Self-Control and Choice in Children: Effects of Food Magnitude and Reinforcer Delay

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SELF-CONTROL AND CHOICE IN CHILDREN:
EFFECTS OF FOOD MAGNITUDE AND
REINFORCER DELAY

by

Ellen Lee Sharenow

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
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Western Michigan University
Kalamazoo, Michigan
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The present research was designed to replicate and extend earlier studies with humans and nonhumans in the area of self-control. A discrete trial, within-subject experimental design over multiple sessions, with food as the reinforcer, was used. Instructions did not describe contingencies of reinforcement. Subjects were preschool age children, a population that questionably possess the verbal repertoire capable of generating sophisticated tacting, or mediating behavior during long delays. Four experiments consisted of fixed-ratio, concurrent chain schedules with initial and terminal links. Initial links were forced trials, terminal links, choice trials. In Experiment I, the effects of differences in magnitude while holding the delays constant was studied. Experiment II assessed the effects of increasing the delay to the larger reinforcer. In Experiment III, delay to one reinforcer chain was increased while magnitudes remained equal. Experiment IV studied the effects of differences in post-reinforcement delay while the magnitude of reinforcement remained equal. Results of Experiments I and II showed that all subjects: (a) preferred the larger reinforcer when delay to the smaller reinforcer was equal, and (b) six of seven subjects shifted their preference when delivery of the larger reinforcer was sufficiently removed in time from the choice point. The data also suggest that possible tacting of contingencies or waiting strategies did not lead to "maximizing" of reinforcement in Experiment II, with the exception of one subject. In Experiment III, two subjects
showed preference for the immediate reinforcer upon introduction of a delay to the other equivalent reinforcer. Two subjects showed preference at larger delay values and two remained indifferent. In Experiment IV key color bias affected the results. One of three subjects displayed preference for the small post-reinforcement delay without key color bias. All subjects exhibited some verbal repertoire to tact some contingencies and/or make their own rules. For some sessions choice was controlled by escape/avoidance/mediating behaviors, lack of motivation for food as a reinforcer, or due to other variables.
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Self-control and choice in children: Effects of food magnitude and reinforcer delay

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Western Michigan University, 1993
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Ellen Lee Sharenow
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CHAPTER I

INTRODUCTION AND REVIEW OF THE SELECTED LITERATURE

Self-control and impulsivity have been topics of considerable investigation over the last eighteen years (for reviews see: Blakely, 1986; Buskist & Miller, 1982; O'Leary & Dubey, 1979). In a broad sense these concepts relate to the problems that arise when behavior has conflicting multiple effects on the environment, some of which are immediate and some of which are delayed. Generally, immediate consequences exert greater control over behavior than delayed consequences, even when the delayed consequences are of greater magnitude and benefit to the organism. The focus of self-control research is to modify behavior so that it will contact delayed rather than immediate consequences. Self-control paradigms have been used extensively in nonhuman (e.g., Rachlin & Green, 1972) and human (e.g., Navarick, 1982) research.

The main focus of nonhuman research has been to identify variables that engender responding for large delayed reinforcers. One model of self-control, henceforth known as the “irreversible model,” gives subjects a choice between a small immediate reinforcer and a large delayed reinforcer. When one of the reinforcers is chosen, subjects are not permitted to select the other alternative; hence the choice is “irreversible.” Concurrent-chain schedules (e.g., Snyderman, 1983) are often employed. Subjects choose between two independent chains that are available on separate operandi. Each chain is composed of an initial-link schedule and a terminal-link schedule. The initial-links are equivalent, the terminal-links are not. The initial-links are available simultaneously and completion of one is followed by; (a) a
stimulus change, (b) entry into the terminal-link of that chain schedule, and (c) termination of the other chain schedule. Reinforcement occurs after completion of the terminal-link, followed by a return to a choice between the two initial-link schedules. The distribution of responses in the initial-links is a measure of "preference" for the terminal-links. Subjects exhibit "impulsive" behavior when they choose the small immediate reinforcer and "self control" when they choose the large delayed reinforcer (Ainslie, 1975; Rachlin & Green, 1972).

Irreversible self-control studies with nonhumans have varied different delay parameters. A study by Green, Fisher, Perlow, and Sherman (1981) varied temporal distance, \( t \), between the choice point and the two alternatives. As \( t \) increased, preference switched from the small immediate to the large delayed reinforcer. A study by Rachlin and Green (1972) varied temporal distance between the choice point and reinforcement using a modified concurrent chain procedure. Initial links consisted of a fixed ratio (FR) schedule in which the 25th response on the left key produced a \( t \) second blackout followed by a choice between a small immediate reinforcer and a large delayed reinforcer. If the 25th response occurred on the right key, a \( t \) second blackout was followed by only the large delayed reinforcer. The authors suggested that responding on the right key "committed" the pigeon to the large delayed reinforcer and responding on the left key allowed another choice \( t \) seconds later. When \( t \) was small, subjects preferred the choice branch and always chose the small immediate reinforcer. As \( t \) increased, preference changed to the "commitment" branch which offered only the large delayed reinforcer.

Navarick and Fantino (1976) increased the absolute value of the delays while holding the absolute differences constant. Pigeons were exposed to a concurrent chain variable-interval VI 1 min, fixed-interval FI \( t \)-s (4.5 s food) chain, VI 1 min FI \( t \)
-10-s (1.5-s food). Results indicated that preference for the large delayed reinforcer increased as the absolute size of the delays increased.

Green and Snyderman (1980) increased the absolute value of the delays but held the proportional differences constant. The authors programmed a concurrent chain, VI 1 min FI x (6-s food) chain, VI 1 min., FI y (2-s food) schedule where x/y ratio values were 6:1, 3:1, and 3:2. For example, a 3:1 ratio of terminal-link delay values might compare the following values; 6-s vs. 2 s, 18-s vs. 6-s and 24-s vs. 8-s. Preference for the large delayed reinforcer decreased in the 6:1 and 3:1 ratio values and increased in the 3:2 ratio values, as the absolute delays increased. In a follow-up study that eliminated procedural problems, Snyderman (1983) concluded that preference for the large delayed reinforcer increased as the absolute delays decreased for all three ratio values. The results of these studies differ from that reported by Navarick and Fantino (1976). It is important to note that in the studies reviewed above, (Green et al., 1981; Rachlin & Green, 1972) as well as Navarick and Fantino (1976), proportional differences between the delays decreased as “t” increased (Blakely, 1986).

Mazur and Logue (1978) were able to obtain “self-control” in pigeons through a fading procedure. In a follow up to a previous study, Logue and Mazur (1981) demonstrated that an extensive fading procedure, using overhead colored delay lights as conditioned reinforcers, could enhance preference for the large delayed reinforcer.

In summary, irreversible self-control studies with nonhumans have shown that preference for a large delayed reinforcer can be enhanced by removing the choice point in time from reinforcement (Green et al., 1981; Rachlin & Green, 1972), decreasing the absolute (Green & Snyderman, 1980; Snyderman, 1983) or proportional (Navarick & Fantino, 1976) differences between delays, or by special training (Logue & Mazur, 1981; Mazur & Logue, 1978). It should be noted that these
investigations studied concurrent chains that programmed food as the reinforcer. Moreover, within-subject experimental analysis of stable responding over many sessions was used.

The focus of research with humans has been to replicate findings of nonhuman research as well as study variables that may be unique to human self-control. The results of human studies have offered equivocal findings from those of nonhuman research. In a self-control study with adults (Logue, Pena-Correal, Rodriguez, & Kabela, 1986) reinforcer amount and delay were varied separately and together over multiple sessions. Points were given and then exchanged for money at the end of each session. Subjects always exhibited self-control by choosing the larger reinforcer regardless of the delay, thereby maximizing total amount of reinforcement. These results mirror those of Mawhinney (1982) who found that adults maximized total amount of reinforcement (i.e., tokens exchangeable for money) under concurrent VI FR schedules.

Other types of reinforcers have been assessed with adults. In these studies, subjects showed both self-control and impulsivity. Solnick, Kannenberg, Eckerman, and Waller (1980) gave subjects a choice between a small immediate or large delayed negative reinforcer (escape from white noise) over multiple sessions. Each alternative was contacted “t” seconds after the choice response. Preferences switched from the small immediate to the large delayed reinforcer as “t” increased. Similar results with escape from white noise were reported by Navarick (1982). These findings replicate studies using nonhuman subjects (e.g., Green et al., 1981). Other investigations have reported limited impulsivity with reinforcers such as video games (Millar & Navarick, 1984), reinforcers established by instruction (Navarick, 1985), and slides of sports and entertainment personalities (Navarick, 1986).
Using procedures similar to Green et al. (1981), Ragotzy, Blakely and Poling (1988) offered severely mentally retarded adolescents a choice between primary reinforcers that differed in magnitude and in some cases, delay. In the first phase, a choice between small and large immediate reinforcers resulted in the large reinforcer being consistently chosen. In the second phase the small reinforcer was delivered immediately, as the large reinforcer was increasingly delayed. A decrease was found in the percentage of trials in which the large, but delayed, reinforcer was chosen. In the third phase, 5-s increments were added to the small and large reinforcers at the point in the previous phase where preference had shifted from the large to the small reinforcer. With significantly long delays, two subjects preferred the large delayed reinforcer. A third subject chose the large reinforcer on half of the trials. Their results are similar to those found with adult humans in the termination of a negative reinforcer (e.g., Navarick, 1982) and numerous pigeon studies in which food was used as a positive reinforcer (e.g., Mazur & Logue, 1978).

