Improving preschoolers' "self control" :: differentially reinforcing the choice of larger, delayed over smaller, immediate rewards.

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IMPROVING PRESCHOOLERS' "SELF-CONTROL": DIFFERENTIALLY REINFORCING THE CHOICE OF LARGER, DELAYED OVER SMALLER, IMMEDIATE REWARDS

By

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Submitted to the Graduate School of the University of Massachusetts in partial fulfillment of the requirements for the degree of

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Department of Psychology
IMPROVING PRESCHOOLERS' "SELF-CONTROL": DIFFERENTIALLY REINFORCING THE CHOICE OF LARGER, DELAYED, OVER SMALLER, IMMEDIATE, REWARDS

A Thesis Presented
By

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ABSTRACT

Improving Preschooler's "Self-Control": Differentially Reinforcing the Choice of Larger, Delayed Over Smaller, Immediate Rewards

September, 1987

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Directed by: Professor Beth Sulzer-Azaroff

Choosing larger or otherwise more reinforcing stimuli, despite a time delay, in preference to smaller but immediate reinforcers is an important aspect of self-control. Can young children, including those who are identified as exhibiting hyperactive behavior or conduct problems, and who have been found consistently to choose smaller but immediately obtained rewards, be taught to wait for larger rewards instead? Five children, (and one comparison subject) three of whom were labeled hyperactive or who displayed conduct problems, were pre-assessed and found to select small, immediate rewards much more often than larger, more delayed ones. Treatment consisted of shaping the child's choice of the delayed reward by differentially reinforcing that choice with more reinforcers than for the more immediate selection, while gradually increasing the durations of the delay interval by very small increments. The postassessments showed that all five children increased their proportions of choice of the delayed rewards.
While prior to training, the point at which the children selected either reward about equally often (point of indifference) ranged from 1.5 to 51.5 seconds, following shaping, their points of indifference rose to a range of from 37.5 to at least 90 seconds. Apparently it is possible to shape choice of delayed rewards by differentially reinforcing those choices in a series of small graduated increments in the delay interval.
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Many of the ills of society are due to individuals' inability to wait for reinforcers. An especially cogent contemporary example is the threat of Acquired Immune Deficiency Syndrome (AIDS). Sexual intercourse can be immediately and powerfully reinforcing, and until recently most people did not consider the potentially dire delayed consequences of their sexual behavior. Individuals now are more likely to evaluate the long term consequences of engaging in sex, as the fear of contracting AIDS increases.

In contrast, there are times when people arrange circumstances to increase the likelihood of obtaining delayed reinforcement. For example, many employees arrange to have a percentage of their salary, put into a savings account. They then use these savings to pay for major purchases, such as a car or house.

The two examples cited above are commonly referred to as issues in "self-control". The term "self-control" is often used to describe responding in a situation in which a choice must be made between alternatives available at the same or different times. An individual
is said to exhibit "self-control" if he can direct his own behavior to obtain more over less advantageous consequences. (Henceforth, in this paper, self-control is defined as responding in a similar manner to those in the situations just described.) Skinner (1953) suggests that self-control might be conceptualized as the organism's making the probability of a response more or less likely by modulating the response's controlling variables. He says this occurs when responses lead to conflicting consequences. In Skinner's definition, the individual acts to manipulate the variables affecting his behavior.

Often we control our behavior by manipulating discriminative stimuli. An example of this is placing a chocolate cake in an oven, out of our sight, in an attempt to avoid eating it. Other methods for altering our responding may involve the use of aversive stimulation. A cigarette smoker may inform all of his co-workers that he wants to quit smoking and expect them to verbally "harass" him when he is smoking in their presence. In this way, the smoker has arranged consequences in his environment to decrease his smoking behavior. These are just two types of examples of methods people employ to gain control over their own behavior.
In developing a procedure for increasing the choice of larger, long term reinforcers, it is necessary to review the literature in both the experimental and applied areas. (Choice is defined as differential behavior with respect to 2 stimuli, manifested by pointing, pecking, verbalizing, or some other response, in the presence of those stimuli.) Much of the experimental research has been conducted in controlled laboratory settings, with pigeons and humans. It has covered such parameters as delay and amount of reinforcement, and the influence of emitting various behaviors and stimuli during delay intervals. Scant literature exists on procedures used either in laboratory and applied settings to increase the proportion of choice of delayed over immediate reinforcers. The following review surveys research in these areas.

**Operant and Laboratory Research**

**in Choice and Delay Situations**

Operant researchers have examined several parameters in choice situations. These include varying the amount and delay of reinforcement, with pigeons, and child and adult humans. The following section surveys research in these areas.
Varying Amount and Delay of Reinforcement

Researchers have studied self-control in the operant laboratory for many years, using infrahuman and human subjects. The laboratory setting enabled researchers to control experimental conditions more stringently. Many of these experimentalists have defined self-control as the choice of large, more-delayed reinforcers over small, less-delayed reinforcers (Ainslie, 1974; Mazur & Logue, 1978; Rachlin & Green, 1972). Findings generally have shown that, other factors being equal, subjects (young humans and pigeons) tend to select less-delayed, small reinforcers (Ainslie, 1974; Burns & Powers, 1975; Green & Snyderman, 1980; Walls & Smith, 1970). In reviewing the animal choice experiments, Ainslie (1975 p. 464), states that "... the effectiveness of a delayed reward declines in a curve with marked upward concavity, so that preference between certain pairs of small-early and larger-later rewards can be expected to shift from the larger to the smaller reward simply as a function of time." He sees impulsiveness as the hyperbolic curves that are used to describe the effectiveness of rewards as they are delayed from the time of choice. Figure 1 displays a hypothetical diagram of the preference for two reinforcers of differing values as a function of time.
Figure 1. Hypothetical gradients of two reinforcers as a function of time: RFT 1 (available at T1) represents the smaller, more-immediate reinforcer and RFT 2 (available at T2) the larger, delayed reinforcer. Preference reversal is indicated by the crossing of the curves. (After Solnick, Kannenberg, Eckerman, & Waller, 1980.)
(Solnick, Kannenberg, Eckerman, & Waller, 1975). In the figure, the two heavy vertical lines ($T_1$ and $T_2$) represent the times of reinforcement for the smaller reinforcer ($T_1$) and the larger reinforcer ($T_2$). The greater the reinforcer, the higher the vertical line. The value of the reinforcers are represented by the height of the curve. In this diagram, initially, the larger, delayed reinforcer has more value. However, as the time of choice approaches, after the indifference (i.e., changeover or crossover) point has passed, the smaller, more-immediate reinforcer is likely to be chosen. (At the indifference point the organism switches from choosing the larger, more delayed reinforcer rather than the smaller, more immediate reinforcer.) In summary, other factors being equal, the selection of a reinforcer is a function of the time of its delivery.

In an attempt to increase self-control in pigeons, Rachlin and Green (1972) devised an experiment based on a principle known as the Matching Law (Herrnstein, 1970). The law states that the relative rate of responding equals the relative rate of reinforcement. Logue, Pena-Correal, Rodriguez, and Kabela (1986, p. 159) presented a revised version of the Matching Law to describe choice as follows:
As Logue, et al. explain, "\( B_L^D_R = A_L^D_R / A_R^D_L \) represent the number of choices of reinforcers obtained from the left and right response alternatives, respectively, and \( A_L, A_R, D_L, \) and \( D_R \) represent the amounts (sizes) and delays of those reinforcers." This equation describes choices between larger, more-delayed reinforcers and smaller, more-immediate reinforcers.

