When subjects were initially contacted and requested to serve as subjects, they were told that they would be pushing buttons and listening to music. The prospective subjects were also informed that they would be participating in

TABLE 1

EACH SUBJECT'S HEIGHT AND WEIGHT

Group	Subject	Height	Weight	Age	Race
Normal Weight	FS	5'6"	132	18	White
	VS	5'7"	145	19	Black
	LW	5'4"	130	17	White
	CD	5'11"	143	18	Black
	ST	5'5"	130	18	White
Obese	BL	5'5"	190	18	White
	KT	4'11"	164	18	Black
	VF	5'3"	170	18	Black
	KD	5'5"	180	19	Black
	DJ	5'4"	174	18	White

the study for approximately ten hours. Once a subject agreed to participate, she was asked to what musical albums she would like to listen. It was emphasized that she had a choice of music and that she should select music she really enjoyed. Table 2 shows a list of the records that the subjects suggested. The subjects were shown this list at the beginning of each session and chose the music to which they would listen during that session.

Experimenters

The experimenters in the present study were the author and two female undergraduate students enrolled in an independent study course. Each experimenter ran subjects from both weight groups. Each subject was run by different experimenters on different days.

Apparatus

The experimental setting was a small room in which there was a desk and a chair. On the desk was the stimulus/response panel. The panel contained five sets of lights and their respective response buttons. Near the bottom of the panel were the two white lights and their respective response buttons. Above the left white light was a green light with its response key. Above the right white button were two lights and their respective keys. One of these lights was red and the other was green. (A facsimile of the panel is presented in Figure 1.)

TABLE 2

LIST OF ALBUMS RECORDED FOR SUBJECTS' LISTENING

The O'Jays	"Ship Ahoy"
Graham Central Station	"Mirror"
The Ohio Players	"Skin-tight"
Diana Ross	"Greatest Hits"
James Cleveland	"All You Need"
Aretha Franklin	"Greatest Hits"
Grover Washington	"Mister Magic"
Seals and Croft	"Summer Breeze
James Taylor	"Mud Slide Slim"
Jim Croce	"I Got a Name"
Traffic	"The Low Spark of High Heeled Boys"
Fleetwood Mac	"Fleetwood Mac"
Captain and Tennille	"Love Will Keep Us Together"
Chicago	"Chicago"
Peter Frampton	"Frampton Comes Alive"
Aaron Copland	"Appalachian Suite"
Aaron Copland	"The Tender Land Suite"
Beethoven	"Third Symphony"

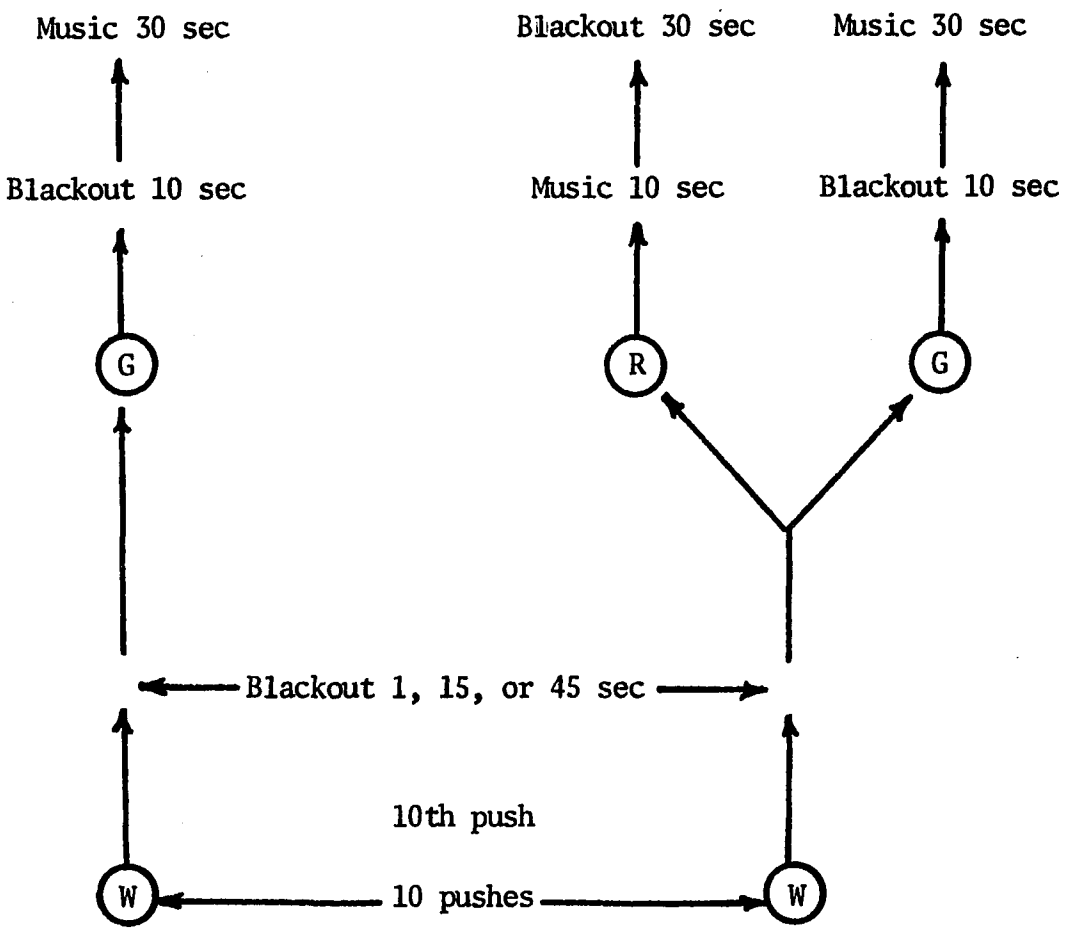


Figure 1. Diagram of panel used to explain procedure to subjects.

Electronic timers and electromechanical equipment that were located in a separate room programmed the experimental conditions and recorded the data. The reinforcers were the musical album, recorded on tape, and controlled by the electromechanical equipment.

Procedure

Each subject was run individually. Each subject was escorted into the experimental room and seated in front of the panel. Before the first session started, the subject was asked to indicate how important she felt music was to her (see Appendix B) and to sign a contract indicating that when she finished her participation in the study she would receive credit for the study and a small gift to thank her for the long hours required of her during the study (see Appendix C). There were no differences between the Normal Weight and Obese subjects in their ratings of the importance of music. The small gift was two free tickets to a movie theater in Greensboro. The subject was then read the following instructions:

> In front of you are sets of lights and buttons. When we start, the two white lights at the bottom will go on. Push the buttons ten times and the lights will go out. (E demonstrated how to push the buttons.) You do not have to count the pushes because they will automatically be counted by equipment in the other room. You may push one button for all ten pushes, or you may

alternate between the buttons, or make whatever combination you wish. After the tenth push, the lights will go out and nothing will happen for a short while. After this delay, some of the top buttons will go on. The last push on the white buttons will determine which of the top lights goes on. If the last push is on the right white button, these two lights will go on. (E pointed to the red and green buttons on the right side of the panel.) Only one push on either button is necessary. If you push the red button, music will come on immediately for ten seconds. Then the music will stop and nothing will happen for thirty seconds, after which the white lights will come on again. If you push the green button, there will be a ten-second delay, and then the music will come on for thirty seconds. If your last push was on the left white button, this green light will come on. (E pointed to the green light on the left side of the panel.) This green button operates exactly the same as the other green button: push it and there will be a ten-second delay followed by music lasting thirty seconds. The lengths of the delays and music are the same for the two green buttons. Each time the white lights come on, it is a new trial. Each trial is independent of every other trial, so that what you do during one trial will not affect what happens in any other trial. One simple

thing to remember is to push only the buttons with the lights that are on and to push the buttons until the lights go off. Also, only push one button at a time. Do you have any questions? (Any questions were answered in terms of the above instructions.)

Since this is your first session, we will start with six practice trials so that you can become familiar with what I have been explaining to you. For these six trials only one of the white lights will come on. Of course this means that you will only be pushing one of the white buttons for all ten pushes. Then only one of the top lights will come on. After the six trials, both of the white lights will come on, and you may do whatever you please.

Here is a list of the albums I have recorded. In addition to the records you suggested, there are other albums on the list, and you may choose whichever album you want. Each day when you come in you will be asked to choose the album you want to listen to for that session. Then you may hear the same album again the next time you come in or you may listen to something else. Please try to pick something you think you will enjoy listening to. Which album would you like to hear today?

After you have completed your participation in this study, I will explain its purpose.

The subjects were also shown the diagram in Figure 1 while the instructions were being given. The diagram was left in front of the panel for the duration of the study so that subjects could consult it whenever they wanted to.