The first basic research study conducted with children (Burns & Powers, 1975) attempted to replicate results produced by Rachlin and Green (1972). Two boys (ages 9-10 years old) could earn tokens for button pressing over multiple sessions. A response on the left button led to a “t” second blackout and a choice between a small immediate (2 tokens) or large delayed (4 tokens, delayed 4-s) reinforcer. A response on the right key led to a “t” second blackout followed by the availability of only the large delayed reinforcer. Tokens could be exchanged for money after the session or at the end of the week. As “t” increased, preference increased for the left key (choice key) in the initial link and the small immediate reinforcer in the terminal link. These results do not replicate those of Rachlin and Green (1972), but should be interpreted cautiously due to methodological problems. Specifically, tokens could be exchanged for money at two different points in time.
(daily or weekly), and subjects were exposed to only ascending values of “t”. Moreover, the disparity in results of this study and those of Rachlin and Green (1972) may be the result of different types of reinforcers.

A study conducted with hyperactive children (Schweitzer & Sulzer-Azaroff, 1988) attempted to teach self-control by gradually increasing the duration of the delay to the larger reinforcer over many sessions. Prior to each session, six children, 4-5 years of age, selected reinforcers from a variety of choices (e.g., edibles, stickers). Initially, children were offered large and small reinforcers with no delay. Delivery of the larger reinforcer was then very gradually increased over multiple sessions. Five of the six children increased their preference for the larger delayed reinforcer. However, the experimenter provided the children with instructions regarding the contingencies of reinforcement: specifically, the correlation between color and reinforcer amount. Additionally, reinforcers were stored and only available until the end of the session.

Various findings have been reported when food alone was used as the sole reinforcer. Mischel and Metzner (1962) exposed 5-12 year old children to a single choice trial where they could choose between a small immediate ($.05 candy bar) or a large delayed reinforcer ($.25 candy bar). Five different delay intervals were used with each age group. The results indicated that the proportion of choices for the smaller immediate reinforcer increased as the delay to the larger reinforcer increased. The disparity of findings in studies by Logue et al. (1986), as compared with Mischel and Metzner (1962), Navarick (1982), and Solnick et al. (1980), suggest that responding under a self-control procedure may be strongly determined by the nature of the reinforcer or its accompanying establishing operations (i.e., motivational variables).
Two previously mentioned studies (e.g., Navarick, 1982; Solnick et al., 1980) highlight another area of disparity between nonhuman and human research: namely, the use of instructions. The function of instructions is, however, unclear. In the first experiment of the Solnick et al. (1980) study, two types of instructions were presented. When subjects were informed about the differences in delay and magnitude of reinforcement, preference switched from the small immediate to the large delayed reinforcer as \( t \) increased. Subjects who received a partial description of the contingencies, involving only the differences in delays, were indifferent in their preferences, irrespective of the value of \( t \). Thus, detailed instructions increased sensitivity to changes in \( t \).

In contrast, Navarick (1982) provided no instructions regarding differences in delays or magnitude of reinforcement, yet reported increased preference for the large reinforcer as \( t \) increased. Schlinger and Blakely (1987) have posited that the use of instructions that describe contingencies between stimuli may alter the function of other stimuli to evoke future behavior. In some of the aforementioned adult studies (e.g., Solnick et al., 1980), it appears that subjects maximized reinforcement by choosing the large delayed reinforcer regardless of \( t \) when prior instructions describing the contingencies were given.

Another possible explanation for the aforementioned finding may be that humans are able to generate their own tacting (or describing) of the contingencies due to an extensive and sophisticated verbal repertoire. Because of these differences, the generality of nonhuman to human research may be limited. Other researchers as well have suggested that instructions may engender insensitivity to schedule changes (e.g., Matthews, Shimoff, Catania, & Sagvolden, 1977; Shimoff, Catania & Matthews, 1981). Thus, it is difficult to predict the effects of instructions. It is for this reason,
perhaps, that many studies have used only minimal instructions. Human studies that use similar procedures are needed.

Other disparities between human and nonhuman research findings may be due to procedural differences. For example, nonhuman studies used within-subject analyses and measured steady-state responding over multiple sessions. Studies with humans, however, often use a single trial (e.g., Mischel & Metzner, 1962) or a single session with multiple trials (e.g., Navarick, 1982). This difference is critical because human responding under self-control procedures may be a function of duration of exposure to experimental conditions (Solnick et al., 1980).

Selection of large delayed reinforcers with children has been shown to be a function of age and verbal ability as well (e.g., Miller, Weinstein & Karniol, 1978; Pouthas Droit, Jacquet & Wearden, 1990). Researchers such as Mischel and Ebbesen (1970) and Mischel, Ebbesen and Zeiss (1972) have examined children's self-control strategies within choice situations. They were interested in identifying "distractors" and "alternative behaviors" young children use to mediate delay periods. Fun activities (e.g., singing, talking to themselves) were found to help children "wait out" long delay periods and facilitate choices of large more delayed reinforcers. Very young children, because they may lack the: (a) verbal repertoire to help them tact contingencies or, (b) the skills necessary to mediate the long delays, tend to choose smaller, immediate reinforcers (Miller et al., 1978; Mischel & Mischel, 1983).

Pouthas et al., (1990) contend that verbal behavior cannot exert control over non-verbal behavior at all levels of development. Evidence for this conclusion comes from studies conducted with preverbal children (e.g., Lowe, Beasty & Bentall, 1983) whose behavior under fixed interval schedules of reinforcement resembled performances of pigeons. Pouthas and Jacquet (1987) examined the point during development at which verbal behavior exerts control over nonverbal behavior. They
studied 4 1/2 year olds under a differential-low-rate-of-reinforcement (DRL) schedule and found that behavior was controlled by the reinforcement contingencies and not their verbal behavior.

In summary, basic research in irreversible self-control conducted with nonhumans (pigeons, rats) and humans (normal adults, children, & mentally retarded adolescents) has led to variant findings, thereby limiting across-species generality. Generally speaking, nonhumans demonstrate impulsivity by preferring a small immediate reinforcer to a large delayed reinforcer. Preference for a large delayed reinforcer can be enhanced by decreasing the proportional (Navarick & Fantino, 1976), or absolute (Green & Snyderman, 1980; Snyderman, 1983) differences between delays. Similar effects can be obtained by removing the choice point in time from reinforcement (Green et al., 1981; Rachlin & Green, 1972) or providing special training (Logue & Mazur, 1981; Mazur & Logue, 1978). Research with humans yield similar results to nonhumans under certain conditions (e.g., Solnick et al., 1981). Under other conditions, however, subjects always choose the large reinforcer, irrespective of the delay (e.g., Logue et al., 1986). The aforementioned diverse findings may be a function of differences in types of reinforcement (Logue et al., 1986), types of instructions (e.g., Schlinger & Blakely, 1987), types of procedural differences (e.g., Navarick, 1982) and/or different ages and verbal repertoires among subjects (e.g., Mischel & Mischel, 1983).

The present research is therefore designed to replicate and extend earlier studies conducted with humans and nonhumans in the area of irreversible self-control. The purpose of this study is to replicate and extend with humans, procedures used in nonhuman research. The present investigation will use a discrete trial, within-subject, experimental design with food as the reinforcer. Furthermore, steady-state responding over multiple sessions will be measured. Prior instructions will not
describe contingencies of reinforcement. Finally, subjects will be 3-4 year old
“normal” children, a population who may not possess the verbal repertoire to generate
sophisticated tacting/self-instruction or mediating waiting behaviors.

The effects of delay and food magnitude on choice will be evaluated in four
experiments. In Experiment I, the effects of differences in reinforcer magnitude will
be studied while holding the delays constant. Experiment II will assess the effects of
increasing the delay to the larger reinforcer. In Experiment III, delay to one reinforcer
chain will be increased while reinforcer magnitudes remain equivalent. Experiment IV
will assess the effects of differences in post-reinforcement delay while the magnitude
of reinforcement remains the same.
CHAPTER II

DESIGN AND METHODOLOGY

Subjects

Seven normal, 3-4 year old children, who attended a local day care facility, were recruited from a pool of children who were available to attend sessions prior to two daily classroom snack periods. Children who readily consumed the reinforcer (cereal) in a pretest were selected. The pretest condition will be described later. Informed consent was obtained from the parents or legal guardian of each child (see Appendix A). Consent was also obtained from the Human Subjects Institutional Review Board (HSIRB) of Western Michigan University (see Appendix B) and Ron Hutchinson, Ph.D., President, of the Child Development Center (CDC). Subjects had no previous experience in a study of self-control. The study was conducted between the months of June, 1988, to August, 1989. Subjects participated from 3-14 months.

Subject 7 was the first child to participate in the study. Consequently, some of the experimental conditions differed for this subject, which will be described later. Subjects 3, 5 and 6 were unable to complete every aspect of the study, but their data are included, nevertheless.

Setting

All sessions were conducted at a local day care facility for children. Subjects met with the experimenter or one of two graduate students, who served as research assistants, from the Department of Psychology. The setting for all sessions was a
classroom (22'8" x 27'3") containing a few pieces furniture, toys, and operant equipment. The operant conditioning equipment was located in one corner of the room facing the wall. Toys were placed in the opposite corner. Illumination was provided by overhead fluorescent lights.

Apparatus

Subjects were seated at a child's table (42 cm tall; 61 cm x 85 cm) and chair (33 cm tall), located in a corner of the classroom. An intelligence panel (30 cm x 41.5 cm) was mounted 7.5 cm from the front edge of the table. On the bottom of the panel were two round telegraph keys (2.54 cm diameter), partially housed by two black boxes (5.08 cm x 10.2 cm x 3.8 cm), 28 cm apart. Two (7w) lights (red and green) were placed above (3.8 cm) each black box, 5.4 cm inches apart. Cereal was provided by a Ralph Gerbrands Universal Dispenser which was mounted inside a metal cabinet that stood behind the intelligence panel and next to the table. When the feeder operated, food quickly dropped into a flexible tube (2.8 cm in diameter) down to a plastic dish (11.4 cm in diameter), located between the two keys. The (7w) white house light, was located 9.2 cm from the top center of the panel (see Figure 1).