In the Rachlin and Green (1972) study, pigeons were offered a choice between a small-immediate reward and a larger-delayed reward. The choice was based upon the relative value of the rewards and the delay in time until they were delivered. They depict the situation as:

- **Red key**: immediate 2-sec food
- **Grn key**: 4-sec delay, 4-sec food

10 sec blackout

**Right white key**

**Choice point A**

**Choice point B**

10 sec blackout

**Blank key**

**Grn key**: 4-sec delay, 4-sec food

**Left white key**
Rachlin and Green (1972) reported that during the initial trials, (point A) the choices depended on the value of the delay; when delays were small pigeons chose the Right white key, eventually leading to the small immediate reward. However, during long delays, pigeons consistently chose the larger-delayed reward. Therefore, self-control was more likely when the choice was remote from the outcome. Rachlin and Green (1972, p.15) referred to the initial choice as a commitment response, which they defined as "simple choice of a presently higher valued alternative". Extrapolating to a human, for example, the probability of going to the dentist could be increased if the patient made the appointment 6 months in advance. The authors proposed that when commitment strategies are "spontaneous" they are more often considered the typical process of self-control.

Research with Children

Rachlin (1976) performed an experiment with children similar to the one he and Green (1972) carried out with pigeons. Rachlin (1976) reported that when choices of the same values were made available and used with children, they originally behaved as pigeons did at choice point A and B, but after time they chose the key associated with the largest reward at A or B. He suggested that children
use language as secondary reinforcers to bridge long delays, while pigeons are unable to do so and are therefore incapable of discriminating events that do not occur within a few seconds of time.

Other laboratory choice tasks with children as subjects have brought mixed results. Burns and Powers (1975) attempted to replicate Rachlin and Green's (1972) study. Again, Rachlin and Green's model predicts a reversal of preference for two reward values as a function of time during a choice task. Two boys were exposed to the same experimental conditions as the pigeons in the Rachlin and Green (1972) study. Although, the authors found a reversal of preference by children, as time was manipulated, their other findings did not replicate those of Rachlin and Green. They found equal preference for both initial options; with the immediate reward more likely to be chosen once the right white key was selected (see Rachlin & Green, 1972). As the experimenters increased the delay of the initial link, the childrens' preferences for the right white key increased, as did a preference for the immediate reward in the terminal link. These children could not be said to have exhibited self-control.
Yates and Revelle (1979) also carried out a choice task with preschool children, using food and toys as rewards. Their results showed that the probability that a child would continue to wait for a delayed reward, increased as a function of previous waiting time. This is similar to the results Rachlin and Green (1972) obtained in their research with pigeons.

Research with Adult Humans

A growing body of research also has been examining self-control in adult humans through choice procedures. A review of this literature can be helpful due to the paucity of data on choice behavior in children. This research also provides a foundation upon which to base the methodology of the present study. Of these studies, those most successful in producing "impulsive" behavior (i.e., the selection of immediate, smaller reinforcers) relied upon the use of negative reinforcement. Solnick, Kannenberg, Eckerman, and Waller (1980) investigated preference reversal in humans using termination of white noise as a negative reinforcer. The experimenters conducted three experiments investigating choice for small immediate reinforcers over large delayed reinforcers. Their subjects responded similarly to those in Rachlin and Green's (1972) study. The experimenters
also reported finding strong individual differences in
the subjects' choice behavior. Navarick (1982) also used
noise as a negative reinforcer in a laboratory choice
study with adults. His subjects also showed a preference
reversal where subjects selected the smaller reinforcer
more often as delays for larger reinforcers increased.

Weinberg (1983) investigated uncertainty of
reinforcement in three self-control experiments, with
rats, pigeons, and humans. In the experiment with the
humans, escape from white noise was used as the
reinforcer. Delay, amount, and the probability of
reinforcement were varied to determine their
interactional effects upon each other. Results with
humans were consistent to some extent with Ainslie's
(1975) and Rachlin and Green's (1972) model. When delay
of reinforcement was short, the smaller, more-immediate
reinforcer was chosen. Weinberg also found that when the
time delays increased, preference for the large-delayed
reinforcer increased. This result occurred through a
delay of 21 seconds for the onset of the small
reinforcer. (The reinforcer was the absence of noise for
3 seconds following a 21 second delay. The larger
reinforcer was a delay of 30 seconds followed by 60
seconds of noise off.) However, in contrast with the 21
second delay, when the delay for the smaller reinforcer was increased to 31 seconds, versus a delay of 61 seconds for the larger reinforcer, preference for the larger reinforcer declined. The author suggested several explanations for the decreasing preference of the larger reinforcers. One hypothesis was that subjects may have been unable to discriminate between the differences in the length, of the noise-on periods, for the two alternatives. Weinberg also suggested the following: 
"... at such a long distance from the choice outcome the two time outs may simply not differ in reinforcement value. More indifference would therefore follow" (Weinberg, 1983, p. 78).

Only a few human studies of choice and delay have used positive reinforcement. Miller and Navarick (1984) conducted one with adults. They used video game playing and were able to obtain impulsive responding in only 40% of their subjects. Logue, Pena-Correlo, Rodriguez, and Kabela (1985) also used positive reinforcement, with adult humans, dispensing points in exchange for money. They conducted five experiments examining the effects of various amounts and delays of delivery of positive reinforcement upon choice behavior. Their subjects consistently chose larger, more-delayed reinforcers,
demonstrating that the amount of reinforcement was a stronger controlling variable than delay. The authors suggested that adult humans follow a maximization strategy, in which subjects maximize the total amount of reinforcement, rather than match their responding with the amount and delay of reinforcement. The authors, therefore, conclude that it is difficult to study impulsivity in a laboratory setting with adult humans. Several explanations were given by the authors for the maximization behavior seen, including the following: subjects may have used verbal cues to count time, which aided them in developing a maximization strategy; money, which was given in exchange for the points after the entire session was over; was too delayed to function as a reinforcer; these particular subjects exhibited more self-control than other subjects, such as institutionalized criminals would, according to Logue, et al. (1985). In conclusion, it appears that the only experiments to consistently show impulsive responding with humans have either involved children or adults when loud noise was used as a negative reinforcer.

Variables Affecting Delay Behavior

Researchers have also examined the effect of several variables upon behavior during delay periods in
pigeons and humans. These include the effects of distractors, alternative behaviors, and the visibility of rewards during delays.

**Variables During the Delay Times**

If you have ever watched children at a birthday party waiting to be served cake, you would notice that they emit various behaviors to pass the time while waiting for their portion. One child may be staring intently at the cake and the server, another may be talking to a neighbor, while another may be grabbing a friend's plate. Some behaviors are more successful than others. Mischel and his colleagues have conducted considerable research examining what stimulus conditions (such as "distractors") and alternative behaviors children engage in during delay periods. In a laboratory environment, Mischel and Ebbensen (1970) investigated the effect of the direction of a preschool child's attention during a delay of gratification task. Four conditions were created in respect to the visibility of rewards to be presented: waiting for either a more preferred but delayed reward; a less preferred but immediately available reward; both rewards; or no rewards. The results showed that children waited longest when neither the delayed nor the immediately available reward was
visible. Successful subjects devised their own self-distraction techniques, in an attempt to avoid looking at the objects. The authors (Mischel & Ebbensen, 1970) observed that while waiting, subjects covered their eyes, rested their heads on their arms, talked to themselves, sang, invented games with their hands and feet, or tried to fall asleep. The authors suggested that diverting attention away from the delayed reward may be necessary to successfully, temporally delay the reward. Yates and Revelle (1979) also found that children bridged the delay gap similarly to those in Mischel and Ebbensen's (1970) study, concluding that distraction can facilitate waiting.

Mischel, Ebbensen, and Zeiss (1972) looked at what constitutes the "best" distractors for delaying reward in preschoolers. Younger children viewed the real stimuli (the actual rewards) longer than the symbolic distractors (picture versions of the rewards). Additionally, in a verbal assessment, children said they preferred viewing real stimuli. Older children attended to irrelevant distractors, which were found to facilitate delays. Yates and Mischel (1979) found similar results and suggested that children's difficulties in withstanding voluntary delays of reward, are due to their preferences
for exposure to real rewards, which in turn tends to inhibit delay responding. Mischel et al. (1972) also found that if the irrelevant stimuli were considered "fun" or relaxing, they were better distractors.