Each subject participated in eighteen sessions, six sessions with each of the three delay intervals. Each session consisted of twenty free-choice trials. In addition to this, the subjects received six forced-choice trials of each of the three delay intervals (one, fifteen, and forty-five seconds) on the first day. The forced-choice trials were such that only one of the three response patterns was made available for each trial. There were two forced-choice trials leading to the left green button, two leading to the red button, and two leading to the right green button. The forced-choice trials were presented in random order. The forced-choice trial procedure was used to ensure that at the start of a new T value, the subjects would experience each of the response contingencies. The free-choice trials consisted of all three possible patterns of responding being made available to the subject, as described below.

Each trial consisted of a chain of events. The initial link of the chain consisted of the two bottom white lights being lit. After a total of ten responses on these buttons in any combination, there was a blackout (none of the lights was on) of T seconds (this value varied as one of the independent variables). After this initial blackout, the

terminal link began. If the last response was on the left white button, the upper left green button was illuminated following the initial blackout. One response on the green button produced a ten-second blackout, followed by thirty seconds of music. This was the "commitment" side. If the last response was on the right white button, the two lights above this button came on after the initial blackout. The left button was red and the right button was green. A response on the red button led to ten seconds of music, followed by a blackout lasting thirty seconds. This was the "lack of self-control" side. A response on the right green button produced the same events as a response on the left green button: blackout for ten seconds, followed by music for thirty seconds. This was the "brute force self-control" side.

Three T values were used in this study: one, fifteen, and forty-five seconds. The one-second T value falls below the expected change-over value (five seconds), and the fifteen and forty-five second T values fall above the expected change-over value. The change-over value is that value predicted by the formula devised by Rachlin and Green (1969) when the reinforcement values of the two incompatible responses are equal. In terms of the present study, the subjects should have selected the small immediate reinforcer when T was below the change-over value. The value of T was constant within any single session. The T values were presented in ascending

order. The subjects were exposed to each T value for six consecutive sessions. As mentioned above, the reinforcement times were ten seconds for the small immediate reinforcer, and thirty seconds for the large delayed reinforcer.

At the end of the study, each subject was asked to come back for debriefing. They were asked if they were aware of how they pushed the buttons in terms of patterns of frequency of choosing certain buttons. They were also asked about any ideas they may have had concerning the purpose of the study. After answering these questions, the purpose of the study was explained, and all questions were answered to ensure that the subjects understood the purpose. The credit slip was filled out and given to the subjects. A few weeks after the end of the study, each subject received two free movie tickets as a token of appreciation for the amount of time spent participating in the study.

CHAPTER III

RESULTS

Individual Data

Figures 2 and 3 present the individual data for the Normal Weight and Obese groups respectively. These figures show the number of times each subject selected each of the keys according to the delay interval. Although individual differences are evident within both groups, some consistent patterns emerged.

One noticeable change was the number of times the lack of self-control key (K-2) was chosen over time. Several subjects (VS, LW, ST, and KD) avoided the small immediate reinforcer during the shortest delay interval (one second) and continued to do so for the duration of the study. Other subjects (BL and FS) demonstrated patterns of decreased responding on K-2 during the longer delay intervals (fifteen and forty-five seconds). Two subjects (CD and VF) did not appear to be responding to the contingencies at all. All of the responses of these two subjects during the three delay intervals were apparently random, selecting each of the three keys an equal number of times. One subject (DH) initially seemed to be responding randomly. During the second and third delay intervals (fifteen and forty-five seconds), DH chose the K-2 less often than either of the two self-control keys,

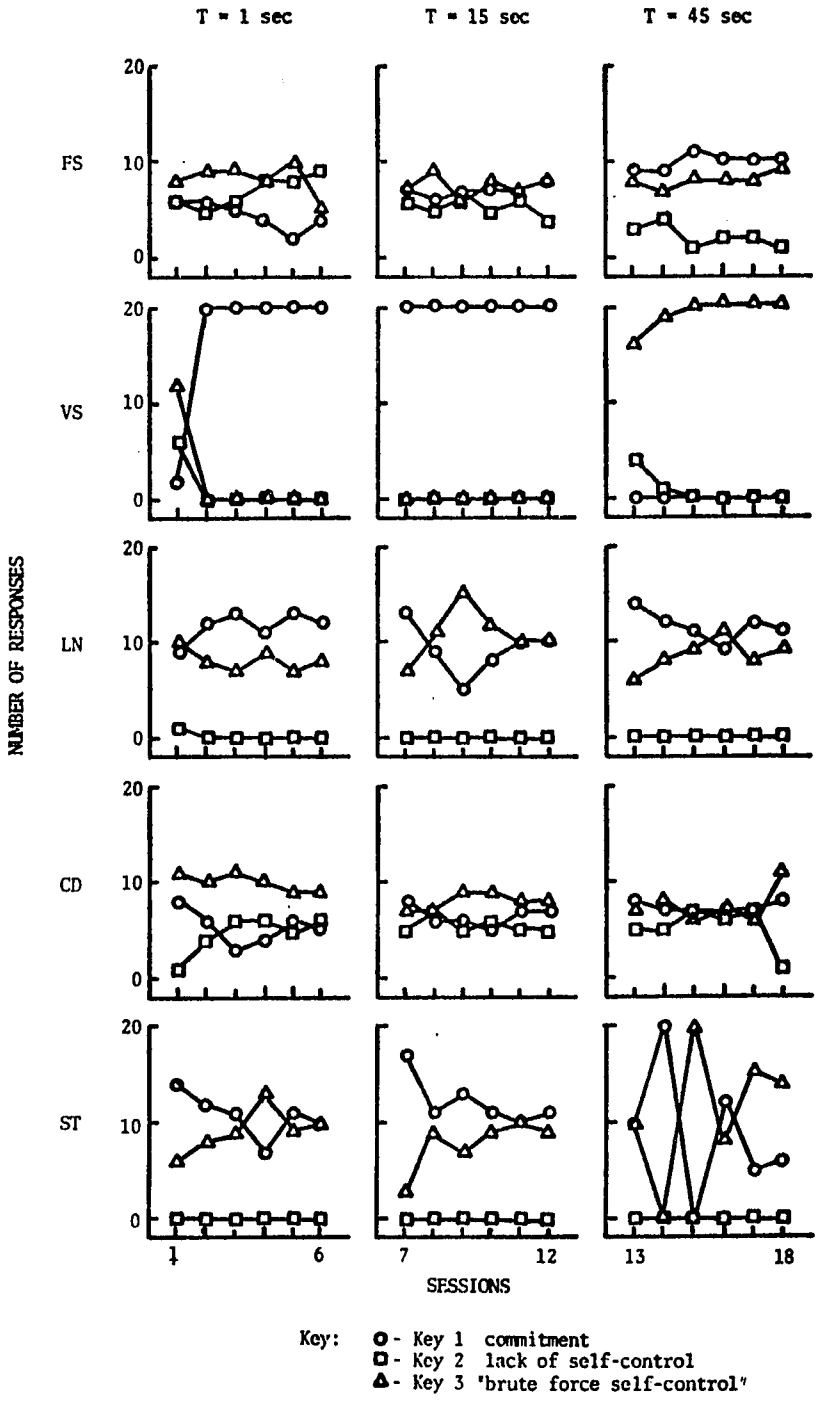


Figure 2. Number of times each key was chosen by normal weight subjects.