Data Collection

Experimental conditions and data collection were controlled by electromechanical relay equipment. Relay equipment was enclosed in a metal cabinet located 15 ft behind the child's table. Data were also collected by the experimenter or research assistant who was seated out of view from the subject and recorded choice responses on a data sheet (see Appendix C).
Figure 1. Diagram of Apparatus.
Response Definition and Dependent Variables

A choice response was defined as the first press (150 grams force), on either key, during the initial link of the concurrent-chain schedule. In Experiments I and II, the dependent variable was the percentage of choice trials on which the larger reinforcer (SR) was chosen (large SR * 100). In Experiment III the dependent variable was the percentage of choice trials on which the immediate reinforcer was chosen (immediate SR * 100). For Experiment IV, the dependent variable was the percentage of trials on which no post-reinforcer delay was chosen (no post-SR delay * 100).

Observer Agreement

During each session, the experimenter or research assistant sat behind and to the left of the subject while recording the choice responses on a data sheet. The data collector was blocked from the subject's view by a see-through partition (stacked milk crates). At the completion of the session, data collected by the experimenter were compared to data transduced by the electromechanical relay equipment. An agreement score was calculated from these two data sources.

Conduction of Sessions and Stability Criteria

Sessions were conducted five days a week, at least one hour before or two hours after daily scheduled snack periods, in order to promote motivation for food (Vollmer & Iwata, 1991). Each subject was exposed to a minimum of five sessions per condition (except for Experiment IV) or until stability criteria were met. Responding was considered stable when three data points were equivalent or if the last five data points evidenced no visible trend within a 20% range. The experimenter
also noted verbal and nonverbal (e.g., disruptive or mediating) behavior during the session.
CHAPTER III

PROCEDURE

Pretest Conditions

Session Reinforcers

One of the goals of the present study was to replicate as closely as possible experimental conditions used with nonhumans in the area of self-control. Primary reinforcers (e.g., food) are most often used in research with nonhumans. Secondary reinforcers (e.g., tokens, money) are most often used in human research. Therefore, cereal, a primary reinforcer, was selected to be used in the study. Another advantage to using food was that given appropriate motivational conditions (i.e., establishing operations), food is intrinsically reinforcing and can be delivered and consumed immediately.

To determine the effectiveness of cereal as a reinforcer, subjects were pretested prior to the first experimental condition. Cereal was chosen as a primary reinforcer because of the rapidness in which it can be consumed, as well as the ease of delivery via electromechanical equipment. Air-puffed cereal was used to attenuate any possible satiation effects. At snack time potential subjects received an amount of cereal approximate to that which they might receive during an experimental session. Seven children who consumed most or all of the cereal were selected as subjects.

During snack time the following day, each child was individually escorted to the experimental room where he/she was given the choice between four different low-sugar cereals: (1) Cocoa Puffs (General Mills), (2) Kix (General Mills), (3) Boddy 16
Buddies (General Mills) and (4) Cheerios (General Mills). Four cereals were displayed in the same order from right to left. The experimenter instructed the child to taste each cereal and to choose the one they liked best. Reinforcer selection was based on the methods used by Mischel (1958), and Mischel & Metzner (1962). The cereal chosen by each child was used throughout the study as the primary reinforcer. All children chose Cocoa Puffs Cereal (General Mills, Minneapolis).

Peabody Picture Vocabulary Test--Revised (PPVT--R) and Age Equivalent Scores

The Peabody Picture Vocabulary Test--Revised (Dunn & Dunn, 1981) was administered to each subject at the beginning and end of the study (except for Subject 6). The PPVT--R is designed to measure a child's receptive (hearing) vocabulary for Standard American English. The test shows the extent of English vocabulary acquisition. Children were shown a series of four pictures and asked to point to the picture which most aptly matched a word given orally by the examiner. An age-equivalent score was calculated to determine the verbal “developmental” age for each subject.

Instructions

Each subject was individually escorted to the the bathroom where they washed their hands and proceeded to the experimental room where they were seated at the experimental table and given the following instructions:

This is a game in which you can earn food to eat. The food will come out of this tube. You can earn the food by pressing one of these two keys. When a light comes on over a key, that means you can press the key. If a light comes on over both keys you must pick only one key to press. When the food comes out, eat it all right away. When the game is finished, this light (house light) will go out. Remember, press only one key and eat all the food right away. If you follow the directions of pressing only one key and eating all the food right away you will get to choose a reward when you are done. You cannot talk to me while you are playing the game.
As the instructions were given, the experimenter pointed to the various lights and keys. The experimenter assessed the child's understanding by asking three questions:

1. “When a light comes on over a key, can you press that key?”
2. “If a light comes over both keys how many keys can you press?”
3. “When the food comes out, what do you do?”

If all three questions were answered correctly the session was started. If the instructions were not followed, the experimenter prompted correct responding by repeating the instructions and questions until the child answered and responded correctly.

Post-Session Reinforcers

Once the first session was completed, subjects were told they could pick from a variety of toys/stickers/activities to play with as a reward for following instructions. Every session thereafter the experimenter asked each subject to answer the three aforementioned questions before the session began. At the end of the session each subject was asked what he/she had done correctly to earn a reward. If the child said, “I pressed the keys and ate the food as soon as it came out,” a reward was given (as long as the verbal behavior matched nonverbal behavior).

Compliance With Instructions

Interaction between the instructor and subject was not permitted once the session began. A child was prompted under the following conditions:

1. If the subject was engaging in a potentially harmful activity to himself or the experimenter.
2. If the subject was not eating his food for more than two choice trials. Or if he/she did not finish eating before the next trial began.

3. If the subject was damaging the intelligence panel (e.g., unscrewing light bulbs, pulling on the feeding tube, etc.,).

4. If the subject did not respond to the next trial within a reasonable period of time (> 15-s).

Noting of Behavior During Sessions

As the study continued over time it was observed that non-compliant, particularly aggressive behavior, was increasing in frequency for many subjects. It was decided to record on the data sheet any verbal and nonverbal behavior emitted by the subject in addition to key pressing. Compliant and/or noncompliant behavior was also recorded which included delayed responding (e.g., > 15-s) to forced or choice trials. These notations were written on the data sheet next to the trial on which they occurred.

General Method

A series of eighteen discrete-trials were administered in sessions lasting approximately 10-15 minutes. A concurrent-chain procedure with fixed-ratio (FR) initial-link schedules and fixed-time (FT) terminal-link schedules were used in all experiments. Each chain was associated with a particular key color (red or green) and presented an equal number of times on each key. The order in which the lights were presented was fixed. For Experiments I and II the red light was randomly correlated with the larger reinforcer for Subjects 1, 3, 4, and 5. Correspondingly, the green light was randomly correlated with the larger reinforcer for Subjects 2, 6 and 7. Because of different delay parameters, post-reinforcement time was added to the
shorter FT chain so that both chains were of equal overall duration, except in Experiment IV (see Figures 3, 4, 6 & 8).

Sessions began with house light illumination followed by eight forced trials and ten choice trials. In forced trials, only one key light (red or green) was illuminated. One response on an illuminated key extinguished the light and initiated entry into the terminal-link, (FT) schedule. In choice trials, one light over each key was illuminated simultaneously (one red, one green). A response (FR 1) on an illuminated key extinguished both lights and initiated entry into the terminal-link FT schedule. In both forced and choice trials, responses during the terminal-link schedule had no effect. At the end of the terminal-link, the appropriate amount of food was delivered from the universal dispenser into the food dish. The next trial began after a 15-s intertrial-interval (ITI). The house light was continuously illuminated until the end of the last trial.

Summary of Experiments

In Experiment I, and II, one chain delivered a large reinforcer (four pieces of cereal), the other a small reinforcer (one piece of cereal). In Experiment III, and IV, both chains delivered one reinforcer.

Experiment I: Simple Magnitude With Color Switch

Condition: Cone Chain FR 1 FT 0-s (1 Reinforcer) Chain FR 1 FT 0-s (4 Reinforcers)

This experiment was designed to evaluate whether differences in reinforcer magnitude would affect choice when delays were held constant. Immediate reinforcers (one or four) were provided after a 0-s delay. To insure that choice was
not due to key color bias, the key colors associated with each chain were switched after stability criteria were met.

**Experiment II: Delay to the Larger Reinforcer With Repeated Exposures**

**Condition: Cone Chain FR 1 FT t-s (4 Reinforcers) Chain FR 1 FT 0-s (1 Reinforcer)**

Experiment II evaluated the effects of differences in delays when reinforcer magnitudes differed. Delay to the small reinforcer remained constant at 0-s. If preference for the larger reinforcer was between 30%-100% and stability criteria were met, delays to the larger reinforcer were increased systematically (5, 10, 20, 40 and 80-s). If preference for the larger reinforcer was between 0% - 20% of choice trials, two former delays were reintroduced in descending order: (1) the next lowest time delay, and (2) 0-s.

**Experiment III: Simple Delay With Color Switch**

**Condition: Cone Chain FR 1 FT t-s (1 Reinforcer) Chain FR 1 FT 0-s (1 Reinforcer)**

Experiment III assessed the impact of differences in delays to reinforcement while the magnitude of reinforcement remained equal. Delay on one chain was kept at 0-s while delay on the other chain was systematically increased (5, 10, 20, 40, and 80-s) if preference for the delayed reinforcer was between 30%-100%, and stability criteria were reached. If preference for the immediate reinforcer was between 80%-100% of choice trials, then colors were switched to ensure responding was not a result of key color bias.
Experiment IV: Post-reinforcement Delay With Color Switch

Condition: Cone Chain FR 1 FT 0-s (1 Reinforcer) Chain FR 1 FT 0-s (1 Reinforcer) FT 80-s

Experiment IV evaluated the impact of two different post-reinforcement delays with equivalent pre-reinforcer magnitudes and delays. Both chains offered one reinforcer after a 0-s delay. Post-reinforcement delay for one chain was 0-s with a 15-s ITI; delay for the other chain was 80-s, followed by the 15-s ITI. Colors were switched to identify possible key color bias. If no key color bias was evident, subjects were exposed once to each color. Key colors were switched back to the original color, if a bias was evident.
CHAPTER IV

RESULTS

Observer Agreement

Data collected by the experimenter or research assistant were compared to data transduced by the electromechanical relay equipment at the completion of every session. One hundred percent (100%) agreement was obtained.