Grosch and Neuringer (1981) employed procedures analogous to Mischel's to examine self-control in pigeons. As the authors pointed out, self-control is often thought of as a class of behavior unique to humans. The authors argued that cognitive psychologists, like Mischel, have something to learn from operant conditioners and vice versa. They say that, "Rather than ignoring different languages, it might be most productive to demand translations between them" (p. 20). They suggest that trading ideas, biases, and jargon between researchers would be fertile and help to explain results. In addition, more directly related to this research, Grosch and Neuringer proposed that "... valuable predictions concerning pigeon self-control can be made on the basis of findings from the human and vice versa" (p. 20). This statement was made on the basis of findings from their experiments, which strongly paralleled the results Mischel obtained with children.

Grosch and Neuringer first examined the visibility of reinforcers and found that pigeons, like children,
waited less time to collect a more preferred visible reinforcer (see Mischel & Ebbensen, 1970). The next experiment was similar to Mischel, Ebbensen, and Zeiss's (1972) study examining the effects of having alternative reinforcers available to act as distractors from the choice reinforcers. Grosch and Neuringer provided an alternative response key and alternative reinforcement for the pigeons, and again they found similar results. Self-control greatly improved. To parallel the Mischel (Mischel, Ebbensen, & Zeiss, 1972) study that looked at the effects of thinking about reinforcers while waiting (children were instructed to think about more or less preferred rewards), Grosch and Neuringer presented hopper lights correlated with primary reinforcement, as conditioned reinforcers. Both experiments found that self-control decreased. Other experiments by the two research groups found that stimuli correlated with positive events led to greater self-control than stimuli correlated with negative events; consuming reinforcement just prior to choice trials decreases self-control; and that prior experience with waiting effects behavior on choice trials. Additionally, both research groups found that punishing waiting led to less self-control in the trials, while greater self-control was exhibited when
waiting was followed by a preferred reinforcer. The results from the Grosch and Neuringer research, suggest that findings from the pigeon literature may be helpful in understanding self-control in humans.

**Developmental Differences and Self-Control**

Another factor to be considered with delays, is the age of the child. Researchers have studied whether the age of a child affects choice in waiting, and the effects of age compared to the importance of amount and delay of reinforcement. Schwarz, Schrager, and Lyons (1983) used a choice task to measure the effect of delays in rewards with 3, 4, and 5 year olds. They used food and nonfood rewards of high and low values, and three different delay times (immediate, 7 hours, and 1 day). The study's results found no main interaction effects of age. The authors deduced from all the results that 3, 4, and 5 year olds were equally sensitive to the delay lengths. In choosing between rewards and delays, subjects as young as 3 years considered how long they were required to wait. They also found that all three age groups would opt for a reward of higher value if it were 7 hours away, but that they were less likely to do so for the 1 day delay. In examining the results, it is important to consider the rather salient size of the delays involved
in the study. Although no main effect of age was found with these delays, effects might surface with shorter delays, such as those differing by minutes or seconds.

Crooks (1977) examined preference by 6 to 7 year olds and 10 to 12 year olds as a function of the magnitude of reward for immediate versus delayed reinforcement. Children were given a choice between receiving a small chocolate bar immediately versus a medium size in a week (Condition 1), or a small bar immediately versus a large bar delivered after one week (Condition 2). As in the Schwarz, et al. (1983) research, no differences as a function of age were found. However, the authors found a preference for the larger delayed reinforcer when the difference in magnitude was large. A significantly greater proportion of children in Condition 2 (small versus large), opted to wait one week, while a greater proportion of those in Condition 1 (small versus medium), preferred the smaller amount of chocolate. Therefore, they found that children will choose to delay reinforcement, but that the amount of reinforcement being used rather than age was a significant factor. Again, as in the Schwarz et al. experiment, the difference in the delays was quite salient.
Miller, Weinstein, and Karniol (1978) studied the effects of self-verbalization upon the length of time kindergarten and third grade children waited before requesting an experimenter to return them to their rooms. Subjects were shown two rewards and were told they would receive the preferred one if they waited for an experimenter to return to the room in which they were left. If they did not want to wait, they could ring a bell and the experimenter would return, but they would then receive the nonpreferred choice. The experimenters manipulated four verbalization conditions, including a task-oriented, reward oriented, irrelevant, and no-verbalization condition. The results showed a difference between the age groups under the no-verbalization condition, with the third graders waiting significantly longer. The authors proposed that the older children used covert verbalizations during the delays. This suggests that when using shorter delay periods, developmental differences may emerge.

Interventions to Increase Responding Under Delayed Reinforcement Conditions

A few researchers have developed operant procedures for increasing self-control. Among the techniques used, has been a systematic program of increasing delay times
prior to reinforcement.

Procedures with Animals

Ferster (1953) performed one of the earliest studies showing that experience could alter self-control. Ferster discovered that as delay in reinforcement increased, the rate of pecking in pigeons declined substantially. He then showed it was possible to maintain rates of responding for 3 out of 4 pigeons under delayed reinforcement by gradually increasing delays. He exposed pigeons to short delays and then gradually increased the delays to 60 seconds. Mazur and Logue (1978) have developed a similar method for increasing pigeons' self-control. They used the same procedure and called it "fading"\(^1\), in which the selection of larger, more-delayed responses were gradually differentially reinforced over smaller, more-immediate reinforcers.

Mazur and Logue exposed a control group of pigeons to a choice situation, with the option of an immediate 2-second reinforcer (2-second access to a food hopper) versus a 6-second reinforcer delayed 6 seconds. In the experimental group, delays were initially 6-seconds for both small and large reinforcers. The delay to the smaller reward was gradually reduced, over 11,000 trials (Logue, 1986), to zero for this group. A final choice
was then presented to the experimental and control group, with a choice between an immediate-small reward and a large-delayed reward. The authors reported that the control subjects hardly ever selected the large-delayed reinforcer, while the experimental subjects preferred the large delayed reinforcer significantly more often. The procedure was subsequently replicated by Logue, Rodriguez, Pena-Correal, and Mauro (1984).

Logue and Mazur (1981) examined the maintenance of pigeons' self-control responses after training via Mazur and Logue's (1978) fading procedure. After approximately 11 months had passed since the Mazur and Logue study, the same pigeons' preferences for the large-delayed reinforcer had not changed. The experimenters manipulated the use of colored overhead lights, which had also been used in the first study, during reinforcer delays and deliveries. They found a significant decrease in the number of large-delayed reinforcer choices, after discontinuing the use of overhead lights. The authors suggested that the lights acted as conditioned reinforcers and helped bridge the gap until the reinforcers were delivered. They proposed that the lights minimized the decrease of the reinforcer value during the delays and concluded that without conditioned
reinforcers during delays, behavior would deteriorate. The colored lights may be equivalent to self-statements and distractors used in the self-control procedures taught to children.

Studies with Children

Walls and Smith (1970) employed a procedure to increase choice for larger-delayed reinforcers in children. As Ferster (1953) and Mazur and Logue (1978) did in their research, they gradually changed the time to reinforcement. Walls and Smith assessed the effectiveness of two treatment conditions with disadvantaged and nondisadvantaged second- and third graders. In the first treatment group (Instrumental Work group), subjects worked at a coding task for 1 minute. Each child in the group was then given a criterion choice test in which he/she could immediately receive a small reward, or by completing an additional work sheet identical to the previous one, obtain a larger reward when finished.

The second group was exposed to a Multiple Experience treatment condition. Children were required to perform three tasks and decide on a choice after each. In task 1 the children had to count to 20. The experimenters then gave subjects a choice between 1 M&M immediately or 3 after waiting 1 minute. The children
were subsequently given a book to read for a minute. After the minute was up, the subjects received 3 M&Ms if they had chosen to delay. If they had not, the waiting period was imposed anyway. After it had passed, they were shown the 3 M&Ms and informed that they would have received them had they opted to wait. The second task involved coding. New rewards (marbles) were then presented and the subjects told they could receive 1 now or 3 after 3 minutes. The same procedure was followed as in Task 1, with an imposed delay for all, with those children who had not chosen to wait, shown the 3 marbles that they could have received. Those children who had chosen to wait received the rewards. Next, they completed a puzzle during Task 3 and again were presented with a choice. However, this choice test was the same criterion choice test used with the Instrumental Work group. The child could choose between obtaining 5 pennies immediately or 7 pennies after 4 days. The researchers also presented the criterion choice to a control group.