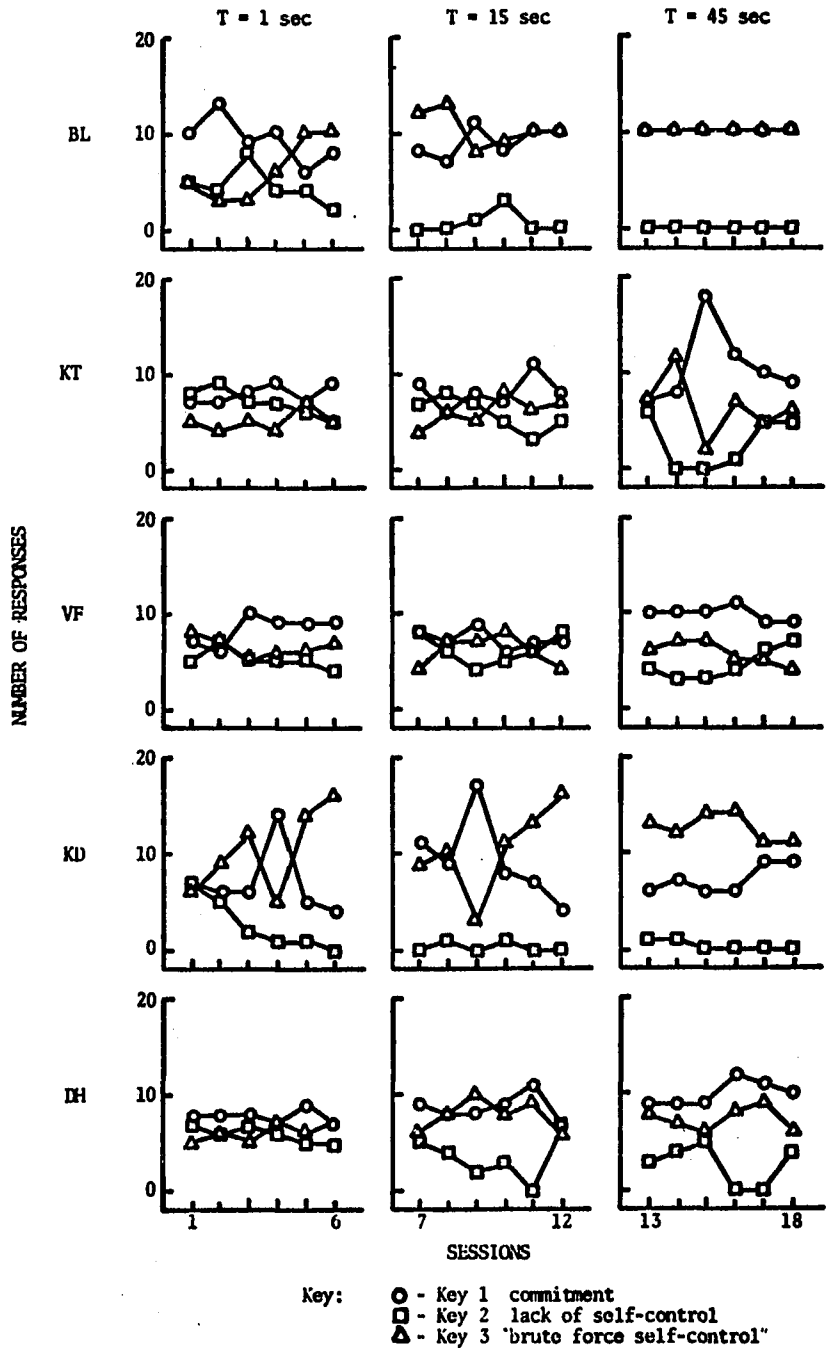


Figure 3. Number of times each key was chosen by obese subjects.

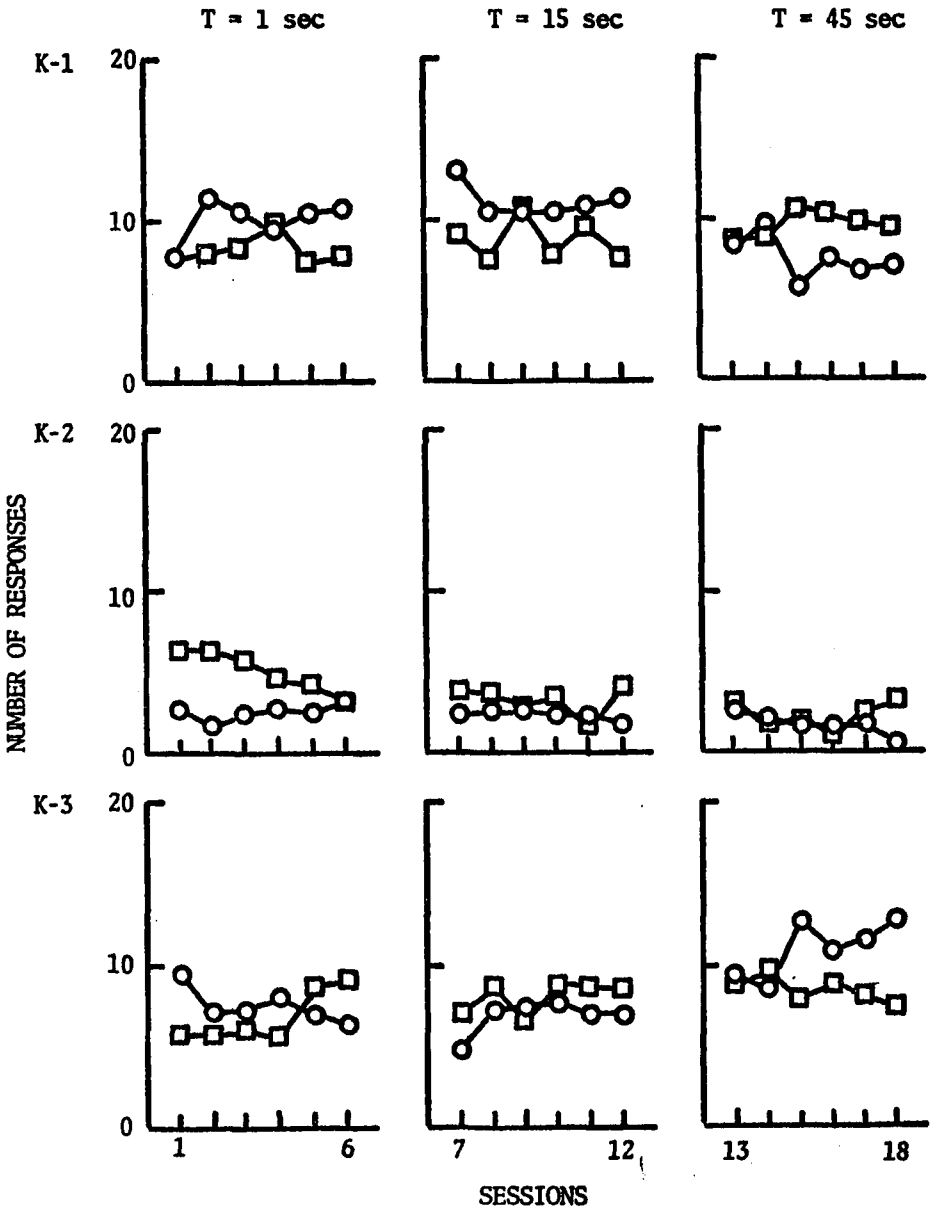
but without a consistent decrease in responding on K-2. The pattern of responding for the last subject (KT) indicated increased variability during the forty-five second delay interval.

The patterns of responding on the two self-control keys (K-1 and K-3) were less discernible than for K-2. Most subjects chose the two self-control keys an equal number of times, with a trend toward increased responding on these two keys as the number of times K-2 was chosen decreased.

Group Data

Figure 4 presents, session-by-session, the mean number of times each key was chosen by the two weight groups. The graph for K-2 shows a difference between the two weight groups: the Normal Weight subjects maintained a low frequency of responding on K-2 and the Obese subjects chose K-2 less often as the delay was increased.

The group data yielded a somewhat different impression than the individual data for the two self-control keys. The pattern of responding for the Normal Weight subjects on the commitment key (K-1) indicated a slight decrease in frequency during the forty-five second delay. The pattern for the "brute force self-control" key (K-3) was the opposite: the Normal Weight subjects slightly increased responding on this key during the forty-five second delay. It should be noted that the changes occurring in both of the self-control keys may have been due to one subject (VS).



K-1 commitment; K-2 lack of self-control; K-3 brute force self-control

Key: ○ - Normal Weight; □ - Obese

Figure 4. Mean number of times each key was chosen by each weight group on each session.

The data for the Obese subjects indicated decreased variability over the sessions in responding on K-1 (commitment key), with a slight trend toward increased responding on this key across the delay intervals. The Obese subjects slightly increased responding on K-3 ("brute force self-control") during the fifteen-second delay interval and maintained this frequency through the forty-five second delay interval.

The between groups comparisons indicated that across all three delay intervals, the Normal Weight subjects chose the small immediate reinforcer (K-2) fewer times than the Obese subjects. The data for the two self-control keys (K-1 and K-3) indicated some changeovers. During the shortest delay interval (one second) the Normal Weight subjects chose K-1 (commitment key) more often than the Obese subjects; but by the forty-five second delay interval, the Obese subjects were selecting the commitment key more often than the Normal Weight subjects. The Normal Weight subjects chose K-3 ("brute force self-control" key) more often than the Obese subjects during the shortest and longest delay times, but not during the intermediate delay time.

Table 3 presents the mean number of times each subject chose each of the keys for the three delay times. Inspection of these data support the descriptions of the first three figures.