Subject Data

*Age and Peabody Picture Vocabulary Test --Revised (PPVT--R) and Age Equivalent Scores*

The Peabody Picture Vocabulary Test--Revised (PPVT--R) was administered to each subject at the beginning and end of the study with the exception of Subject 6. She left the day care center before she could be tested. Table 1 displays the following: (a) subject number, (b) sex, (c) start and end ages, (d) PPVT--R age equivalents, start and end ages, and (e) age category rankings.

Start age and start PPVT--R age equivalent rankings were the same for Subjects 4, 5, 6 and 7 (ranking 1st, 3rd, 5th, and 2nd, respectively). Subjects 1, 2 and 3 traded among 4th, 5th and 6th place. All subjects, except for Subject 1 and 6, had a higher PPVT--R age equivalent score than their chronological age at the beginning of the study. Subject 1 also had a lower PPVT--R score than her chronological age at the conclusion of the study; Subject 6 was unavailable for testing.

The "developmental" differences between start age and start PPVT--R age equivalent scores are listed as follows: (a) Subject 1, minus 8 months; (b) Subject 2, 23
Table 1
Age and Peabody Picture Vocabulary Test — Revised (PPVT—R)
Age-Equivalent Scores

<table>
<thead>
<tr>
<th>Subj</th>
<th>Sex</th>
<th>Start Age/Rank</th>
<th>Start PPVT—R Age Equiv./Rank</th>
<th>End Age/Rank</th>
<th>End PPVT—R Age Equiv./Rank</th>
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</thead>
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<tr>
<td>1</td>
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<td>4 y, 2 m</td>
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<td>2</td>
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<td>3 y, 5 m</td>
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<td>4 y, 1 m</td>
<td>(5) (4 y, 2 m)(5)</td>
</tr>
<tr>
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<td>M</td>
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<td>3 y, 11 m</td>
<td>(6) (4 y, 10 m)(3)</td>
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<td>M</td>
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<td>4 y, 7 m</td>
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<td>M</td>
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<tr>
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<td>(5) (3 y, 4 m)(5)</td>
<td>4 y, 5 m</td>
<td>(3) couldn't test</td>
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<tr>
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<td>M</td>
<td>3 y, 9 m</td>
<td>(2) (4 y, 6 m)(2)</td>
<td>4 y, 11 m</td>
<td>(1) (5 y, 10 m)(2)</td>
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</tbody>
</table>

* y = years, m = months
1 = highest age rank, 6 = lowest age rank

plus 2 months; (c) Subject 3, plus 6 months; (d) Subject 4, plus 3 months; (e)
Subject 5, plus 8 months; (f) Subject 6, minus 1 month; and (g) Subject 7, plus 9
months. A comparison of end age and end PPVT—R age equivalent scores produced
these results: (a) Subject 1, minus 7 months; (b) Subject 2, plus 1 month; (c)
Subject 3, plus 11 months; (d) Subject 4, plus 21 months; (e) Subject 5, plus 8
months; (f) Subject 6, couldn't test; and (g) Subject 7, plus 11 months. Subjects
participated in the study for the following lengths of time: (a) Subject 1, 7 months;
(b) Subject 2, 7 months; (c) Subject 3, 10 months; (d) Subject 4, 4 months; (e)
Subject 5, 3 months; (f) Subject 6, 12 months; and (g) Subject 7, 14 months.

Start and end age rankings are equal for Subjects 1, 2, and 3 (fourth, fifth and
sixth place, respectively) as are end PPVT—R age equivalent rankings for Subjects 1,
4, and 7 (sixth, first, and second place, respectively).

**Experiment I: Simple Magnitude With Color Switch**

Figure 2 displays in graph form the percentage of trials on which the larger reinforcer was chosen over the smaller reinforcer at 0-s delays, for both chains. Once stability was reached, colors were switched. Figure 3 shows a diagram of Experiment I with the larger and smaller reinforcers delivered at 0-s. Table 2 shows experimental conditions for each subject. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. The larger reinforcer was correlated with four pieces of cereal; the smaller reinforcer with one piece of cereal (Cocoa Puffs, General Mills).

All seven subjects preferred, with some between-subject variability (80% - 100%), the larger reinforcer when the delay for both chains was 0-s. Switching colors appeared to have minimal effect, with the exception of Subject 3 who required 20 sessions to obtain stable responding. For all other subjects, preference for the immediate, larger reinforcer was achieved in 3-7 sessions (see Figures 2, 3 & Table 2). Figures and tables for Experiment I will be shown in the following section.

**Experiment II: Delay to the Larger Reinforcer with Repeated Exposures**

Figure 2 displays in graph form the percentage of trials on which the larger reinforcer was chosen over the smaller reinforcer as delay to the larger reinforcer increased as delay to the smaller reinforcer remained at 0-s. Figure 4 shows the procedural diagram for Experiment II. Once preference for the larger reinforcer was stable and within the 0%-20% range, two former delay values were repeated in descending order: (1) the next lowest delay value were preference shifted from the
Figure 2. Graphs of Experiments I: Simple Magnitude With Color Switch & Experiment II: Delay to the Larger Reinforcer With Repeated Exposures.

*Expt. I: Larger and smaller reinforcers delivered at 0 seconds.

*Expt. II: Delay to larger reinforcer increases as delay to smaller reinforcer remains at 0 seconds.
Figure 2--Continued

*Expt. I: Larger and smaller reinforcers delivered at 0 seconds.

*Expt. II: Delay to larger reinforcer increases as delay to smaller reinforcer remains at 0 seconds.
Figure 3. Diagram of Experiment I: Simple Magnitude With Color Switch.
*Larger and Smaller reinforcer delivered at 0 seconds.

Figure 4. Diagram of Experiment II: Delay to the Larger Reinforcer With Repeated Exposures.
*Delay to larger reinforcer increases as delay to smaller reinforcer remains at 0 seconds.
Table 2
Experimental Conditions for Experiment I: Simple Magnitude With Color Switch

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<th>Condition</th>
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<th>Delay in Seconds</th>
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*Experimental conditions for each subject during Experiment I. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. The larger reinforcer was correlated with four pieces of cereal; the smaller reinforcer with one piece of cereal (Cocoa Puffs, General Mills). Color switch occurred in Condition 2 for all subjects.
Table 3
Experimental Conditions for Experiment II: Delay to the Larger Reinforcer With Repeated Exposures

<table>
<thead>
<tr>
<th>Condition</th>
<th>Sessions to Stability</th>
<th>Red Key Reinforcer</th>
<th>Delay in Seconds</th>
<th>Green Key Reinforcer</th>
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*Table 3 Experimental conditions for each subject during Experiment II. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. Delays are listed in seconds. The larger reinforcer was correlated with four pieces of cereal; the smaller reinforcer with one piece of cereal (Cocoa Puffs, General Mills).
Table 3--Continued

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<thead>
<tr>
<th>Condition</th>
<th>Sessions to Stability</th>
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Table 3 Experimental conditions for each subject during Experiment II. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. Delays are listed in seconds. The larger reinforcer was correlated with four pieces of cereal; the smaller reinforcer with one piece of cereal (Cocoa Puffs, General Mills).
larger delayed reinforcer to the smaller immediate reinforcer, and (2) 0-s. Table 3 shows experimental conditions for each subject during Experiment II. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. The larger reinforcer was correlated with four pieces of cereal; the smaller reinforcer with one piece of cereal (Cocoa Puffs, General Mills).

As delays to the larger reinforcer were systematically increased (5, 10, 20, 40 and 80-s) and the smaller reinforcer remained at 0-s, percentage of trials on which the larger reinforcer was chosen shifted from the larger to the smaller reinforcer for all subjects, except Subject 7 (see Figure 2). The time values at which preference shifted were as follows: (a) Subject 6, 10-s; (b) Subject 2, 4 and 5, 20-s; (c) Subject 3, 40-s; (d) Subject 1, 80-s (see Figure 2 & Table 3).

The number of sessions required to reach stable responding varied for each subject. Stability was achieved for Subject 1 in 3-11 sessions, Subject 2 in 3-19 sessions, Subject 3 in 3-28 sessions, Subject 4 in 3-20 sessions, Subject 5 in 5-16 sessions, Subject 6 in 3-10 sessions, and Subject 7 in 3-35 sessions. Three subjects (1, 3 & 4) required the greatest number of sessions to reach stable responding at the delay value where preference shifted from the larger delayed reinforcer to the smaller immediate reinforcer (see Table 3).

As delays to the larger reinforcer were systematically increased (5, 10, 20, 40 and 80-s) and the smaller reinforcer remained at 0-s, percentage of trials on which the larger reinforcer was chosen shifted from the larger to the smaller reinforcer for all subjects, except Subject 7 (see Figure 2). The time values at which preference shifted were as follows: (a) Subject 6, 10-s; (b) Subject 2, 4 and 5, 20-s; (c) Subject 3, 40-s; (d) Subject 1, 80-s (see Figure 2 & Table 3).
The number of sessions required to reach stable responding varied for each subject. Stability was achieved for Subject 1 in 3-11 sessions, Subject 2 in 3-19 sessions, Subject 3 in 3-28 sessions, Subject 4 in 3-20 sessions, Subject 5 in 5-16 sessions, Subject 6 in 3-10 sessions, and Subject 7 in 3-35 sessions. Three subjects (1, 3 & 4) required the greatest number of sessions to reach stable responding at the delay value where preference shifted from the larger delayed reinforcer to the smaller immediate reinforcer (see Table 3).

Subject 7 was the first child to participate in the study. Initially, smaller 5-s delay progressions had been chosen. The delay was increased by 5-s until a 40-s delay was reached. At that point, the delay was increased to 50-s and then finally to 100-s. Although preference for the larger reinforcer began declining at 40-s, at 100-s the larger delayed reinforcer continued to be chosen 70% of the time (see Figure 2 and Table 3).