The results showed that disadvantaged children in both groups made fewer nondelay decisions, but that the multiple pretraining experience was most successful at changing choice behavior. The authors suggested that the
association between the social class and choice of delay can be altered and state that (Walls & Smith, 1970, p. 122) "this relationship appears to break down as the delay interval is lessened and/or the ratio of the magnitude of larger delayed reward to the immediately available smaller positive outcome is increased". Walls and Smith present a behavioral framework to explain why the fading procedure worked particularly well with the disadvantaged group. They claim these subjects will start out only tolerating short delays, and when their responses have been reinforced for doing so, the delay can gradually increase the delay until the goal has been reached. The idea is that as the youth are exposed to some measure of success for delaying their behavior, they will be more likely to repeat it in the future. The results obtained in this study were similar to those found with pigeons, where in building in the experience (Ferster, 1953) of gradually increasing delays resulted in a greater choice of larger, more-delayed reinforcers.

Applied Interventions for Increasing Self-Control

Strategies for Dealing with Impulsivity

Many self-control procedures have developed in response to the limitations of other treatments. Applied behavior analysis, for example, has relied on an
operational approach to teaching self-control strategies to children. However, Bornstein and Quevillon (1976) point out two areas of deficiency in the strategies. First, a proportion of treated subjects do not improve; and second, after the removal of an intervention, change usually fails to generalize or maintain. Nevertheless, there are advantages to self-management training that make it desirable to specifically modify the behavior of children identified as impulsive. The training still teaches children the skills needed to use in situations requiring self-control, and it may decrease the level of involvement demanded from teachers and parents.

Researchers are also interested in developing alternative self-control strategies in preference to using stimulants, the most frequently used treatment for such impulsive children. One of the problems with using stimulants is that the drug's beneficial effects cease immediately after it is withdrawn (Douglas, 1975).

Cognitive Strategies

Cognitive and cognitive-behavioral researchers have conducted considerable research aimed at increasing self-control in children. Most of the techniques developed have focused on teaching subjects to use instructions and rules.
Self-Instructional Procedures

The application of self-instructions to improve performance has evolved from the cognitive-behavioral approach. The developmentalist, Luria (1959), who contributed greatly to the study of the functional relation between verbal and nonverbal behavior, showed that children were able to inhibit their behavior by improving in their abilities to follow adult or their own instructions, as they matured. He suggested a progression of verbal control of a child's behavior from external to internal. In the beginning stages, behavior is controlled by the speech of others, usually adults. Next, the children control their behavior with their own external verbalizations. Finally, he presumed the child's self-verbalizations become covert, and later still, the covert speech gains an even more controlling role.

Much of the pioneering work in self-instructional training developed out of Meichenbaum and Goodman's (1969) observation that in impulsive children, verbal behavior controls nonverbal behavior less effectively. Thus, Meichenbaum and Goodman hypothesized, and demonstrated (1971) that self-control could be verbally mediated. Meichenbaum and Goodman developed a package to teach children self-instructions: The child follows an
adult model and at the outset of a task, talks to himself out loud. The self-talk is audibly faded until it is private. The application of such training has been used by others with a variety of populations and settings in the past (Bornstein & Quevillon, 1976; Coats, 1979; Finch, Wilkinson, Nelson, & Montgomery, 1975; Friedling & O'Leary, 1979; Heider, 1971; Mischel & Ebbensen, 1970; Nelson & Birkimer, 1978).

Although these earlier successes with cognitive instructional training were reported, researchers (Barkley, 1981; Abikoff, 1986) have been increasingly finding fault with the training packages. They found that academic skills and behavior problems were not addressed, as the early research had suggested (Douglas, Parry, Marton, Garson, 1976). Furthermore, Barkley (1981, p. 261) reported that the effects of successful cognitive training programs ceased after intervention was halted, with a lack of generalization beyond the training situation.

The Effects of the Content of Self-Instructions

Investigators also examined the effects of the content of the self-statements. Anderson and Moreland (1982) compared the rationales of statements such as, "If I wait I'll get another cookie". They found that
children who specified as a group the consequences of waiting, (i.e., "the instrumental self-verbalization group") waited the longest compared to groups using moralistic verbalizations (a nursery rhyme) or a control group told to just wait. Hartig and Kanfer (1973) and Toner (1981) found similar results in that children using task-centered statements (e.g., it is good to wait) waited longer than children using reward-centered statements only. Although the above variables all play an important role, Nelson and Birkimer (1978) found that self-reinforcement was a necessary component for modifying impulsive behavior via self-instructions. They compared latency to response and number of errors on a matching task with 48 impulsive second and third graders. There were significantly fewer errors with a significant increase in response latency, in the condition combining self-instructions and self-reinforcement versus the self-instruction alone condition.

**Individual Differences and Self-Control**

There are major differences in how well individuals successfully influence the variables of which their behavior are a function. While some visitors to Las Vegas are easily "tempted" to gamble, others have no problem holding on to their money. Variations in the
amount of self-control can be seen in children at early ages. Some children can cooperatively share toys, while others grab toys out of the hands of their schoolmates. As a child matures, the negative consequences for impulsive behavior (the opposite of self-control behavior) increase.

A particular group of individuals, labeled hyperactive or Attention Deficit Disordered with Hyperactivity (ADDH) are characterized by their choice of more immediate reinforcement (Douglas & Parry, 1983). Research (Firestone & Douglas, 1975; Douglas & Parry, 1983) examining the effects of reinforcement schedules on the responding of children identified as hyperactive in comparison to control subjects, may be relevant to the procedure investigated in the present study. The results indicated that hyperactive children respond differently to reinforcement contingencies. There may be some connection between the differences in responding that hyperactive children exhibit under particular reinforcement schedules and the lack of control children have over their impulses, or their choice of immediate reinforcement. Firestone and Douglas (1975) compared the effects of reward and punishment on performance during a delayed reaction time task. Responding was evaluated
under three reinforcement conditions: Reward, punishment, and reward plus punishment. In comparison to the control group, hyperactive children responded more variably and slowly during all conditions of the study. However, under all three conditions, variability decreased significantly from baseline responding.

Douglas and Parry (1983) compared the responding of control subjects to hyperactive subjects under continuous, partial, and noncontingent schedules of reinforcement with a delayed reaction time task. Again, researchers found greater variability in the responding of the hyperactive children. Only during the continuous reward condition did response variability decrease in the hyperactive subjects, while variability decreased for control subjects under partial and continuous conditions. Additional differences were found between the two groups of subjects when reward was delivered on a noncontingent schedule. Performance for both groups improved when praise was delivered for high quality performance. When praise was delivered randomly, the control subjects' responding continued to improve, while responding by the hyperactive children deteriorated. Performance actually improved in the hyperactive youngsters when the noncontingent rewards were withdrawn.
Based on these results, Douglas and Parry concluded that the use of inconsistent rewards can damage the performance of hyperactive children. Furthermore, the researchers (Douglas & Parry, 1983; Parry & Douglas, 1983) suggested that hyperactive children need training to learn to deal with partial or reduced reward schedules. The authors recommend specific training to decrease the problem behaviors (slower reaction times, increased variability, and increased inappropriate behavior) found under these schedules. They (Douglas & Parry, 1983) say:

It is possible that this problem could be avoided by training hyperactive children to cope with gradually decreasing ratios of reinforcement or gradually increasing delays of reward. Extended training, or overlearning, might also help them internalize the task demands so that they would be less dependent on continuous reinforcement. (p. 325)

Barkley, Copeland, and Sivage (1980) also found differences in the amount of appropriate behavior exhibited by hyperactive subjects under different reinforcement schedules. Appropriate behavior decreased when the schedule was switched from a variable interval
schedule (VI) of 1 minute (VI 1) to a VI 3. When the reinforcement schedule was changed to a VI 1.5, appropriate behavior increased.