TABLE 3

MEAN NUMBER OF RESPONSES PER KEY
FOR EACH T VALUE

	K-1			K-2			K-3		
	T_1	T_{15}	T_{45}	T_1	T_{15}	T_{45}	T_1	T_{15}	T_{45}
Normal Weight									
FS	4.83	7.0	9.83	7.0	5.50	2.17	8.17	7.50	8.0
VS	17.0	20.0	0	1.0	0	0.83	2.0	0	19.17
LW	11.67	9.17	11.50	0.17	0	0	8.17	10.83	8.50
CD	5.33	6.50	7.33	4.67	5.50	5.17	10.0	8.0	7.50
ST	10.83	12.17	8.83	0	0	0	9.17	7.83	11.17
Group Means	9.32	10.968	7.498	2.568	2.20	1.634	7.502	6.832	10.868
Obese									
BL	9.33	9.0	10.0	4.50	0.67	0	6.17	10.33	10.0
KT	7.83	8.17	10.67	7.0	5.83	2.83	5.0	6.0	6.50
VF	8.33	7.83	9.83	5.17	6.17	4.50	6.50	6.0	5.67
KD	7.0	9.33	7.17	2.67	0.33	0.33	10.33	10.33	12.50
DH	8.0	8.67	10.0	6.0	3.50	2.67	6.0	7.83	7.33
Group Means	8.098	8.60	9.534	5.068	3.30	2.066	6.80	8.098	8.40

K-1: commitment key

K-2: Lack of self-control key

K-3: brute force self-control key

Several statistical analyses were conducted. A 2 (Weight group) x 3 (Delay intervals) repeated measures analysis of variance was computed for each key separately. The mean number of responses by each subject within each delay interval was the dependent variable for all three analyses. A fourth and similar analysis was computed for the ratio of the mean number of times each subject chose the commitment key over the sum of the mean number of times both self-control keys were selected (K-1/[K-1 + K-3]). The arcsin of the ratio was the dependent variable. The summary tables for these four analyses are presented in Tables 4-7.

The only statistically significant result was found in the analysis for K-2 (lack of self-control key), where there was a main effect for delay intervals, F (2, 16) = 7.651, $p < .01$. A Scheffe' post hoc test was performed to determine where the significant differences were among the delay intervals. The results of the Scheffe' indicated that the subjects chose the small immediate reinforcer (K-2) significantly fewer times during the longest delay (forty-five seconds) than during the shortest delay (one second) (C.V. = 1.968, $p < .05$). This analysis also indicated a trend for the Weight x Delay interaction (F [2, 16] = 2.195, $p < .144$). Scheffe' post hoc tests were performed on the simple effects. The results of the Scheffe' tests indicated that the Obese subjects significantly decreased their responding on K-2 from the shortest delay interval to the longest delay interval (C.V. = 3.002, $p < .01$).

TABLE 4

ANALYSIS OF VARIANCE SUMMARY TABLE FOR
K-1 (COMMITMENT KEY)

Source of Variance	df	SS	MS	F	P
Weight Group	1	3.91	3.91	0.384	.553
Delay Interval	2	8.16	4.08	0.201	.759
Subjects Within Weight Group	8	81.45	10.182		
Weight Group x Delay Interval	2	28.88	14.44	0.993	.392
Delay Interval x Subjects Within Weight Group	16	232.71	14.54		

TABLE 5

ANALYSIS OF VARIANCE SUMMARY TABLE FOR K-2
(LACK OF SELF-CONTROL)

Source of Variance	df	SS	MS	F	P
Weight Group	1	13.55	13.55	0.841	.386
Delay Interval	2	19.41	9.71	7.651**	.005
Subjects Within Weight Group	8	128.89	16.11		
Weight Group x Delay Interval	2	5.57	2.78	2.195	.144
Delay Interval x Subjects Within Weight Group	16	20.29	1.27		

**p < .01

TABLE 6

ANALYSIS OF VARIANCE SUMMARY TABLE FOR K-3
("BRUTE FORCE SELF-CONTROL")

Source of Variance	df	SS	MS	F	P
Weight Group	1	3.02	3.02	0.354	.568
Delay Interval	2	36.56	18.28	1.471	.259
Subjects Within Weight Group	8	68.26	8.53		
Weight Group x Delay Interval	2	17.44	8.72	0.702	.510
Delay Interval x Subjects Within Weight Group	16	198.83	12.43		

TABLE 7

ANALYSIS OF VARIANCE SUMMARY TABLE FOR THE RATIO OF K-1/(K-1 + K-3)

Source of Variance	df	SS	MS	F	P
Weight Group	1	0.003	0.003	0.036	.854
Delay Interval	2	0.42	0.21	0.685	.518
Subjects Within Weight Group	8	0.61	0.08		
Weight Group x Delay Interval	2	0.55	0.27	0.904	.425
Delay Interval x Subject Within Weight Group	16	4.85	0.30		

Self-Report by Subjects

All of the subjects were questioned at the end of their participation in the study. The subjects were asked what they thought the study was about and if they were aware of how they pushed the buttons. Only one subject (KD) said she thought the study dealt with delay of gratification. Other answers were that the study was investigating reaction time and rate of responding. About half of the subjects said that if they liked the music they pushed the green buttons (self-control keys), indicating that the choice was made while the white buttons were on. The other half said that they did not like the red button (lack of self-control key), so they did not push it; and they concluded that it made no difference which of the two green buttons they pushed since they were both the same.

CHAPTER IV

DISCUSSION

One purpose of the present study was to determine if Rachlin's commitment model was applicable to college student subjects. The results of this study did not support the commitment model. According to the commitment model, subjects should not have demonstrated self-control (i.e., should have chosen the small immediate reinforcer) when the initial delay was less than five seconds (Baum & Rachlin, 1969). The model also predicted that when the delay was longer than five seconds, subjects should have employed the commitment strategy of self-control. Rachlin's pigeons did perform according to the predictions. However, human subjects seem to deviate from the predictions. The two children in the Burns and Powers (1975) study did not exhibit any form of self-control and continued to select the small immediate reward even at longer delay times. The little girl in Rachlin's (1975) study demonstrated self-control by selecting both forms of self-control (commitment and "brute force self-control") equally. Finally, the statistical analyses of the number of times the small immediate reinforcer was chosen by the college student subjects in the present study indicated a significant decrease from the shortest delay interval to the longest delay interval. However, the data

from individual subjects was quite varied. Most subjects, when they demonstrated self-control, did so by selecting both forms of self-control and at both long and short delay intervals. Some subjects demonstrated self-control when the delay was less than five seconds, and other subjects failed to demonstrate self-control, even at longer delay intervals.

The discrepancy between Rachlin's model and the results of the several studies employing human subjects presents a problem, since apparently commitment does occur in some naturalistic circumstances. Some of the techniques proposed by Stuart and Davis (1972) which are also now being employed by Weight Watchers, Inc. are based on a commitment strategy. Rachlin (1974) also discussed payroll savings plans as another form of commitment. In both of these situations, people perform certain responses which enable them to follow long-term contingencies. Commitment does not have to be the only form of self-control. Some people are able to employ what Rachlin (1974) called "brute force self-control." As Rachlin (1975) explained, the commitment strategy could be taught as an initial stage of self-control to people who have difficulty employing "brute force self-control."

Research on the commitment model could lead to more precise and effective self-control procedures and offer a possible explanation for why people employ stimulus control techniques. Several possible explanations could be offered

to account for the discrepancy between the results of the studies on commitment and what happens in "real life." Rachlin (1975) has already suggested an explanation. Rachlin said that the pigeons and human subjects may be responsive to different intervals of time. The time intervals appropriate for humans may not be specified in Rachlin's commitment formula. The time intervals involved with more realistic situations would be even more difficult to specify. Additionally, quantifying the amounts of the reinforcers to include in Rachlin's formula for the alternate responses would be next to impossible in realistic settings.

The discrepancy between the results of the animal study (Rachlin & Green, 1972) and of the human studies (Rachlin, 1975, and this paper) raises the question of the generalizability of animal research. Many of the techniques employed by behavior therapists are based on principles discovered through animal research. Several authors (Adams & Hughes, 1976; Kanfer & Phillips, 1970) have indicated that animal research can be useful in determining the basic principles which help clinicians with techniques in therapeutic settings. However, these authors warn about the limitations of animal research in dealing with symbolic and/or linguistic behavior. The limitations of animal research could have a bearing on the results of the present study. For example and as previously mentioned, Rotter (1973) suggested that a person's expectation of actually receiving the reinforcer

must be taken into account in determining performance. In the present study, the subjects' expectancy was 100% for the three top buttons (commitment, lack of self-control, and "brute force self-control"). However, in naturalistic situations, a person's expectancy of receiving the reward for exhibiting self-control would probably be much lower, especially with people who have a history of lack of self-control. The level of expectancy in realistic settings would also be difficult to determine.

A second explanation has to do with the specific reinforcer used in this study. The reinforcer was operationally defined as listening to certain durations of music that each subject decided she wanted to hear. The reinforcing value of the music was never empirically tested. Empirical validation could have been done by initially presenting only the red and green buttons on the choice side as a concurrent situation. The durations of the music and the delays could have been varied. Once differential responding was achieved (subjects selecting the small immediate reinforcer more often than the larger delayed reinforcer), the test of the commitment model could then have proceeded, employing the optimum durations and delays. Rachlin (1975) approximated this approach in his study with the little girl. Although he did not get commitment, he did get self-control with the longer delays. This procedure would provide a more valid test of the commitment model because the subjects would all be starting at the point at which they did demonstrate a preference

for the small immediate reinforcer (did not exhibit self-control). Another aspect of the small immediate reinforcer as used in the present experiment was discussed in Appendix A. Several subjects found the blackout after the small immediate reinforcer aversive. These subjects indicated that the blackout before the larger delayed reinforcer was not as aversive, since they had the music to look forward to. The aversive property of the blackout following the small immediate reinforcer may have introduced a variable not accounted for in Rachlin's formula.