Comparison of Initial and Second Exposure Sessions for Experiment II

If preference for the larger reinforcer was between 0%-20% and stability criteria were met, two former delays were reintroduced in descending order: (1) the next lower delay value, and, (2) 0-s. Figure 2 shows in diagram form the descending exposure values. Table 4 compares the initial and second exposure sessions from Experiment II. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. The larger reinforcer was correlated with four pieces of cereal; the smaller reinforcer with one piece of cereal.

For Subjects 1 through, second exposure preference to the next lower value more closely approximated values similar to the next higher delay value where...
Table 4
Experimental Conditions for Experiment II: Comparison of Initial and Second Exposure Sessions

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<th>Condition</th>
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<tr>
<td>2</td>
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</table>

(Susan) Subject 1

| 1         | 6       | Smaller   | 0               | Larger     | 0               |
| 2         | 19      | Smaller   | 0               | Larger     | 0               |
| 1         | 5       | Smaller   | 0               | Larger     | 20              |
| 2         | 3       | Smaller   | 0               | Larger     | 20              |

(Sam) Subject 2

| 1         | 20      | Larger    | 0               | Smaller    | 0               |
| 2         | 20      | Larger    | 0               | Smaller    | 0               |
| 1         | 25      | Larger    | 20              | Smaller    | 0               |
| 2         | 6       | Larger    | 20              | Smaller    | 0               |

(Tom) Subject 3

| 1         | 3       | Larger    | 0               | Smaller    | 0               |
| 2         | 10      | Larger    | 0               | Smaller    | 0               |
| 1         | 8       | Larger    | 10              | Smaller    | 0               |
| 2         | 10      | Larger    | 10              | Smaller    | 0               |

(Ivan) Subject 4

*Table 4 compares the initial and second exposure sessions for Experiment II. If preference for the larger reinforcer was between 80%-100%, two former delays were reintroduced in descending order: (1) the next lower delay value, and (2) 0-s. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. The larger reinforcer was correlated with four pieces of cereal; the smaller reinforcer with one piece of cereal (Cocoa Puffs, General Mills).
Table 4—Continued

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*Table 4 compares the initial and second exposure sessions for Experiment II. If preference for the larger reinforcer was between 80%-100%, two former delays were reintroduced in descending order: (1) the next lower delay value, and (2) 0-s. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. The larger reinforcer was correlated with four pieces of cereal; the smaller reinforcer with one piece of cereal (Cocoa Puffs, General Mills).

preference had shifted from the large delayed to the small immediate reinforcer. Initial exposure to the same delay value resulted in preference for the larger delayed reinforcer 80%-100% of the time for Subjects 1-6. Values for the second exposure were as follows: (a) Subjects 2 and 4, 0%; (b) Subjects 1, 6, 10%; (c) Subject 5, 20%; and (d) Subject 3, 30% (see Figures 2, & Table 4).

On second exposure to the 0-s delay to the larger reinforcer, Subjects 1, 2, 4, 5 and 6 demonstrated preference for the larger reinforcer, similar to that as evidenced on first exposure, within the 80% - 100% range. Subject 5 chose the larger reinforcer.
60% of the time. Subjects 1, 4, 5 and 6 required more sessions to reach stable responding on second exposure to the next lowest delay value (6 vs. 5, 10 vs 8, 16 vs 5, & 10 vs 3, respectively). Subjects 2, 4, 5 and 6 required more sessions to reach stable responding during second exposure to the 0-s delay, (19 vs. 6, 10 vs. 3, 15 vs. 7 & 8 vs. 6, respectively). The exceptions to this trend were Subject 1 who needed more sessions to reach stability at the initial 0-s delay exposure sessions (7 vs. 3), and Subject 3 who required 20 sessions on first and second exposures sessions at the 0-s delay value (see Table 4).

As delays increased to the larger reinforcer the number of sessions required to reach stability did not change dramatically (except for Subject 3). However, for Subjects 1, 3 and 4, the largest number of sessions needed to achieve stable responding occurred at the point where preference shifted. Generally, the greatest number of sessions required to reach stability occurred at the preference shift and second exposure delay values.

Experiment III: Simple Delay With Color Switch

Figure 5 displays in graph form the percentage of trials on which the immediate reinforcer was chosen over the delayed reinforcer when both reinforcers were of equal value (1 reinforcer). If preference for the immediate reinforcer fell within the 80%-100% range, colors were switched. Figure 6 shows the diagram of Experiment III with delay to one reinforcer chain increased as the other chain remains at 0-s. Table 5 shows experimental conditions for each subject during Experiment III. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds.
Both reinforcer chains were correlated with one piece of cereal (Cocoa Puffs, General Mills).
Figure 5. Graphs of Experiment III: Simple Delay With Color Switch.

*Reinforcers are equal. Delay to one reinforcer chain is increased.
Reinforcers are equal. Delay to one reinforcer chain is increased.
Figure 6. Diagram of Experiment III: Simple Delay With Color Switch.

*Reinforcers are equal. Delay to one reinforcer chain is increased.
### Table 5
Experimental Conditions for Experiment III: Simple Delay With Color Switch

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Table 5--Continued

*Table 5  Experimental conditions for each subject during Experiment III. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. Both reinforcer chains were correlated with one piece of cereal (Cocoa Puffs, General Mills). Subjects 1, 4, 5 and 7 met criteria for color switch.

With magnitude of reinforcement held constant (1 reinforcer) for both chains, and the delay to one chain systematically increased, four subjects (Subjects 1, 4, 5, & 7) preferred the small immediate reinforcer in the 80%-100% range at the following values: (a) Subjects 1 and 4, 5-s; (b) Subject 7, 10-s; and (c) Subject 5, 80-s. Subjects 2 and 6 never reached criterion (50% and 70% at 80-s, respectively). Subject 3 left the day care center before completing the study. At the point where preference for the immediate reinforcer reached criterion (80%-100%), colors were switched to check for possible key color bias. Subjects 1, 4, 5 and 7 continued to prefer the small immediate reinforcer at the same time delay.

The number of sessions required to reach stable responding ranged from 8-10 for Subject 1, 6-22 for Subject 2, 5-14 for Subject 3, 7-11 for Subject 4, 3-6 for Subject 5, 5-10 for Subject 6 and 5-6 for Subject 7 (see Figures 5, 6 & Table 5).

Experiment IV: Post-Reinforcement Delay With Color Switch

Figure 7 displays in graph form the percentage of trials on which no post-reinforcer delay (0-s) was chosen over a post-reinforcer delay (80-s). Subject 7 received a 100-s post-reinforcement delay because of his previous exposure to this value in Experiment I. Reinforcers were equal on both chains (1 reinforcer). Once stability criteria were reached, colors were switched. If preference for the 0-s post-reinforcer delay was between 80%-100%, with no evident key color bias, a third exposure trial was not presented.
Figure 7. Graphs of Experiment IV: Post-reinforcement Delay With Color Switch.

*Reinforcers are equal. Post-reinforcement delays are unequal.
Figure 8. Diagram of Experiment IV: Post-reinforcement Delay With Color Switch.

*Reinforcers are equal. Post-reinforcement delays are unequal.
Table 6
Experimental Conditions for Experiment IV: Post-reinforcement Delay With Color Switch

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*Table 6 Experimental conditions for each subject during Experiment IV. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. Both reinforcer chains were correlated with one piece of cereal (Cocoa Puffs, General Mills).

Figure 8 shows a diagram of Experiment IV with equal reinforcers and unequal post-reinforcement delays. Table 6 shows experimental conditions for each subject during Experiment IV. Data are displayed in chronological order and are labeled according to number of conditions, number of sessions required until stable responding was achieved, delay and magnitude of reinforcement. The delays are listed in seconds. Both reinforcer chains were correlated with one piece of cereal (Cocoa Puffs, General Mills). Subjects 1, 4, 5 and 7 were chosen for this experiment because they had demonstrated preference for the small immediate reinforcer in
Experiment III. Unfortunately Subject 5 was unable to participate in this last experiment due to time constraints.

Only one subject, Subject 7, preferred the chain on which no post-reinforcement delay was available on first and second exposures, in the 80%-100% range. Alternately, Subjects 1 and 4 showed similar preferences as well in the 80%-100% range, but only on second exposure, after key colors had been switched. First exposure to the 80-s post-reinforcement delay resulted in a 30% preference for Subject 1 and a 0% preference for Subject 4.

Second exposure with a key color switch resulted in an 80% -100% preference for both subjects. A final third exposure for Subjects 1 and 4, which returned the keys to their original colors, resulted in similar results to that of the first exposure (0% - 30% preference). As in the previous experiment, the number of sessions required to reach stability ranged between: (a) 3-14 sessions for Subject 1, (b) 5-7 sessions for Subject 4, and (c) 8-10 sessions for Subject 7 (see Figures 7, 8 & Table 6).

Behavior Observed During Experimental Sessions

All subjects engaged in a variety of behaviors during experimental sessions. Initially, the majority of time was spent sitting quietly, talking and singing. As the experiment continued over time, however, many other behaviors were exhibited, some of which were not allowed at the day care center (e.g., screaming, kicking furniture, swearing) and potentially self-injurious behaviors (e.g., slapping self). Subjects displayed many similar behaviors (e.g., singing, reciting the alphabet, playing with clothes/intelligence panel, talking to the experimenter, not paying attention to the panel). Many took longer than 3-s to press the response key for the next trial to begin, especially after a previous long delay. Finally, subjects emitted
verbal statements which indicated they were tacting the contingencies, or making their own rules. Clearly, subjects were not consistently motivated to engage in experimental sessions as evidenced by some of the behaviors exhibited. Two behaviors stand out in particular: asking if they could leave, and not eating the cereal.