The studies that found differences in responding under the various schedules, have major implications for designing a training program to increase the choice of larger, more-delayed over smaller immediate reinforcers. Researchers have established that performance in impulsive children, tends to deteriorate under schedules with less than continuous reinforcement. Data also suggest that a procedure, similar to that used by Ferster (1953) and Mazur and Logue (1978), employing gradually increasing delay times would be most successful at helping impulsive children to maintain performance, and perhaps to select more delayed reinforcers.

**Conclusion**

Every day organisms come into contact with situations where a choice must be made between immediate and long term consequences. The measurement and definition of behavior in such conditions is done by examining magnitude and delay of reinforcers. How individuals respond in those situations varies greatly. Along with any additional predisposing or physiological factors, (e.g., some children who exhibit a high rate of
hyperactive behaviors) the way people manage the probability of their own responding relates to their learning history. Nevertheless, most people learn through their experiences to wait across various situations. Teachers, parents, or others probably have taught them strategies for obtaining more delayed larger reinforcers. In addition, individuals may have learned strategies by observing, and then modelling others in their environment. Those without such an advantageous conditioning history, may be taught systematically how to wait during delay times. Previous research with pigeons (Ferster, 1953; Mazur & Logue, 1978) has shown that by progressively changing the time to reinforcement, rates of responding can be maintained under delayed reinforcement schedules. A similar procedure with children, where the waiting time for reinforcement is gradually increased, is one such planned, systematic procedure. If this strategy is effective in a controlled laboratory setting, it would have implications for a systematic educational curriculum. For example, a contingency could stipulate that if a child works for 5 consecutive minutes, he could have the option of going to recess for 10 minutes; but if he works for 10 minutes he would be allowed 20 minutes of recess. The time that he
is required to work under the options could gradually be increased.

This study examined the effectiveness of a procedure used to increase children's choice of delayed over immediate reinforcement. This research specifically attempted to change the learning history of preschool-aged children who had been identified as exhibiting more impulsive behavior than others in their classroom.
Footnote

1In applied settings fading usually refers to gradually changing a property of a discriminative stimulus. In training, behavior is first brought under the control of antecedent stimuli that are easy to discriminate. Training then proceeds by gradually introducing more difficult-to-discriminate stimuli.
Subjects

Six children attending two different preschools were the subjects of this study, with one child serving as a comparison subject. All were initially identified by their teacher in response to a request that subjects were needed who show some form of "impulsive" and/or "hyperactive" behavior. (Specific subject parameters for each child are detailed below.) Prior to selecting the children, a number of steps were followed.

Initially, the experimenter presented the research concept to teachers at local preschools, describing the type of child she sought for the study. (See Appendix 1 for recruitment letter.) After the teachers had identified children and informed parents of the opportunity to participate in the study, the experimenter observed the children in their classrooms during group, structured, and unstructured situations.

The major requirement for inclusion in the study was that the child show some form of impulsive behavior during the preassessment phase of the study. This was defined as the choice of 1 reinforcer with no delay (or 5 seconds in the case of Subject A, the pilot subject) 50%
of the time or more in preference to 3 rewards when the delay for the rewards was 60 seconds. (A more detailed description of the procedure follows in the General Procedure Section.) At this point, parents were formally invited to permit their children to participate and given a written description of the procedure, informed consent forms, questionnaires pertaining to choice of rewards for their children, and a standardized behavior rating scale (see Appendix 2).

Parents were asked to complete the Werry-Weiss-Peters Activity Rating Scale (WWPARS, Werry, 1968), a behavioral assessment scale containing 22 items of daily child behaviors across five settings. This scale was selected because it was one of the few available with norms for preschool-age children and is often employed in research involving children with hyperactivity. The original WWPARS included 31 items but was modified by Routh, Schroeder, and O'Tuama (1974), who developed norms collected on 140 typical children from 3 to 9 years old. The settings included in the scale are: public places, meals, television, play, and sleep. Each behavior can be rated as "no", "some", "much", or "nonapplicable". A total score is then found by summing each answer, which is rated as a 0, 1, or 2. Scores falling two standard
deviations above the mean for each age group are considered indicative of hyperactivity.

The WWPARS is presumed to indicate the seriousness of a child's behavioral disturbance within the family (Barkley, 1981; Ross & Ross, 1982). Barkley reports that the scale is effective in discriminating differences in child behavior when in drug therapy and when the parents are in parent training. Furthermore, it correlates well with child noncompliance to parental commands, with measures ranging from .40 to .70. It does not, however, correlate well with measures of activity level or attention span. Test-retest reliability for the scale has not been reported. Table 1 lists scores for Subjects B through F on the scale.

The children's teachers were asked to complete the Child Behavior Checklist for teachers (CBCL, Achenbach & Edelbrock, 1980). This assessment tool was mainly used to gather descriptive information about the children while in school and to rule out other child problems. It could not be used diagnostically, since norms for the scale begin with children 6 years of age. Many of the items on the scale were not relevant to the age group of the subjects participating in this study. The CBCL examines adaptive functioning as well as problem
<table>
<thead>
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<th>Subject</th>
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<th>Pop. SD</th>
<th>Score</th>
<th>Stand. Score</th>
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<td>35</td>
<td>2.89</td>
</tr>
<tr>
<td>C</td>
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<td>5.76</td>
<td>23</td>
<td>1.35</td>
</tr>
<tr>
<td>D</td>
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<td>12.35</td>
<td>7.90</td>
<td>29</td>
<td>2.12</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>11.13</td>
<td>5.12</td>
<td>27</td>
<td>3.09</td>
</tr>
<tr>
<td>F</td>
<td>4</td>
<td>12.35</td>
<td>7.90</td>
<td>14</td>
<td>.21</td>
</tr>
</tbody>
</table>

Note. Standard scores of over 2 indicate hyperactivity.
behaviors. This checklist was helpful in identifying specific problem behaviors in the school setting. (See Appendix 3 for the checklist.)

Individual subject descriptions. Subject A was the first participant in the experiment and served as a pilot subject. She was 4 years and 9 months old when the study began, having moved to this country from Israel 6 months earlier. By the time the experiment began, she could produce simple sentences in English and within approximately 3 months she was quite fluent in the language. Her teachers considered her above average in intelligence but reported that she often had difficulty waiting in situations involving other children, that she seemed immature at times, and often "spoke too quickly". The teachers acknowledged that the impulsivity they noticed might have been partially due to the child's lack of skill in communicating. By the end of the study the child was fluent in English and her teachers felt that her impulsive acts appeared to have decreased. Subject A's behavior was not considered a problem by her teachers and, therefore, fewer screening devices were used with her.

Subject B was a 4 year old boy who had been referred to his preschool as a special-needs child, due to his
behavior problems. He had previously attended three other preschools in his local district and each considered itself unequipped to manage the boy's behavior problems. The child's father also reported that the boy was unmanageable at home. The subject's behavior met the criteria of DSM-III of Attention Deficit Disorder with Hyperactivity.

Subject C was a female of 3 years and 6 months labeled "impatient, somewhat immature, and restless" and was reported by her teachers to exhibit more behavior management problems than the other typical children in her preschool. Her parents also suggested that she needed help in gaining patience.

Subject D was 4 years and 5 months old and identified as a behavior management problem in his preschool. He did not follow teacher's instructions and often aggressed against teachers and other children. This child's impulsive behavior was most often displayed during social situations that required cooperation with others. Disruptions commonly occurred over sharing with other children or after teachers gave instructions. Impulsive behavior was seen less often during academic activities. After working with the child and observing him in various activities at home and school, the
researcher concluded that a label of "conduct disordered" would have been more appropriate than "hyperactive", or "attentional deficit disorder".

Teachers selected Subject E on the basis of his behavior during academic work. He was 5 years and 8 months old and not considered a behavior problem in school. His teachers reported that he was easily distracted and frustrated during his work. His academic performance was also considered far below his grade level.