Another possible explanation was suggested by the subjects' answers to the questions at debriefing. Most subjects indicated that they had decided not to choose the small immediate reinforcer regardless of which of the top lights came on. The implication was that the subjects were only making one decision, at the white buttons or even before the session began, about how they were going to respond. Rachlin's model implies that there are two possible choice points: the first is at the white buttons, and the second being at the red and green buttons on the "choice" side. Whereas the "choice" side may have presented a true choice situation for the pigeons, for human subjects the decision had already been made by the time the red and green lights came on.

The second hypothesis of this study was concerned with differences between normal weight and obese subjects. The second hypothesis predicted that it would take a longer delay

for the obese subjects than for the normal weight subjects before the obese subjects would demonstrate self-control; and that once the obese subjects exhibited self-control, they would employ the commitment strategy more often than the normal weight subjects. This hypothesis was suggested by Rachlin's (1975) discussion of "addictive personalities" and by Schachter's work. The results of this study did not support the second hypothesis. Visual inspection of the data indicated that obese subjects may be different from normal weight subjects in that the obese subjects may have a generalized lack of self-control. The group data indicated that the normal weight subjects chose the small immediate reinforcer consistently less often than did the obese subjects, but this difference was not statistically significant. While the normal weight subjects maintained a low rate of responding on the lack of self-control key (K-2), the obese subjects did significantly decrease their selection of the small immediate reinforcer. Also, as a group, the obese subjects never attained the low level of responding on the "lack of self-control" key at which the normal weight subjects started. The data from the individual subjects indicated a wide variety of response patterns.

The three subjects (VS, LW, and ST) who did exhibit self-control during the one-second delay interval were normal weight subjects. However, the remaining two normal-weight subjects (FS and CD) never completely demonstrated self-control,

even when the delay was forty-five seconds. The general trend for the obese subjects was toward increased responding on the self-control keys. Two of the obese subjects (BL and KD) did eventually exhibit self-control. Two other obese subjects (KT and DH) demonstrated self-control during several sessions but did not maintain this performance. One obese subject (VF) responded like the two normal weight subjects and never demonstrated self-control. Although there were great individual differences, the group data indicated that regardless of weight group, once a subject decided to avoid the small immediate reinforcer, no preference was shown for one form of self-control over the other. Normal weight and obese subjects did not differ in their ability to employ "brute force self-control." It may take obese subjects longer to employ self-control, but once they do, there is no difference between obese and normal weight subjects in the type of self-control employed.

Rachlin attempted to specify certain parameters that might predict when people would employ a commitment strategy of self-control. The results of this study indicated that the formula Rachlin suggested is apparently inadequate in dealing with human behavior. The verbal information from the subjects in the present study was valuable in assessing its drawbacks and should be considered in further research. The feedback from the subjects indicated an aversive quality of blackout following the small immediate reinforcer that was

not included in Rachlin's formula. In naturalistic situations involving obese people, a small immediate reinforcer might be eating a tempting piece of cake, rather than staying on a diet. Some possible aversive aspects of eating the cake might include negative feedback from other people or negative self-evaluations by the person eating the cake. These possible aversive aspects may or may not be present in naturalistic situations, but some aversiveness was clearly introduced in the present study. The suggestion of empirically testing the reinforcer might eliminate the aversive aspect of the small immediate reinforcer, in addition to providing a more valid test of commitment. Naturalistic situations could be investigated to help delineate the parameters of commitment behavior. One important variable not included in the present study is expectancy of receiving the reward. For people who have difficulty in exhibiting self-control, expectancy could be assumed to be very low for self-control behavior. The expectancy of receiving an immediate reinforcer, such as a piece of cake, could be very much higher than the expectancy for delayed reinforcers that involve some form of self-control. Further research in this area could include varying degrees of expectancy for the small immediate reinforcer and the larger delayed reinforcer. If the expectancy for the small immediate reinforcer was much higher than for the larger delayed reinforcer, an analog study would more closely approximate realistic conditions.

Further research should be conducted in this area to determine the parameters controlling self-control behavior, and more specifically, commitment responses.

BIBLIOGRAPHY

Adams, H. E., & Hughes, H. H. Animal analogues of behavioral treatment procedures: A critical evaluation. In M. Hersen, R. Eisler, & P. Miller (Eds.), Progress in behavior therapy, vol. 3. New York: Academic Press, 1976.

Ainslie, G. The learning of an operant to limit the subject's own future behavior. Described in H. Rachlin, Introduction to modern behaviorism. San Francisco: W. H. Freeman, 1970.

Baum, W. M., & Rachlin, H. Choice as time allocation. Journal of the Experimental Analysis of Behavior, 1969, 12, 861-874.

Bernstein, D. A. Modification of smoking behavior: An evaluative review. Psychological Bulletin, 1969, 71, 418-440.

Burns, D. J., & Powers, R. B. Choice and self-control in children: A test of Rachlin's model. Bulletin of the Psychonomic Society, 1975, 5, 156-158.

Catania, A. C. Concurrent performances: A baseline for the study of reinforcement magnitude. Journal of the Experimental Analysis of Behavior, 1963, 6, 299-300.

Chung, S., & Herrnstein, R. J. Choice and delay of reinforcement. Journal of the Experimental Analysis of Behavior, 1967, 10, 67-74.

Decke, E. Effects of taste on the eating behavior of obese and normal persons. Cited in S. Schachter, Emotion, obesity, and crime. New York: Academic Press, 1971.

Gaul, D. J., Craighead, W. E., & Mahoney, M. J. The relationship between eating rates and obesity. Journal of Consulting and Clinical Psychology, 1975, 43, 123-125.

Goldman, R., Jaffa, M., & Schachter, S. Yom Kippur, Air France, dormitory food, and the eating behavior of obese and normal persons. Journal of Personality and Social Psychology, 1968, 10, 117-123.

Gormanous, G. K., & Lowe, W. C. Locus of control and obesity. Psychological Reports, 1975, 37, 30.

Grinker, J. Behavioral and metabolic consequences of weight reduction. Journal of the American Dietetic Association, 1973, 62, 30-34.

Grinker, J., Glucksman, M. L., Hirsch, J., & Viseltear, G. Time perception as a function of weight reduction: A differentiation based on age at onset of obesity. Psychosomatic Medicine, 1973, 35, 104-111.

Grusec, J. E. Waiting for rewards and punishments: Effects of reinforcement value on choice. Journal of Personality and Social Psychology, 1968, 9, 85-89.

Hall, S. M., & Hall, R. G. Methodological and outcome considerations in the behavioral treatment of obesity. Behavior Therapy, 1974, 5, 352-364.

Hall, S. M., Hall, R. G., Hanson, R. W., & Borden, B. L. Performance of two self-managed treatments of overweight in university and community populations. Journal of Consulting and Clinical Psychology, 1974, 42, 781-786.

Herrnstein, R. J. Relative and absolute strength of response as a function of frequency of reinforcement. Journal of the Experimental Analysis of Behavior, 1961, 4, 267-272.

Irwin, F. W., Armitt, F. M., & Simon, C. W. Studies in object-preferences. I. The effect of temporal proximity. Journal of Experimental Psychology, 1943, 33, 64-72.

Jeffrey, D. B. Some methodological issues in research on obesity. Psychological Reports, 1974, 35, 623-626.

Johnson, W. G. The effects of cue prominence and obesity on effort to obtain food. In S. Schachter & J. Rodin (Eds.), Obese humans and rats. New York: John Wiley & Sons, 1974.

Kanfer, F. H., & Phillips, J. S. Learning foundation of behavior therapy. New York: John Wiley & Sons, 1970.

Karp, S. A., & Pardes, H. Psychological differentiation (field dependence) in obese women. Psychosomatic Medicine, 1965, 27, 238-244.

Karpowitz, D. H., & Zeis, F. R. Personality and behavior differences of obese and nonobese adolescents. Journal of Consulting and Clinical Psychology, 1975, 43, 886-891.

Mahoney, M. J. Fat fiction. Behavior Therapy, 1975, 6, 416-418. (a)

Mahoney, M. J. The obese eating style: Bites, beliefs, and behavior modification. Addictive Behaviors, 1975, 1, 47-53. (b)

Mahoney, M. J., & Thoresen, C. E. Self-Control: Power to the person. California: Brooks/Cole Publishing Co., 1974.