### Table 7

Behaviors Observed During Experimental Sessions

<table>
<thead>
<tr>
<th>SUBJECT 1 (Susan)</th>
<th>Verbal Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Little ones are coming out.&quot; (When red and green keys were delivering one SR).</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Other behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting quietly</td>
</tr>
<tr>
<td>Singing/talking to self and experimenter</td>
</tr>
<tr>
<td>Crying/whining</td>
</tr>
<tr>
<td>Playing with shoes, chair, clothing, intelligence panel, watch, black boxes stretching</td>
</tr>
<tr>
<td>Scratching head</td>
</tr>
<tr>
<td>Picking nose</td>
</tr>
<tr>
<td>Whistling</td>
</tr>
<tr>
<td>Slapping hands, head, elbow</td>
</tr>
<tr>
<td>Scratching mosquito bites</td>
</tr>
<tr>
<td>Thumb sucking</td>
</tr>
<tr>
<td>Making sounds</td>
</tr>
<tr>
<td>Kicking feet</td>
</tr>
<tr>
<td>Clapping hands</td>
</tr>
<tr>
<td>Turning in chair and looking out the window, bouncing in chair</td>
</tr>
<tr>
<td>Getting out of chair</td>
</tr>
<tr>
<td>Counting</td>
</tr>
<tr>
<td>Tapping feet on floor</td>
</tr>
<tr>
<td>Rubbing eyes</td>
</tr>
<tr>
<td>Shaking head</td>
</tr>
<tr>
<td>Taking clothing off</td>
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<tr>
<td>Not attending to lights</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBJECT 2 (Sam)</th>
<th>Verbal Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 80-s delay for green, which he chose, he said, &quot;Hey when is the light going to come on.&quot;</td>
<td></td>
</tr>
<tr>
<td>When four SR's came out in the previous phase he said,&quot;Only one came out, I want four to come out.&quot;</td>
<td></td>
</tr>
</tbody>
</table>
During three forced trials he said, "Four came out right away". In the previous condition only 1 immediate SR was delivered. When green was delivered 4 SR at 40-s delay, he said, "I don't like red, I like green." When colors were switched he said, "Hey it changed again." When colors were switched he said, "Hey I pushed red and four didn't come out." Later, "green has four " (colors were switched).

Other Behaviors

Sitting quietly
Singing/talking to self and experimenter
Crying/whining
Playing with shoes, lights and clothes
Kicking table
Yelling
Stamping foot and food
Rocking in chair
Making sounds
Hitting both keys at once
Hitting head, wall
Turning and looking out the window
Biting food dish
Pressing keys with foot
Banging on black boxes
Throwing clothes at, and pulling tube on, intelligence panel
Smelling food dish
Playing with screen
Asking to go to the bathroom
Reciting the alphabet
Lying on floor
Clapping hands
Not eating cereal

SUBJECT 3 (Tom)

Verbal Behaviors

"Which one is green?"
Says to green key, "I'm going to pick you later."
When green = 1 SR at 0-s, red = 4 SR at 40-s, he chooses red and says, "no green."

Other Behaviors

Sitting quietly
Singing/talking quietly to self and experimenter
Crying/whining
Playing with lights, clothes, screen, bandaid, food tube
Clapping/hitting knee
Yelling/swearing
Table 7--Continued

Asking for mother
Commenting on the food and lights
Turning and looking out the window
Placing head in chair/falling off of chair
Stamping feet and food on floor
Shaking head
Rubbing abdomen
Laying head down on table,
Unscrewing lightbulb from panel/covering lights with hands
Not attending to keys
Pushing same key throughout session/playing duck, duck, goose, with lights
Covering ears
Getting out of seat/standing up
Saying alphabet
Making strange sounds
Dropping cereal on the floor
Pressing lever with foot
Staring at the ceiling

SUBJECT 4 (Ivan)

Verbal Behaviors

"I have red in my pants, so I'll pick red today."
When previous phase delivered 4 SR's he said, "Only one came out."
"Red one, green four. Red one, green, four."
"I'll push red. I like red.
"Since I picked four, I'll pick four again.
"One came out slow. One came out fast .

Other Behaviors

Sitting quietly
Singing/talking to self and experimenter
Playing with shoes, clothes, food
Spitting
Picking and blowing nose
Clapping
Choosing red, green, red, green pattern regardless of contingencies
Slapping legs
Kicking
Licking the lights
Making sounds
Snapping fingers
Banging black boxes, table
Yelling
Counting
Putting head in hands
Crushing food
Slamming chair
Table 7--Continued

Howling
Reciting alphabet
Hitting self/ screen/side of food dish
Biting arm
Pressing keys with head
Counting cereal

SUBJECT 5 (David)

Verbal Behavior

"You made a mistake, you made a mistake. Why is it going so fast?"
Choosing the right key exclusively while saying, "I won't back down."
"Red is not fast. Green comes out right away, red has to wait four minutes."
With a 40-s delay he says, "Food keeps coming out when I don't press a button."
When the contingencies switched to the first delay he said, "Four should come out, only one came out."
At 20-s delay he says, "This is too long."

Other Behaviors

Sitting quietly
Singing/talking to self and experimenter
Playing with clothes, chair, shoes
Complaining of not feeling well
Clapping hands
Asking to go to the bathroom
Rubbing black box
Making sounds
Slapping legs
Tapping fingers
Kicking table
Saying he was done
Placing mouth over lights
Pressing key with his head
Crushing cereal/counting the cereal
Falling on the floor

SUBJECT 6 (Kathy)

Verbal Behaviors

Said "oh," as though she had made a mistake when she chose the smaller reinforcer.
Asked experimenter "Why does red make one? When previously pressing the green key made four come out."

Other Behaviors

Sitting quietly
Table 7--Continued

- Singing/talking to self and experimenter
- Slapping legs
- Playing with clothes, shoes, hands, legs, nose, fingers, lights, food dish, screen, food tube
- Picking fingernails
- Counting
- Slapping dish
- Picking at scab on leg
- Screaming/crying
- Rocking in chair
- Talking to self
- Moving the chair around/twisting in chair/tipping chair over
- Placing clothes in the food dish/coughing
- Tapping fingers on table
- Reciting alphabet
- Scratching self
- Looking at the ceiling

SUBJECT 7 (Greg)

Verbal Behaviors

After history of 4:1 ratio changes to 1:1 he says, "Only one came out."
When green = 4 SR at 100-s and red = 1 SR at 0-s, he said "whoopsie" as though he had hit the wrong key.
Accidentally pressed the green key with his arm, while reaching to press the red. He said "I wanted the red." (Presses green key and says correctly before the food is delivered, "here comes four big ones."
When red = 1 SR at 0-s, green = 4 SR at 50-s, he says, "I'll never be done, its taking a long time."
He pushed the delayed key and asked, "when will it come on?"
"I want the white light to go off."

Other Behaviors

- Sitting quietly
- Singing/talking to self and experimenter
- Tapping feet
- Pounding chair with hand
- Slapping legs
- Picking nose (and sometimes eating it)
- Swinging in chair
- Counting
- Yelling/yelling at black boxes
- Making noises
- Clapping
- Kicking/shuffling and stamping feet
Table 7--Continued

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Playing with lights, clothes, watch, shoes, screen, food dish</td>
<td></td>
</tr>
<tr>
<td>Crushing cereal</td>
<td></td>
</tr>
<tr>
<td>Complaining of feeling sick</td>
<td></td>
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<tr>
<td>Shooting panel with imaginary gun</td>
<td></td>
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<tr>
<td>Smashing cereal before eating it</td>
<td></td>
</tr>
<tr>
<td>Pounding and scratching table. Taking clothes off</td>
<td></td>
</tr>
<tr>
<td>Dropping cereal on floor</td>
<td></td>
</tr>
<tr>
<td>Placing head on table</td>
<td></td>
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<tr>
<td>Behaving as though he is playing the drums</td>
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<tr>
<td>Telling stories</td>
<td></td>
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<tr>
<td>Asking to go to the bathroom</td>
<td></td>
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<tr>
<td>Turning around in chair and looking out window</td>
<td></td>
</tr>
<tr>
<td>Standing up</td>
<td></td>
</tr>
<tr>
<td>Tipping chair over</td>
<td></td>
</tr>
<tr>
<td>Rocking in chair</td>
<td></td>
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<tr>
<td>Reciting alphabet</td>
<td></td>
</tr>
<tr>
<td>Whining</td>
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CHAPTER V

DISCUSSION AND RECOMMENDATIONS

Introduction

Numerous studies conducted with the irreversible model of self-control have assayed the effects of manipulating magnitude of reinforcement and/or delay with nonhumans (e.g., Green et al., 1981) and humans (e.g., Schweitzer & Sulzer-Azaroff, 1988). Outcome data with pigeons yield what could be called impulsive behavior, (i.e., pigeons prefer small immediate reinforcers over large delayed reinforcers when given a choice). However, preference for large delayed reinforcers can be enhanced by removing the choice point in time (e.g., Green et al., 1981; Rachlin & Green, 1972), by using extensive training procedures (e.g., Logue & Mazur, 1981), and decreasing the the proportional (e.g., Navarick & Fantino, 1976) or absolute differences (e.g., Green & Snyderman, 1980) between the delays.

Research with humans has led to similar results as with nonhumans under certain conditions (e.g., Solnick). However, under other conditions, humans “maximize” reinforcement irrespective of delay parameters (e.g., Logue, et al., 1986). These differences may be a function of differences in types of reinforcement (e.g., Logue, 1986), verbal descriptions of the contingencies of reinforcement (e.g., Schlinger & Blakely, 1987), procedural differences (e.g., Navarick, 1982), or age and verbal ability (e.g., Mischel & Mischel, 1983). This study, using children as subjects, was designed to replicate and extend the aforementioned research in the area of self-control.
Review of Results and Recommendations

For Experiments I and II, results of the study showed that: (a) all subjects preferred the larger reinforcer when delay to the smaller reinforcer was equivalent, and (b) six of seven subjects behaved impulsively when delivery of the larger reinforcer was sufficiently removed in time from the choice point. These results replicate of Ragotzy, Blakely and Poling, (1988) and Green et al., (1981).