Subject F only participated in the assessment phase of the study. She was not included because her responding was quite variable during the assessment phase. Her data were included to show a pattern of responding in absence of the intervention. She was 4 years and 8 months old when the study began. In school and home she was considered a behavior management problem. Her behavior was very similar to that of Subject D, in that she failed to follow her teachers' instructions and aggressed toward others. She was also restless in group activities and usually did not sit through structured activities as long as the other children. After working with her, the experimenter also considered the label of conduct disorder a more
appropriate label rather than hyperactive.

Setting

The research was conducted at 3 different settings. The first was an educational preschool which integrates developmentally disabled children with peers who lack any apparent disabilities. Subjects A, B, and C attended this school, which was affiliated with the Department of Psychology at the University of Massachusetts. The experimental procedure was conducted with subjects A and C, in a 3.66 m X 3.66 m room, set aside for table activities. During the experiment, the researcher and subject sat at a table across from each other. Often one or two other children were working on structured tasks with a teacher in another area of the room. Furthermore, audible special group activities were ongoing in the adjoining room, but the noise level was relatively constant throughout the study. The schedule permitted a more preferable arrangement for Subject B. Data were collected with this child in the playroom, 5.18 m X 4.57 m, while all of the other children participated in a morning meeting in the other room. Consequently, the ambience was quieter for Subject B than for the other two children.
Data were collected for Subjects D, E, and F in two different locations at another local preschool. Initially, during the early preassessment sessions, an office, 3.66 m X 2.74 m in size, was used. Teachers occasionally walked in and out of the room, producing some distraction. About halfway through preassessment, the experiment was moved to another room (3.66 m X 2.74 m), free of distraction.

The last setting was Subject D's home. This child had stopped attending his preschool toward the end of his preassessment and consequently the remainder of the study was carried out at his home. The experiment took place in the living room, from which all toys had been removed.

Personnel

The experimenter was a female Doctoral student in the Department of Psychology, enrolled in a program specializing in developmental disabilities. A Professor of the department who has been specializing in developmental disabilities and applied behavior analysis and two other professors specializing in the experimental analysis of behavior supervised the experimenter. The experimenter collected data during the sessions and supervised two undergraduate research assistants who helped score video tapes of the sessions. The
experimenter trained the research assistants and maintained records on the reliability of performance of all three. Course credit was given to the assistants for their participation.

Materials

A wooden divider .61 m X 1.22 m in size was placed between the experimenter and the child. (See Figure 2 for a diagram of the apparatus.) On the side facing the child, a clown's face was depicted. The clown's nose was a red light bulb and the eyes were clear light bulbs. The face functioned as a discriminative stimulus and was illuminated to indicate the time at which choices were available. Beneath the clown's face were two battery operated bulbs, or indicator lights. These were illuminated during the delay periods that occurred after a choice had been selected. The color of the lights corresponded to the color of the boxes being used during that particular session. The light that was illuminated was the same color as the box that the child selected during that particular trial. For example, if a yellow and blue box were presented during a session, yellow and blue lights would be placed on the panel. The experimenter would illuminate the blue light when the subject chose the blue box.
Figure 2. A diagram of the apparatus.
A wide-angle door viewer (peep hole) was placed in the middle of the left side of the screen. This enabled the experimenter to observe the child, inconspicuously, during the sessions.

At the bottom of the divider were two 25 cm × 15 cm apertures, through which wooden boxes with hinged tops could be presented. Within each box was a well, constructed from a plastic margarine dish, to hold the rewards. A screw in the hinge of each box top could be removed easily, permitting tops to be exchanged readily. Boxes operated similarly to drawers in a piece of furniture, with gliders to guide them. During delay and intertrial interval (ITI) periods, the covers were removed from the child's view with only the front of the box remaining visible. Three switches were mounted on a side box facing the experimenter: one to operate the clown's nose and eyes, and one for each of the two indicator lights. A small clock with a second hand signalled to the experimenter the length of time passed for the ITI and delay period.

Children could select rewards from an array presented at the beginning of each session and were permitted to alter their selections between one trial and the next. At the request of their teachers, rewards for
Subjects D, E, and F were restricted to stickers. These consisted of a set of various brightly colored, peel off pictures, from which subjects could select as rewards for particular trials. Subjects A, B, and C could choose between stickers, marshmallows, raisins, yogurt raisins, and various types of cheese crackers.

A cardboard box with a slit on top, was placed on the table in front of the apparatus and used as a type of reward savings bank. When the child finished looking at a sticker, (or in the case of edibles, if the child preferred to save them) he or she deposited the rewards through the slit in the box. The children were discouraged from looking into the box or touching it during times other than when they received the reinforcers. [The reason rewards were stored in a container, out of sight, was because Mischel and Ebbesen (1970) found that children had a more difficult time waiting for rewards if they were visible.] The reward bank was also used to prevent the children from playing with the rewards during future delay periods. At the end of each session, the rewards were placed in envelopes for the child to take them home later. As mentioned previously, Subject A's early sessions differed from those with others. Subject A received plastic poker
chips that later were traded in for other rewards (e.g., stickers or edibles, at the end of each trial).

Data sheets were used to record responses. These were devised to enable the observer to jot down information quickly and efficiently. VHS format videotape equipment was used to record sessions for purposes of calculating reliability of data scored during the sessions.

Data Recording

Watching the subject via the door viewer, the experimenter recorded any unusual events, behaviors, or conditions, such as interruptions, excessive noise, recent vacations, conduct problems, and so on that might interfere with the experiment. During the sessions, the experimenter recorded the subject's responses and other relevant information (i.e., interruptions, noise, etc.) on a score sheet (see Appendix 4). Within the session, videotape and paper and pencil recordings were made of the sequence of forced-choice trials, and the colors and sequences of each choice trial selected.

Reliability

To provide an estimate of observer reliability, videotape recordings were taken periodically, depending upon the setting and the availability of the equipment.
The machine was typically placed 10 feet away from the subject and the total number of sessions taped varied from child to child and setting to setting. The tapes were independently scored by two research assistants and the experimenter. The researcher trained the observers by showing them tapes of the sessions and scoring the observations from the tapes onto data sheets. Each taped session was compared on a trial-by-trial basis with the data collected by the experimenter within the session. Trials were scored as agreeing if the color of the box chosen by the subjects on the in vivo score sheet matched the color of the box based on the tape recording. Interobserver agreement (IOA) was calculated by dividing the number of agreements on each trial by the number of agreements plus disagreements, and multiplied by 100. IOA was 100% across trials and subjects. Table 2 shows the number of sessions and agreement checks that IOA was calculated on for each subject.

Experimental Design

The experimenter assessed each subject's choices of either a more-immediate, small reward or a larger reward for which the delay varied in duration as a function of the phase in the study. This enabled responding before, during, and after the intervention to be compared. Since
Table 2

**Interobserver Agreement**

<table>
<thead>
<tr>
<th>Subject</th>
<th># of Sessions</th>
<th># of Agreement Checks</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>47</td>
<td>35</td>
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<tr>
<td>B</td>
<td>49</td>
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</tr>
<tr>
<td>F</td>
<td>18</td>
<td>5</td>
</tr>
</tbody>
</table>
it was not possible to establish a stable baseline for Subject F, she was only involved in the assessment phase. Her data were presented to highlight any time-dependent influences that might have remained uncontrolled.

Children were tested in a multiple-baseline fashion, with replication across subjects. Figure 3 shows the time lines and sequencing of the study across the subjects. To help control for confounding variables, the experimenter varied the length of the preassessment and began the intervention at different times. The variable lengths of the preassessment phase helped control for maturation, length of exposure to the experimental situation, and other time-dependent variables. In Setting 1, the training for Subject A overlapped with Subject B's preassessment, and Subject B's training overlapped with Subject C's preassessment. In Setting 2 the training of Subject E overlapped with Subject D's preassessment and with the comparison subject, Subject F. This partial overlap was designed to help control for extraneous variables, particular to that setting, that could have affected the data. For example, suppose an event, such as a novel teaching procedure had been introduced in the classroom simultaneous with the introduction of the experimental intervention. Data on other children not
Figure 3. Notation of the sequential arrangement for each phase of the study. Dashed lines indicate assessments and solid lines indicate training.
receiving that intervention at that time, would help to reveal whether the new teaching procedure had a general influence on the performance of the latter children. If not, it would be reasonable to conclude that it did not account for changes in first subjects' performance either.