Mahrer, A. R. The role of expectancy in delayed reinforcement. Journal of Experimental Psychology, 1956, 52, 101-105.

McArthur, L. Z., & Burstein, B. Field dependent eating and perception as a function of weight and sex. Journal of Personality, 1975, 43, 402-420.

Metropolitan Life Insurance Company. New weight standards for men and women. Statistical Bulletin, 1959, 40, 1-4.

Meyer, J. E., & Pudel, V. Experimental studies on food intake in obese and normal weight subjects. Journal of Psychosomatic Research, 1972, 16, 305-308.

Mischel, W., & Grusec, J. Waiting for rewards and punishments: Effects of time and probability on children. Journal of Personality and Social Psychology, 1967, 5, 24-31.

Mischel, W., Grusec, J., & Masters, J. C. Effects of expected delay time on the subjective value of rewards and punishments. Journal of Personality and Social Psychology, 1969, 11, 363-373.

Nisbett, R. E. Taste, deprivation, and weight determinants of eating behavior. Journal of Personality and Social Psychology, 1968, 10, 107-116.

Pliner, P. On the generalizability of the externality hypothesis. In S. Schachter and J. Rodin (Eds.), Obese humans and rats. New York: John Wiley & Sons, 1974.

Rachlin, H. Introduction to modern behaviorism. San Francisco: W. H. Freeman and Co., 1970.

Rachlin, H. Self-control. Behaviorism, Spring 1974, 94-107.

Rachlin, H. Self-control: A form of environmental control. In P. Scott Lawrence (Chair), Self-Control: Theoretical and empirical perspectives. Symposium presented at University of North Carolina at Greensboro, 1975.

Rachlin, H., & Green, L. Commitment, choice and self-control. Journal of the Experimental Analysis of Behavior, 1972, 17, 15-22.

Rodin, J. Effects of distraction of the performance of obese and normal subjects. In S. Schachter and J. Rodin (Eds.), Obese humans and rats. New York: John Wiley & Sons, 1974.

Rodin, J., Herman, C. P., & Schachter, S. Obesity and various tests of external sensitivity. In S. Schachter & J. Rodin (Eds.), Obese humans and rats. New York: John Wiley & Sons, 1974.

Ross, L. Effects of manipulating salience of food upon consumption by obese and normal eaters. In S. Schachter and J. Rodin (Eds.), Obese humans and rats. New York: John Wiley & Sons, 1974.

Rotter, J. B. Social learning and clinical psychology. Englewood Cliffs, N. J.: Prentice-Hall, 1973.

Schachter, S. Emotion, obesity and crime. New York: Academic Press, 1971.

Schachter, S., & Friedman, L. N. The effects of work and cue prominence on eating behavior. In S. Schachter and J. Rodin (Eds.), Obese humans and rats. New York: John Wiley & Sons, 1974.

Schachter, S., Friedman, L. N., & Handler, J. Who eats with chopsticks? In S. Schachter & J. Rodin (Eds.), Obese humans and rats. New York: John Wiley & Sons, 1974.

Schachter, S., & Gross, L. Manipulated time and eating behavior. Journal of Personality and Social Psychology, 1968, 10, 98-106.

Schachter, S., & Rodin, J. Obese humans and rats. New York: John Wiley & Sons, 1974.

Sigal, J. J., & Adler, L. Motivational effects of hunger on time estimation and delay of gratification in obese and nonobese boys. Journal of Genetic Psychology, 1976, 128, 7-16.

Silverstein, T. Psychological factors in obesity. In I. M. Baird & A. M. Howard (Eds.), Obesity: Medical and scientific aspects. Livingston, England: Howard Edinburgh, 1969.

Stuart, R. B., & Davis, B. Slim chance in a fat world: Behavioral control of obesity. Champaign, Ill.: Research Press, 1972.

Stunkard, A., & Burt, V. Obesity and the body image. II: Age at onset of disturbance in the body image. American Journal of Psychiatry, 1967, 123, 1443-1447.

Thoresen, C. E., & Mahoney, M. J. Behavioral self-control. New York: Holt, Rinehart, and Winston, 1974.

APPENDIX A

DESCRIPTION AND RESULTS OF PILOT WORK

The work described by Rachlin (1975) involving children employed reinforcement values of 10 and 20 seconds for the immediate and delayed reinforcers. The children were assumed to be impulsive and thus only one response was required during the initial link, i.e., the initial sequence of button pushes. Since the present study was the first attempt to extend Rachlin's model to adult humans, pilot work was conducted during the summer of 1976 to determine the number of required responses during the initial link, delay times, and reinforcement durations that were used in the study.

Subjects

Twelve female undergraduates at the University of North Carolina at Greensboro served as subjects for the pilot work. The subjects were divided into six groups, with two subjects per group. The various groups differed in the number of initial link responses, the delay intervals used, and the reinforcement durations to determine which combination of these events would be used in the present study. The different parameters used for the pilot work are presented in Table A1.

Apparatus

The experimental setting was the same as for the study: a small room with a desk and a chair. The stimulus/response

TABLE A-1

Description of the Various Parameters Employed During Pilot Work for the Six Groups

Group	Responses required on white buttons	Delay Times		Reinforcement Times *	
		Short	Long	X	Y
1	5	1"	15"	10"	30"
2	5	2"	30"	10"	20"
3	15	2"	60"	15"	30"
4	15	2"	60"	15"	45"
5	15	2"	45"	10"	30"
6	15	2"	45"	15"	45"

*For the two green buttons X is the delay, and Y is the listening time. For the red button, X is the listening time and Y is the blackout time.

panel was on the desk. The panel was described in the Method section of the study.

Located in a separate room were the electronic timers and electromechanical equipment which programmed the experimental conditions and recorded the data. The reinforcers were musical albums recorded on reel-to-reel tape and controlled by the electromechanical equipment.

Procedure

Each subject was run individually. The subject was seated in front of the panel containing the lights and buttons. Each subject was informed that during the session some of the lights would be on and that she should push only those buttons associated with the lights that were on. Further she was told the buttons should be pushed one at a time, and until the lights went off. She was also told that sometimes one or two lights would be on at the same time. The subject was informed that sometimes none of the lights would be on and that at those times, no buttons should be pushed. It was explained that first the two white lights on the bottom would come on, and after the first blackout, some of the upper lights would go on. Additionally, the subjects in Groups 3-6 were given more detailed information about the procedure. They were told the number of responses required on the white buttons, that the red button led to immediate music followed by a blackout, and that the two green buttons were exactly the

same and led to a blackout followed by music lasting longer than with the red button.

Each session consisted of twenty free-choice trials. The subjects in Groups 1 and 2 also received six forced-choice trials for several sessions after starting on a new delay interval. The subjects in Groups 3-6 only received the six forced-choice trials during the first session of the new delay interval. The forced-choice trials were such that only one of the three response patterns was made available for a trial. Each response pattern was presented twice and in random order. The forced-choice trial procedure was used to ensure that at the beginning of a new delay interval the subject would experience each of the response contingencies. The twenty free-choice trials consisted of all three response patterns being made available, as described below.

Each trial consisted of a chain of events. The initial link of the chain consisted of the two bottom white lights being lit. After the required number of responses on the white buttons, there was a blackout of T seconds (this value varied as one of the independent variables during pilot work), during which time no lights were on. After this initial blackout, the terminal link began. If the last response on the white buttons was on the left white button, the upper left green light came on after the initial blackout. One response on the button produced a blackout for X seconds (see Table A-1 for the values of T, X, and Y for each group),

followed by Y seconds of music. This was the "commitment" side. If the last response was on the right white button, the two lights above this button came on after the initial blackout. The left button was red, and the right button was green. A response of the red button led to X seconds of music, followed by a blackout lasting Y seconds. This was the "lack of self-control" side. A response on the right green button produced the same events as a response on the left green button: blackout for X seconds, followed by music for Y seconds. This was the "brute force self-control" side.

Two T values were used for each group during the pilot work. The various T values were selected so that one would be well below the expected change-over value and the other would be well above it. The value of T was constant within any single session. Subjects were exposed to each T value for a number of sessions ranging from three to seven. (Due to time limitations, it was not possible to equate the number of sessions across subjects.)

Results

Table A-2 presents the mean number of times each of the red and two green keys was pushed by each subject according to group. The means of the groups are also shown.