After preference shifted from the larger delayed to the smaller immediate reinforcer, two previous delay values were repeated: (1) the delay prior to the preference shift, and (2) 0-s. Interestingly, on second descending exposure to the next lower delay value, all six subjects exhibited greater preference for the smaller immediate reinforcer; whereas on initial ascending exposure to the same delay value, all six subjects showed preference for the larger delayed reinforcer. Two possible explanations may account for this phenomenon: (1) perhaps after preference shifts to the smaller immediate reinforcer, small changes in delays become less discriminable, and/or (2) because preference has just shifted to smaller delays, waiting tolerance for the larger reinforcer decreases.

On second descending exposure to the 0-s delay, five of six subjects chose the larger reinforcer (80%-100%), as they had during initial exposure. A 0-s delay between the larger and smaller reinforcer was clearly more discriminable than second exposure to the next lowest value where preference had shifted. These results do not replicate those of Ragotzy, Blakely and Poling (1988). Second exposures to descending delay values resulted in preferences that closely matched first exposure responding.

Of the seven subjects, only Subject 7 did not switch preference at a 100-s delay. As described previously, he was the first child to participate in the study. We
hypothesized, based on a comparison of Subject 7’s data with data taken from subsequent subjects, that these delay progression were, perhaps, not discriminable enough. The possible functional variables could have included: (a) the small time progressions (5 seconds) in the initial stages of the study, may have been less discriminable, or (b) may have conditioned tolerance to larger and more discriminable delays when they were introduced later (e.g., Schweitzer & Sultzer-Azaroff, 1988; Logue and Mazur, 1981), and (c) Subject 7 participated in the study for the longest period of time (14 months) and was the oldest child at the completion of the study. Due to any one of or a combination of these factors, allowed him to maximize reinforcement due to a more sophisticated verbal repertoire of appropriate contingency tacting, or better waiting strategies.

Anecdotally, Subject 7 used singing and talking to himself as his main waiting strategies and was able to tolerate the delays with less non-compliant behavior. These observations correspond to the findings of Mischel, Ebbesen and Zeiss, (1972) who found that children who engaged in “enjoyable activities” during waiting periods were more likely to choose the large delayed reinforcer.

Subject 4, who was the oldest child when he started the study and score highest on the PPVT--R, at the beginning and end of the study, responded similarly to that of the other subjects. Although he was able to tact the contingencies, he created rules for himself that did not correspond to the contingencies (see Table 7). Anecdotally, he engaged in a lot off-task and inappropriate behaviors.

The results of Experiment III, where delay to one reinforcer was increased as the delay to the other equivalent reinforcer remained at a 0-s delay were surprising for a number of reasons. It was hypothesized that after receiving equal amounts of food from each chain, subjects would prefer the immediate reinforcer the moment a delay was introduced on the alternate chain. Only two subjects, 1 and 4, showed
preference for the immediate reinforcer with the introduction of a 5-s delay on the alternate chain. Subject 7 preferred the immediate reinforcer at 10-s and Subject 5 at 80-s. Subjects 2 and 6 remained indifferent (50% and 70% choice to delay, respectively). Subject 3, before dropping out of the study, showed no preference for the immediate reinforcer at a 10-s delay. Interpretation of these results are challenging. We suspect that previous experience with a large delayed reinforcer in Experiment II may have conditioned tolerance for waiting even though the reinforcer amounts in Experiment III were equal and waiting therefore no longer advantageous. Waiting itself may have become a conditioned reinforcer as well.

Key color bias may also have been a factor in Experiment III. Once colors were switched in Experiment I, the same color was correlated with the large delayed reinforcer in Experiment II. The preponderance of exposure time correlating the same color with a large reinforcer may have conditioned generalized responding. Switching colors at the beginning of Experiment III may have produced different results. Another alternative would have been to introduce Experiment III after Experiment I, instead of after Experiment II.

It is evident that key color bias played a role in Experiment IV. Logue, Smith and Rachlin, (1985) reported that post-reinforcer delays did not affect choice unless pre-reinforcer delays were unequal. In this study, when subjects chose between to equal reinforcers (one piece of cereal) and equal pre-reinforcer delays (0-s), Subjects 1 and 4 displayed preference for a 0-s post-reinforcement delay, but with only one key color. Subject 7 was the only subject able to correctly discriminate a larger post-reinforcement delay regardless of key color. Again, as in the previous experiment, the same key color correlated with the larger reinforcer in Experiments I and II was used. Changing key-colors in order to weaken this potential effect is an important variable for any future research in this area.
Verbal behavior emitted by the subjects indicated that a repertoire to correctly or incorrectly tact contingencies and/or make their own rules was present but varied across subjects. This aspect of the study was not experimentally incorporated for fear that asking subjects to report the contingencies after each phase would heighten awareness and inadvertently shape tacking that could influence future responding (e.g., Schlinger & Blakely, 1987). Any verbal behavior emitted by the subjects was simply recorded. One goal of the study was to learn whether children exhibited this behavior, and if so, did this appear to control behavior similar to that of adults who maximized reinforcement (e.g., Logue et al., 1986). On a purely observational level, subjects did tact some contingencies. However, tacking did not lead to maximizing in Experiment II, with the possible exception of Subject 7. It was also evident that during some sessions choice behavior was based on self-generated rules that did not correlate with the contingencies whatsoever. For example, Subject 4 said, “I have red in my pants, so I'll pick red today.”

Theoretical Issues

Skinner (1953) proposed that self-control could be analyzed in terms of environmental variables, thereby rejecting the prevailing notion of the “self” (e.g., homunculus) as the causal variable. He operationally defined the self-control repertoire as a combination of “controlled” and “controlling” responses. Controlled responses are those which produce immediate consequences, whereas controlling responses affect the probability of the other responses from occurring. Therefore a controlling response (e.g., a commitment to wait for the larger reinforcer) would affect the probability of the controlled response (e.g., choosing the smaller immediate reinforcer). Skinner identified a number of controlling responses (i.e., techniques or
alternative behaviors) that would change the probability of a controlled response from occurring (e.g., doing something else, hiding the reinforcer).

Skinner's proposal is supported by a series of studies by Mischel and his colleagues. In one study (Mischel & Ebbesen, 1970) subjects were exposed to a "reversible choice procedure." Children (ages 3-5 years old) could wait for a more preferred delayed reinforcer or reverse their choice and signal during the delay for the less preferred reinforcer that was dispensed immediately. Candy was the reinforcer. Waiting for the preferred reinforcer was enhanced when the less preferred reinforcer was concealed (Mischel & Ebbesen, 1970), when an alternative response was available during the delay (Mischel, Ebbesen & Zeiss, 1972), and when "waiting" for the large reinforcer was previously conditioned (Mischel & Staub, 1965). Similar results were obtained with pigeons in an analogue study conducted by Grosch and Neuringer (1981).

**Mediating/Waiting Behaviors**

A functional analysis of these so called "mediating or waiting behaviors" (e.g., singing, banging, counting) displayed during the sessions was difficult to assess. As mentioned previously, researchers who observed children during waiting periods to reinforcement (e.g., Mischell & Ebbesen, 1970; Mischell et al., 1972) found that children were able to tolerate waiting times more successfully if they engaged in enjoyable "distracting behaviors," which were taught to the children. In the present study, our goal was not to teach enjoyable waiting behaviors. We just observed and noted waiting behaviors while they were occurring. Therefore, it was not always clear whether all of the "waiting behaviors" were in fact, enjoyable or functioned as mediating/waiting behaviors, self-stimulatory behaviors or escape/avoidance behaviors. In addition, some of the behaviors may have been
inadvertently strengthened because reinforcement was occasionally delivered while they were occurring (see Table 7).

**Math Models**

In the commitment model of self-control, subjects emit a response (a commitment) that changes future contingencies such that the probability of responding for small immediate reinforcers is weakened or precluded (Rachlin, 1976). Various math models of matching behavior have been posited to precisely describe the reported findings. Herrnstein (1970) proposed a matching law that predicted a match between the proportion of responses and the proportion of reinforcers for that response. In 1969, Baum and Rachlin, incorporated the delay to reinforcement as a variable in the matching law. Their addition stated that the relative preference for a response is proportional to the relative “value” of the consequence for that response; with value defined as a function of amount, rate and immediacy of reinforcement.

Another model of choice, described by Fantino (1969), proposed that organisms choose stimuli correlated with the greatest reduction in time to primary reinforcement. His “delay-reduction hypothesis” therefore predicts choice of the smaller immediate reinforcer over the larger more delayed reinforcer as time increases to the larger reinforcer (Navarick & Fantino, 1976).

Unfortunately, no model has demonstrated total accuracy in predicting choice behavior. Blakely (1986) contends that “as the difference in delays become less discriminable, perhaps the differences in reinforcement magnitude affect choice to a greater extent. (p. 42).” This explanation might account for the findings in our study, particularly with Subject 7 in Experiment I, and with the results of the second exposure to the next smallest delay where preference had shifted in Experiment II.
Role of Age and Verbal Behavior

Preference for a larger reinforcer has been correlated with age despite an extant verbal repertoire that can tact contingencies (Pouthas, et al., 1990). Results of the study showed that despite the ability of young children to tact the contingencies, their verbal behavior did not predict self-control behavior. It does appear, "that verbal control of behavior cannot be manifested at all levels of development," (Pouthas et al., 1990, p. 22).

Training programs promoting self-control in children have most often used self-instruction (e.g., reciting rules to oneself). Despite some initial success, it has become clear that these programs do not generalize beyond the training situation and are inappropriate for younger children with a less sophisticated verbal repertoire (Schweitzer & Sulzer-Azaroff, 1988).