Orientation of Subjects

The experimenter accompanied the child to a room where the apparatus was placed on a table, explaining that they were going to play a game. The child was seated in a chair facing the clown. During the initial one or two sessions, the apparatus and the "clown game" were explained to the child, until it was clear that the child understood. First, the experimenter turned on the lights for the clown's face and pushed the boxes through the divider to the side facing the child. Next, she showed how to open the boxes and indicate a choice, by tapping a box top. She asked the subject to practice choosing boxes and reinforced successive approximations with praise until the child mastered the response, requiring only occasional reminders throughout the study. If subjects touched the two boxes simultaneously or attempted to open one without tapping it first, they were reminded about the correct way to proceed. If a child
continued to respond inappropriately, the boxes were immediately removed from view by withdrawing them completely.

**General Procedure**

Individual variations of the procedure are detailed in the section below, entitled, Individual Subject Variations.

**Forced Choice Trials.** During "the forced-choice", (i.e., single choice) trials, the experimenter presented one box at a time. The child was still required to touch the box, as in the choice trials, to remind the child to touch the top during the choice trials. The child then waited the corresponding time for that particular delay. These trials ensured that the children were exposed to the contingencies corresponding to each of the two boxes.

**Choice Trials.** During the procedure, the clown light, was turned on and the boxes were presented partially (4/5 of the way past the wooden divider). (Recall that this prevented subjects from opening the boxes immediately, as boxes could not be opened unless they were completely exposed.) After the child touched the box top, the clown light was turned off and a colored delay light corresponding to the color of the box top the child had touched, was illuminated. If the immediate
choice box was selected, the researcher exposed the box completely, so the child could open it. If a delay box was selected, it was retracted for the programmed time delay. At the end of the delay period, the box was presented completely for the child to open. The experimenter turned the delay light off whenever the subject lifted the top of the box and retrieved the rewards. The youngsters typically examined the stickers at this point for a few seconds and then placed them in their reward bank. [The children who earned edibles either ate or stored them.]. New trials began when the child either had consumed the edibles or deposited the rewards in the bank and when the required intertrial interval was over.

The experimenter controlled the intertrial intervals (ITIs). The ITIs (time between onset of successive trials) were programmed to keep the overall rate of reinforcement relatively constant. (Otherwise, a child might continuously choose the immediate reward very rapidly, earning an inordinately large number of rewards.) Thus the rate of delivery of rewards (number of opportunities to earn) was controlled and was independent of the choice behavior of the child, while the overall number of rewards received depended on the
child's choice. The ITI was large enough to include the time it typically took the child to respond plus the delay period plus the time the child typically took to consume or look at the reinforcer. At reward delays of 5-30 seconds, a 60 second ITI was used. At longer reward delays, longer ITIs were used. The intertrial interval always was a multiple of 15 seconds, for ease in keeping track of the time. For example, if the response latency and reward delivery took a total of 65 seconds, then the new trial would not begin until 10 seconds more had passed.

Preassessment. Figure 4 depicts the pre and postassessment procedure. The primary goal of the preassessment phase, was to determine indifference points for each subject. Indifference points, or cross-over ranges, occur at a range of delays and values in which the child switches from choosing the larger, more-delayed reinforcer to the smaller, more-immediate reinforcer. During each session, sets of delays were presented to the subject [e.g., 0 second (1 reward) versus 30 second (3 rewards); 0 second (1 reward) versus 0 second (3 rewards) and so on] in order to determine their indifference points before the training procedure was implemented. Originally, for four of the subjects, the researcher
Figure 4. Flowchart of pre and postassessment phases.
presented blocks of sample delays, with a fairly large range between them, in a descending order of time (e.g., 60 seconds, 30 seconds, 15 seconds; each paired against a choice entailing a 0 second delay). This was done for the first 3-5 sessions of the preassessment condition, to prevent exposure to the formal intervention of gradually increasing delays. However, after subjects appeared to begin associating particular colors with particular delay periods, it was decided that the blocks of delays should be presented in random order (e.g., 60, 30, 90, 0, 45; each versus 0 seconds). Table 3 shows the order of delays used for each subject for the pre and postassessment phases of the study. The delays corresponding to each box stayed the same for all 14 trials within a given session.

In general, the preassessment sessions consisted of presenting four forced-choice trials (only one box presented at a time), followed by 10 choice trials. Preassessment continued until each child's responding reached stability (defined below). In an effort to reach the criterion of stability, three additional sessions with 0 seconds versus 0 seconds were completed, if during the 0 second versus 0 second session, the child did not choose the larger reward 80% of the time or more.
Table 3

Order of Long Delays in Seconds

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*Delay for small \( S_R=5 \) sec. All other small \( S_R=0 \) sec.

□ Randomization of box top colors. Colors were randomized for all subjects during the postassessment. #Sessions at child’s home.
In an attempt to demonstrate the stability of responding, identical pairs of preassessment delay periods were repeated over several sessions. This was done to assess daily variability of responding that might have been influenced by factors outside of the experimenter's control. (e.g., an unusually distracting activity taking place in the experimental room).

During most of the preassessment sessions, the colors of the box tops remained the same, yellow for the triple, and blue for the single rewards. Originally, for most subjects, only 2 colors were used throughout the preassessment. Then, in an effort to heighten the discriminability of different delay periods, for Subjects B-F, the experimenter varied colors of the box tops between sessions. The colors for a particular session were selected on a random basis. For example, in session 6, with Subject B, the tops were purple (1 reward) and Green (3 rewards) throughout the session; in session 7, white (1 rewards) and pink (3 rewards); in session 8, black (1 reward) and red (3 rewards); and so on. (This procedural change is indicated in Table 3.) This change was instituted to mitigate the influence of a particular color's cuing a particular time delay from proceeding sessions. It appeared that some children began to
associate particular colors with particular delays from prior sessions, even when the delays had been substantially altered, as some children chose the box with three rewards less than 70% of the time during sessions when the triple reward could be obtained as quickly as the single ones (i.e., both immediate). The decision to change the colors was also based on comments from subjects, such as, "I hate yellow, you have to wait so long for it". At one point when Subject E said this to the researcher, after a session in which the delays were equivalent, she replied, "But today they were the same time, you did not have to wait any longer for the yellow than the blue". The child then said, "Well, no, maybe not today, but usually I do, so I don't like it". Teachers and parents also reported that the children had told them similar anecdotes about the colors of the boxes and delay times. It is likely that the yellow box became a conditioned aversive stimulus for some children. Once colors were randomized between sessions the experimenter observed that choice switched over to the box containing the multiple rewards, especially when the delay for the larger reward was brief.

Training. The procedure of differentially reinforcing waiting during increasing delay times always
began with the delays for both reward values set at zero. Then the first delay was introduced, approximately 2 1/2 seconds. (This was used with most subjects to see how each child would react to the increase and to provide an estimate of how many training trials would be needed to reach the criteria for the subsequent delay increase.) Once the criterion was met for a given delay period, delays increased by 5 second increments for the box with three rewards. In some circumstances, it took several sessions before the criterion was reached. Occasionally, however, subjects reached criterion for a particular delay quickly enough to permit an additional training session with an increased delay. The criterion for extending delays was the selection of the box with three rewards for four out of five trials. (See Figure 5 for the flow chart of the procedure). Each time a new delay period was introduced, four forced-choice trials were presented including two trials with one box top color paired with no delay, containing a single reward, and two trials with the box containing the multiple rewards. Each session began with forced-choice trials whether or not the delay was increased from the previous session.