Initially, an attempt was made to have the subjects stay with one T value until reaching a criteria of 67% responding on one of the three upper keys. The 67% criteria was

TABLE A-2

Mean Percent of Responses on Each Key for Each Subject at Both T Values

		Short T			Long T		
Group	Subject	Left Green**	Red	Right Green	Left Green**	Red	Right Green
1	JM	31.43	48.57	20.00	45.00	3.75	51.25
	LF	38.75	35.00	26.25	41.67	25.00	33.33
Mean		35.69	41.78	23.13	43.34	14.38	42.29
2	RR	20.00	7.50	72.50	12.50	5.00	82.50
	MC	38.00	38.00	24.00	35.00	35.00	30.00
Mean		29.00	27.75	48.25	23.75	20.00	56.25
3	JD	45.83	6.67	47.50	45.83	0	54.17
	JR*	45.00	0	55.00	40.83	24.50	34.67
Mean		45.42	3.34	51.25	48.33	12.25	44.42
4	CA	33.33	42.50	24.17	41.00	46.00	13.00
	MS*	60.00	0	40.00	58.00	3.00	39.00
Mean		46.67	21.25	32.09	49.50	24.50	26.00
5	SJ	44.00	32.00	33.00	44.00	1.00	55.00
	LR*	33.33	11.67	55.00	31.67	18.33	50.00
Mean		38.67	17.38	44.00	37.84	9.67	52.50
6	TR	28.75	25.00	46.25	28.33	33.33	38.33
	KS*	51.67	6.67	41.67	35.00	18.33	46.67
Mean		40.21	15.83	43.96	31.67	25.83	42.50

*These subjects started with the longer T value.
**Left Green key is commitment
Red key is lack of self-control
Right Green key is "brute force self-control"

selected in order to obtain above-chance responding on one of the top keys. However, due to time limitations, the criteria were discontinued. Some subjects stayed with one T value for up to seven sessions without reaching criteria. As a result, an arbitrary number of sessions for each T value was decided upon, depending on how many sessions a subject had time to participate in. As mentioned above, this ranged from three to seven sessions per T value.

Figures A1 and A2 are representative samples of the subjects' patterns of responding. Both figures show variability across sessions, which was typical of most subjects. JM was first exposed to the short T duration, and her graph shows that at this duration over sessions she indicated a slight preference for the small immediate reinforcer. When presented with the longer T value, she changed her preference and avoided the small immediate reinforcer without preferring one form of self-control (commitment or "brute force") over the other. In general, subjects presented with the shorter T value first would often select the small immediate reinforcer and then decrease the number of times they selected the small immediate reinforcer when T was increased. Four of the subjects were presented with the longer T value before the shorter T value. JR (Figure A2) was a typical instance of these four subjects. When presented with the longer T value first, these subjects soon learned to avoid the small immediate reinforcer. Then, when T was shortened, these subjects

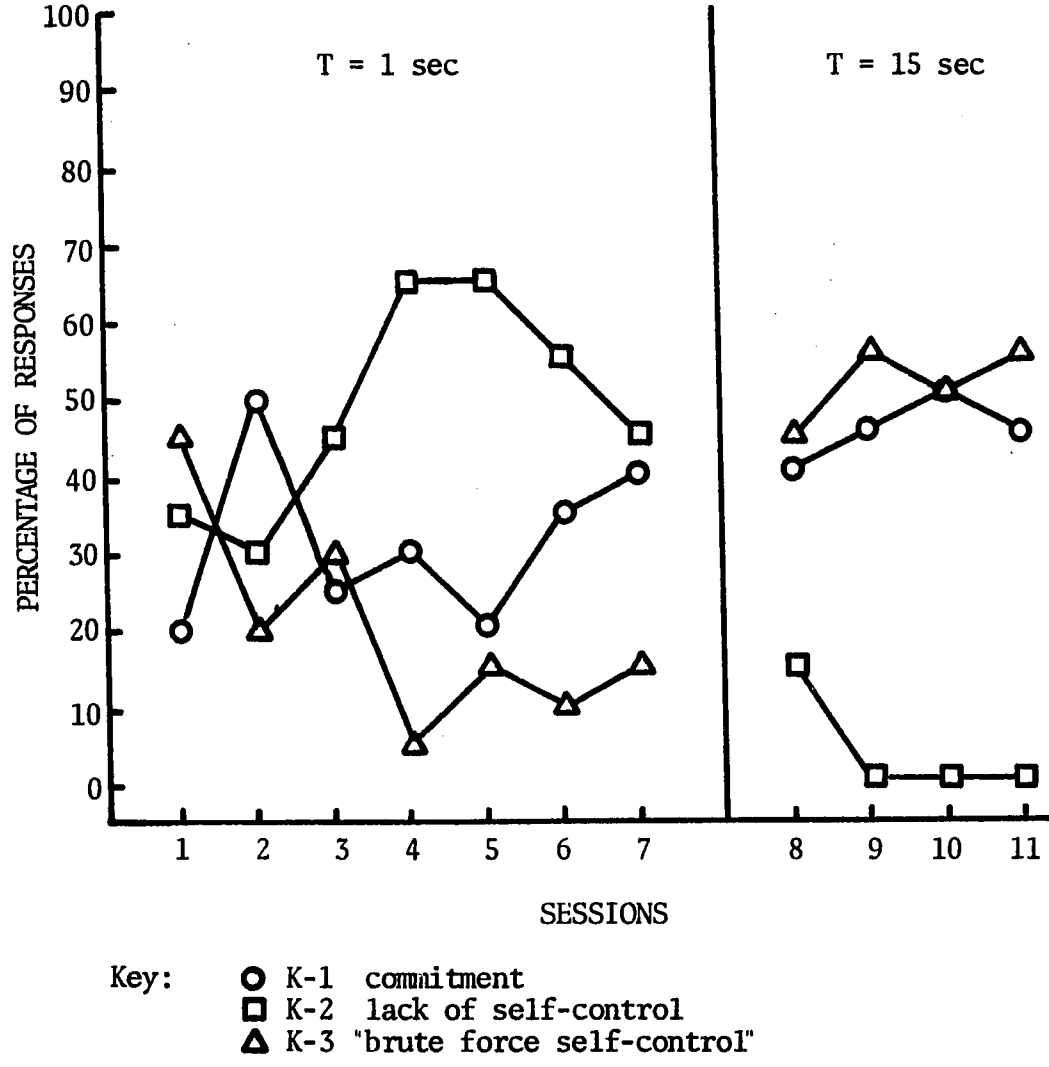


Figure A-1. Percentage of responses on each key for both T values, pilot subject JM.

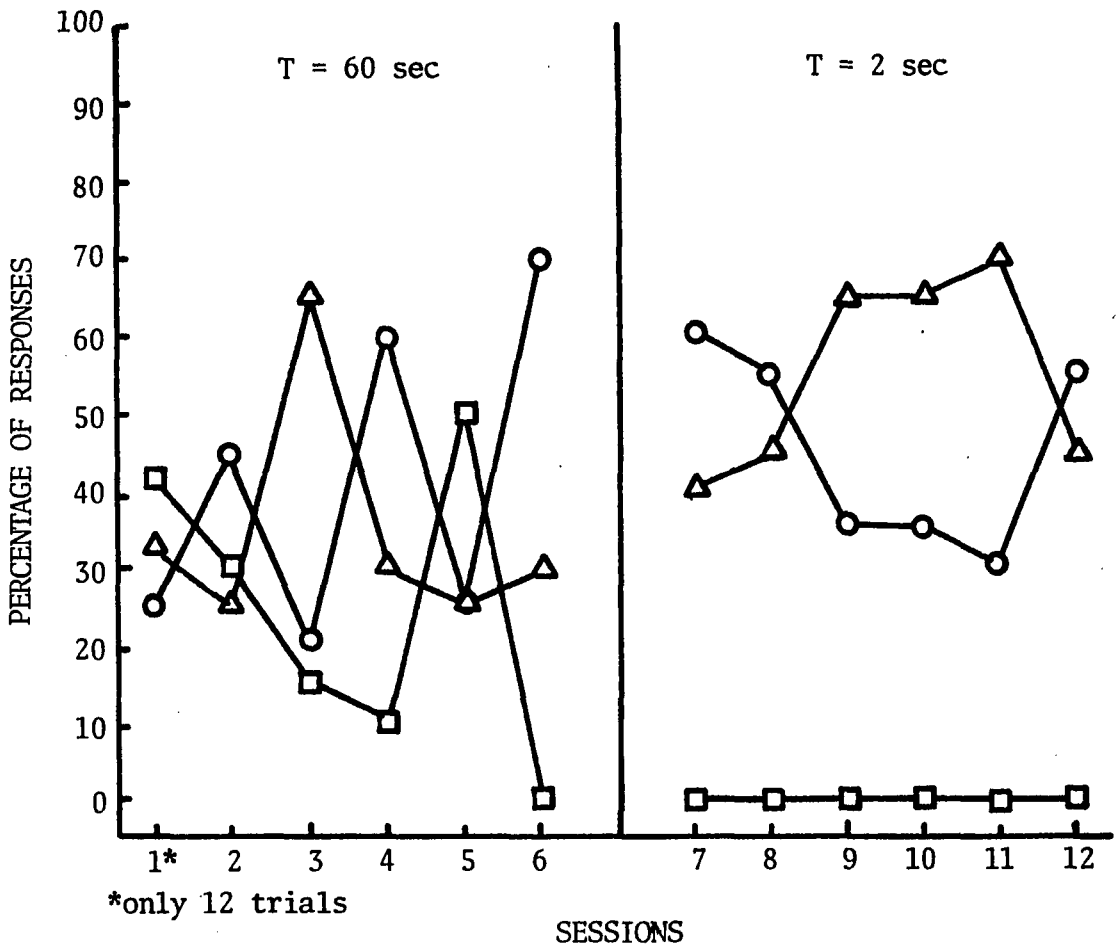


Figure A-2. Percentage of responses on each key for both T values, pilot subject JR.