The ability of verbal behavior in children to affect operant choice behavior similar to that of "maximizing" adults can be explained at least partially by the theory proposed by Schlinger and Blakely (1987). They contend that verbal behavior which describes a relationship between stimuli can alter the function of other stimuli to evoke behavior. These function altering contingency specifying stimuli, "can alter the the evocative function of discriminative stimuli, establishing operations, conditioned stimuli, as well as the efficacy of reinforcing and punishing stimuli that can function as second order respondent conditioning" (Schlinger & Blakely, 1987, p. 41). Their theory suggests that adults can be given instructions regarding the contingencies and/or generate their own instructions which in turn alters future behavior. In support of their theory Logue et al., (1986) reported that subjects produced their own verbally based cues which determined their "maximization" strategies. Findings by other researchers have supported with this explanation as well (e.g., Bentall & Lowe, 1982; Bentall, Lowe & Beasty, 1985). Therefore use of instructions with adults, given by
the experimenter or self-generated, can in turn evoke behavior which maximizes reinforcement regardless of the delay. The generality of results in the area of self-control with children rests with a greater understanding of their existing verbal behavior as it correlates or matches with their future non-verbal behavior. It appears age and verbal ability may be functional factors in relation to choosing delayed but larger reinforcers.

Other Variables

A number of other variables may have contributed to controlling choice behavior in this study. Subjects were not always highly motivated for food as evidenced by behavior exhibited when food was present (e.g., dropping food on the floor, not eating food). As in any study with humans, particularly children, depriving subjects of food to increase motivation is clearly not an option. In anticipation of this problem, we added a changing menu of non-edible reinforcers for the subjects after the session for following instructions. Although satiation effects did not seem to be a problem, providing subjects with a choice of different cereals every session may have increased motivation for food.

Another variable that may have influenced responding was taking subjects out of the classroom to the experimental room. Unfortunately, many times we were removing children from enjoyable activities and doing so may have functioned, to some degree, of increasing the probability of behaviors which would return them to the classroom (i.e., inappropriate behavior during the study).

One goal of the study was to expose children to multiple trials over time. Unfortunately, based on purely anecdotal observation, and despite the changing variety of reinforcers available for following directions, it appeared that as delays increased and total session time increased, subjects exhibited less “enjoyment/fun”, as...
evidenced by asking the experimenter if they could leave, or asking if the session was over yet, along with an increase in aggressive-type or non-compliant behaviors. Additionally, reinforcing effectiveness of participating may have decreased as a function of the overall lengthiness of the study. One child participated in the study for over one year.

The home or classroom situation of the subjects may also have affected responding as well. The experimenter was aware that some subjects were experiencing difficulties. It was obvious, for at least one subject, that his interest in participating was negligible. He sporadically attended to the intelligence panel and appeared to often choose keys at random.

Conclusions

The present research was designed to replicate and extend earlier studies using humans and nonhumans in the area of self-control. A discrete trial, within-subject design over multiple sessions, and food as a reinforcer were used. Furthermore, prior instructions did not include a description of the contingencies of reinforcement. Normal pre-school age children were chosen as subjects, a population that questionably possesses a verbal repertoire capable of generating sophisticated tacting/self-instruction or mediating behavior during long delays. Results of the first experiment demonstrated that children will choose a larger reinforcer over a smaller reinforcer when the delay is 0-s. Results of the second experiment demonstrated that systematically increasing delays to the larger reinforcer generally resulted in children behaving “impulsively,” (i.e., more like nonverbal humans than verbal humans). These findings replicate previous studies by with children (e.g., Pouthas, et al., 1990) and with retarded adolescents (Ragotzy, Blakely & Poling, 1988).
Results of Experiments III and IV were confounded for some subjects by a key color bias. Other functional variables which contributed were a lack of mediating/waiting behaviors, in addition to verbal repertoires not sufficiently developed to control choice behavior. Further research should address the more obvious problems of maintaining motivation and reinforcer effectiveness when conducting long-term experiments with young children. Other important factors include an analysis of verbal and nonverbal repertoires to mediate long delays and attempt to analyze any other controlling variables more clearly.
Appendix A

Informed Consent Form
Western Michigan University
Department of Psychology

Dear Parent:

My name is Ellen Sharenow and I am a doctoral student in psychology at Western Michigan University, and a former CDC teacher. I am conducting a study with children in the area of self-control. Self-control is currently an important area of research, one that has been investigated with adults and not children. In the study, children will be given a choice between a small immediate reward and a large delayed reward. Choosing a small immediate reward is known as compulsive behavior. Choosing a large delayed reward is known as impulsive behavior. For ten to fifteen minutes each day, a child will be seated at a table on which two telegraph keys are mounted. Pressing either key will be associated with receiving a small immediate or large delayed reward. The reward will be cereal. The general purpose of the study is to determine under what conditions children will exhibit self-control behavior. I would like to have your child participate in my study. The information gathered may help us teach children how to control their own behavior. This study will not interfere with the program at CDC.

In order to participate in the study your child must be three to four years of age, available to participate ten to fifteen minutes each day and enjoy eating cereal. I will also be administering a vocabulary test to determine their general level of language development. I expect the study to run from one and a half to three months.

If you would like your child to participate, please fill out and sign the informed consent form on the next page. Enclosed is a self-addressed stamped envelope. Thank you very much.

Sincerely,

Ellen L. Sharenow, MA

P.S. If you have any further questions, please contact me at 345-4268.
CONSENT FORM

Child's name ____________________________

Birthdate ______________________________

Parent(s) ________________________________

Phone _______________________(home) ______________________(work)

Will your child be attending CDC through July? Yes No ______

Will you be taking a vacation this summer? If yes, how long?___________

Please list, in order of preference, your child's favorite cereals:

1. 

2. 

3. 

4. 

Do I have your permission to use another brand of cereal if necessary? 

Yes ______  No ______

Weekly CDC schedule:

Mon Tues Wed Thur Fri

I, ______________________________, hereby give my informed consent to allow my child, ________________, to participate in the Self-Control study conducted by Ellen Sharenow. The purpose of this study is to compare various self-control procedures that will affect choice behavior. I understand that if my child is accepted as a participant he/she will take a vocabulary test to assess his/her general level of language development. He/she will also spend approximately ten to fifteen minutes a day choosing between various amounts of rewards and delays. I further understand that the results of the choice procedure will be communicated to me at the end of the study.

I agree to allow the information which is obtained to be presented to other professionals by reports, conferences or publication. I understand every effort will be made to ensure confidentiality of my child's identity; that his/her full name will not be used in discussion or on reports presented to other professionals; and that all data will be stored in a locked room with only relevant staff allowed access. These data may be kept for comparison.
I understand that I may freely withdraw my consent at any time, without negative consequences. I agree to have my child participate in the Self-Control study.

Signed ________________________________ Date ____________

Signed ________________________________ Date ____________
Appendix B

Approval Letter From the Human Subjects Institutional Review Board (HSIRB)
DIRECTIONS: Please type or print each response except signatures. Refer to the Western Michigan University Policy for the Protection of Human Subjects to determine the appropriate level of review.

PRINCIPAL INVESTIGATOR: Ellen L. Sharenow
DEPARTMENT: Psychology

Home Phone: 345-4268
Office Phone: 

Home Address: 302 S. Kendall #41
Office Address: 301 Wood Hall
Kalamazoo, MI 49007

PROJECT TITLE: Self Control and Choice in Children: Effects of Food as a Positive Reinforcer

SUBMISSION DATE: 2/27/87
PROPOSED PROJECT DATES: 3/15/87 TO 8/37

Note: The principal investigator should not initiate the research project until the protocol has been reviewed and approved by the Human Subjects Institutional Review Board.

APPLICATION IS: X New ___Renewal ___Continuation ___Supplement
SOURCE OF FUNDING: (if applicable)

STUDENT RESEARCH (Fill out if applicable.)

Name of Student: Ellen Sharenow
Phone: 345-4268
Address: 302 S. Kendall, #41

The research is: ___ Undergraduate Level X Graduate Level

Faculty Advisor: Galen Alexi, Ph.D
Department: Psychology

Signature of Faculty Advisor: 

Signature of Investigator: 

VULNERABLE SUBJECT INVOLVEMENT (Fill out if applicable.)

Research involves subjects who are: (check as many as apply)

1. X children
   approximate age:
2. ___ mentally retarded persons
   check if institutionalized
3. ___ mental health patients
   check if institutionalized
4. ___ prisoners
5. ___ pregnant women
6. Other subjects whose life circumstances may interfere with their ability to make free choices in consenting to take part in research

(Describe Please)
LEVEL OF REVIEW: Please indicate here if you think that the research project is exempt from review, subject to expedited review, or subject to full review.

___ Exempt (Forward 1 application to IRB Chair)

Which category of exemption applies? 

___ Expedited (Forward 1 applications to IRB Chair)

___ Subject to full IRB review (Forward 5 applications to IRB Chair)

Comments:

Your application was reviewed and the Human Subject Institutional Review Board (HSIRB) has determined that:

1. The proposed activities, subject to any conditions and/or restrictions indicated in Remarks below, have (a) provided adequate safeguards to protect the rights and welfare of human subjects involved, (b) established appropriate procedure and/or documents to obtain informed consent, and (c) demonstrated that the potential benefits of the research substantially outweigh the risks.

2. The proposed activities, for reasons indicated in Remarks below do not provide adequate protection for the rights and welfare of the human subjects.

At its meeting on 3/14/7, the HSIRB (approved) (provisionally approved, see remarks) this application with regard to the treatment of human subject. The HSIRB categorized this application as:

___ 1. Involving subjects at no more than minimal risk.

___ 2. Involving subjects at more than minimal risk.

REMARKS:

Signature HSIRB Chair
Date
TO:       Ellen Sharenow
FROM:     Ellen Page-Robin, Chair
RE:       Research Protocol
DATE:     February 16, 1988

This letter will serve as confirmation that your research protocol, "Self-Control and Choice in Children: Effects of Food as a Positive Reinforcer" was approved at no more than minimal risk after expedited review in March of 1987.

In addition, the recent inclusion of the Peabody Picture Vocabulary test listed in the amended consent form has been approved for use in the current research being conducted.

Please call me at 383-4917 if you have any questions.
Appendix C
Data Sheet
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BIBLIOGRAPHY


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