continued to avoid the small immediate reinforcer. Thus, there was an apparent order effect. If subjects were presented with the short T value first, they demonstrated the expected change-over by avoiding the small immediate reinforcer when later presented with the longer T value. However, those subjects who were first exposed to the longer T value and also learned to avoid the small immediate reinforcer continued to do so when the T value was decreased. These findings lend support to Rachlin's model. Although subjects did not necessarily employ the commitment strategy, they were able to exhibit self-control with the longer T values. Also, once a person demonstrated self-control, it became easier to do so even when the choice point was brought closer in time (as demonstrated by those subjects starting with the longer T value and then changing to the shorter T value).

Figure A3 is included because it demonstrates another interesting finding. Subjects for pilot work were not screened on the basis of weight. CA happened to be an overweight, black female whose pattern of responding was unique within the pilot subjects. (She was the only subject who was either overweight or black.) CA responded as expected during the shorter T value: she selected the small immediate reinforcer. However, when T was increased, she continued to select the small immediate reinforcer at a fairly high frequency. It should also be noted that when she did exhibit

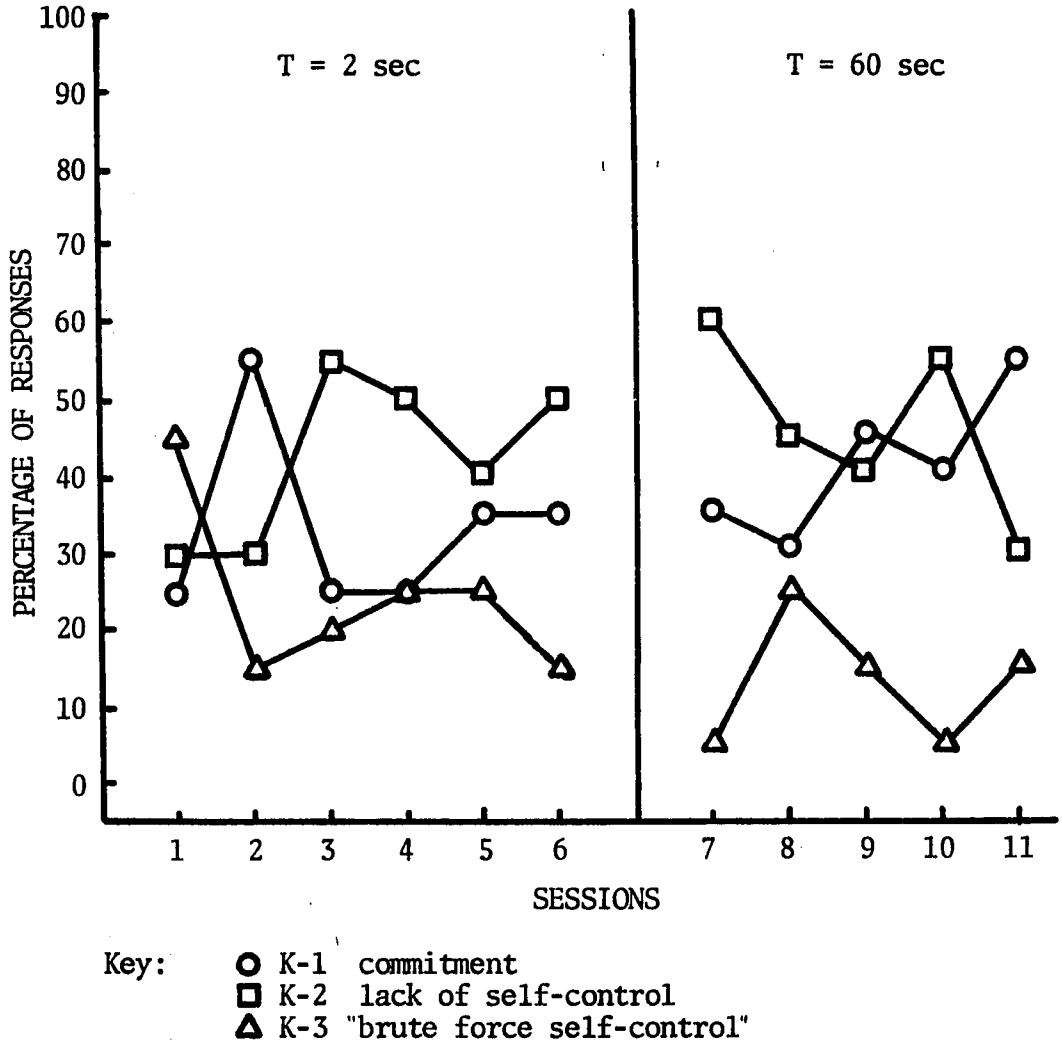


Figure A-3. Percentage of responses on each key for both T values, pilot subject CA.

self-control, she did so by choosing the commitment side rather than the "brute force self-control" side. Apparently, when faced with the choice side, CA most often chose the small immediate reinforcer.

Several subjects indicated that the blackout after the small immediate reinforcer, before the white lights came on again, was aversive. Not all of the subjects mentioned this, but those who did said that the blackout while waiting for the larger, delayed reinforcer did not seem as aversive, since they had the music to look forward to. Once a subject mentioned the aversive property of the small immediate reinforcer, she started avoiding the small immediate reinforcer, regardless of what T value was being presented. The reported aversiveness of the small immediate reinforcer could be introducing a variable not accounted for by Rachlin's formula.

The results of the pilot work determined certain methodological procedures and the parameters that were used in the present study. As shown in Table A1, Groups 1 and 5 were exposed to 10 and 30 seconds of reinforcement. Despite the difference in the number of responses required during the initial link and in delay intervals, both of these groups demonstrated the predicted change-over. It was decided that the 10 and 30 second reinforcement durations would be used in the study. An arbitrary decision was made concerning the number of responses required in the initial link. Group 1 was required to push the white buttons five times, and

Group 5 had a 15-push requirement. Since both of these requirements were effective in demanding some work on the part of the subjects to get to the terminal link, it was decided that a 10-push requirement would be used in the present study. Ten pushes was half way between the requirements of Groups 1 and 5, and perhaps ten pushes would eliminate the possibility of random responding evidenced by one subject in Group 1. Three delay intervals (one, fifteen, and forty-five seconds) were selected for use in the study. Each of these three values was tested during pilot work with the 10 and 30 second reinforcement durations. These three values were selected to test Rachlin's formula and to determine if it would take a longer delay before the obese subjects were able to exhibit self-control. Since there was an apparent order effect for the T values, the T values would be presented in increasing order. Subjects would be exposed to each T value for six sessions each. The data from the pilot work indicated that by the fifth session, the subjects had stabilized their responding.

As mentioned above, Groups 1 and 2 did not receive instructions concerning the contingencies used in the study. The subjects in these two groups had to learn the contingencies through experience, which took time and had some negative consequences in terms of the subjects' patterns of responding. All of the subjects did learn the contingencies, but not all of them responded in accordance with the contingencies. Half of the subjects continued to respond either

randomly or according to patterns across the top row of buttons (e.g., going back and forth across the top row of buttons) even after learning the contingencies. The subjects in Groups 3-6 were told the contingencies at the beginning, and none of these subjects responded randomly or in patterns. As a result, it was decided that full instructions, including details of the contingencies, would be used in the present study. Some of the subjects in Groups 3-6 indicated confusion even after the instructions were given. The decision was made to show the subjects a diagram of the panel, including the time intervals, to facilitate the subjects' understanding of the instructions.

APPENDIX B

"IMPORTANCE OF MUSIC" RATING SCALE

Name_____

Please rate below (by circling a number) the degree to which you feel music is important to you.

1-------2-------3-------4-------5-------6-------7
very little very much

APPENDIX C

AGREEMENT TO PARTICIPATE IN THE STUDY IN EXCHANGE FOR CREDIT AND A GIFT

I, _____, agree to participate in eighteen experimental sessions for Maria Zakrzewski. Upon completion of the experiment I will receive experimental credit for Psychology 221 and a small prize for participating in this study.

_____
(Subject's Signature)