The number of sessions devoted to training varied from subject to subject. The total number of trials per
Figure 5. Flowchart of training phase.
subject for all the sessions combined, ranged from 49 to 86. A criterion for terminating the intervention with Subject E was that training on a particular delay would continue until 50 choice trials passed without the child choosing the larger reward at least 4 out of 5 times. Training stopped before this with most subjects, for other reasons, such as termination of the school year.

**Postassessment.** The postassessment phase was similar to the preassessment phase. Over a number of sessions, the experimenter randomly presented to each child a series of choices consisting of boxes with colored tops corresponding to varying delay periods. An attempt was made to use all of the same delay periods as those that had been presented during the original assessment. Due to time constraints (i.e., children leaving school for the summer) this was not always possible. When time was limited, the researcher randomly chose values from the original set by using a lottery system. Each time value from the set of delays that had been used for each individual child was written on a scrap of paper. These were mixed up and several were drawn. The order in which the delays were drawn determined the order of presentation. (See Table 3 for the order.) This protocol was followed until the
available time expired.

The procedure followed was basically the same as the preassessment. Each session began with four forced-choice trials and finished with ten choice trials, their order chosen randomly via the lottery system. Furthermore, the colors of the tops that corresponded with each different delay time were randomized. Due to time limitations, it was not possible to obtain data on a specific delay period for more than one session.

**Individual Subject Variations**

As the procedure was refined and the experiment progressed, variations were required for particular subjects. Those are detailed below.

**Pilot Subject/Subject A.** As the first participant in the experiment, this child served as a pilot subject. Based on this initial trial, the procedure was modified for the other subjects. Specifically this subject earned tokens, exchangeable for rewards at the end of each trial, during a portion of the preassessment phase, while other subjects received their rewards directly following each choice. In addition, during the preassessment, all the other children were screened with a varying time delay versus (in conjunction with) a no delay time, or 0 seconds (i.e., 15 seconds versus 0 seconds;) only. This
child was tested on varying time delays versus a 5 second delay as well as the 0 second delay. This was done because the experimenter was trying to find the optimal delay times to use. Based on previous pilot data with another subject not included in this study (that pilot subject always chose the more delayed reward), the researcher decided to start titrating the delay times at 5 seconds. After a few trials with Subject A, it became clear that she would choose the smaller reward, within 15 to 30 seconds, and, so the experimenter tried the varying delay times versus the no delay choice. When the no delay time was shown to be effective in the procedure, this was adopted for the other children. Furthermore, for this subject, throughout preassessment, the colors of the box tops remained the same, yellow for the larger amount of reward and blue for the smaller.

In addition, three probe sessions were inserted during the postassessment phase. These consisted of four forced-choice trials and four choice trials and were used to determine whether or not the subject would generalize beyond the delay intervals she experienced during training. (The experimenter suspected that the Subject could delay for longer periods based upon her behavior during the sessions.)
Furthermore, there was a variation in Subject A's postassessment procedure. Unlike most subjects, who experienced a particular delay period for only one session, Subject A, was exposed to the 0 vs. 35 seconds choice twice, during sessions 3 and 6 of the postassessment.

**Subject B.** During Subject B's preassessment the experimenter presented the sets of delays randomly throughout. This differed from other subjects, for whom portions of their preassessment had been presented in blocks of descending time delays. Another variation was the division of testing for a particular set of delays over two days. On a few occasions it took more than one day to obtain a block of 10 choice trials. This typically occurred with the larger delays, for two reasons. First, Subject B often misbehaved during long delays and sometimes the time alloted for a session was insufficient to complete the requisite number of trials. For example, one session had to begin late because the subject's class cleaned up slowly from a special activity.

**Subject C.** Throughout the preassessment, the color of the box tops on the apparatus were randomized. All of the other variations and rationales in her procedure were
identical to those of Subject B.

**Subject D.** Subject D's training progressed as the others' except at one point when the delay for the box with three rewards was increased by 10 seconds. In addition, one probe session similar to Subject A's was conducted during training.

**Subject E.** The only variation in Subject E's training was the need to meet a criterion to determine when to terminate the intervention.

**Subject F.** Subject F's involvement of the study consisted solely of 10 1/2 weeks of assessment.
CHAPTER 3

Results

Training

In general, the training procedure resulted in indifference points shifting for 4 out of 5 children, with subjects choosing larger reinforcers at longer delays. Analyses were based on the last ten trials of each session. (An exception to this were two of Subject A's sessions, which included fewer than 10 trials). Figure 6 shows the number of trials each subject required to reach the criterion of choosing the larger delayed reward on four out of five trials for each particular delay interval. For instance, it took Subject E 6 trials before he reached the criterion of selecting the large reward at least 4 out of 5 times when its presentation was delayed for 5 seconds. When the delay for the larger was 10 seconds, 30 trials were required for him to reach that criterion.

Pre and Postassessment Changes

Figure 7 shows the average percentage of large reinforcer choices as a function of its delay interval. During the pretest, all subjects, except D, showed almost exclusive preference for the smaller reinforcer when delays for the larger reward exceeded 15 seconds. As delays increased, all subjects showed increasing
Figure 6. Number of trials to reach criterion during training as a function of duration of delay to larger reinforcer. Criterion was the choice of 4 large reinforcer choices within 5 choice trials. The "*" in Subject B's graph indicates a 2 week vacation between sessions.
Figure 7. The average percent of trials the large reinforcer was chosen for each delay interval. Note that the short delay was fixed at zero seconds, except for Subject A who was given some trials with a 5 second delay interval (dashed lines).
preference for the smaller reinforcer. After training, indifference points shifted for 4 out of 5 children with subjects choosing larger reinforcers at longer delays. Additionally, the postassessment revealed that 3 out of 5 subjects, chose the box with the larger rewards at delays exceeding the durations used during the training phase.

Table 4 displays all of the delays presented, and their corresponding percentages of large reinforcer choices. The averages in Figure 7 were based on these figures. Table 4 also presents probe data for Subjects A and E taken during their training sessions. These sessions were composed of 4 forced-choice and choice trials. In these data, Subjects A and E selected large rewards with delay periods that extended beyond those they had experienced during training.

Recall that during Subject A's preassessment, smaller reward delays started at 5 seconds and then dropped to zero seconds. Some variability occurred around the fourth, fifth, and ninth session, perhaps due to carry over from earlier sessions. Stability was obtained for the sixth, seven, and eighth sessions. Data for sessions 6 and 7, were based on 7 and 9 trials rather than 10 due to time constraints.
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PERCENTAGE OF LARGE REINFORCER CHOICE

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After training, Subject A consistently reached criteria. Probes during training showed that the subject ultimately chose the larger reinforcer, even with delays as long as 90 seconds. A change in responding can be seen under the 60 second delay condition. At that value, she had chosen the larger reward only 10% of the time during the short delay in the preassessment, while during the postassessment, she selected the larger reward 70% of the time. (See Figure 7).

Subject B.'s data were fairly stable throughout the study. A maximum of 5 trials was required to train this subject to reach criterion on each delay value, except for the 30 second delay phase (during which time a 2 week vacation period had intervened). For the latter value, 47 trials were required before criterion was reached. (The child also exhibited conduct problems following his vacation, as was usual after he had been away from the preschool setting for extended periods of time.) The postassessment revealed a 77% increase of choosing the larger reward at a 60 second delay. The child often misbehaved during that last postassessment phase, perhaps due to the extensiveness of the delay.

Subject C's change in choice of the large reinforcer during preassessment occurred abruptly between 5 and 10 seconds. During training, the number of trials required
to reach criterion never surpassed 13. Postassessment revealed a change of 40% in preference for the large reward at a delay of 60 seconds.

Subject D.'s preassessment responding was highly variable, but began to stabilize once the colors on the covers of the box tops were altered. (It appeared that the subject became satiated with the use of stickers as rewards and behavior management problems also increased. See the Discussion Section.) Training required numerous trials (between 5-35) before the criterion was met. When a probe was presented at 45 seconds, the subject chose the larger reinforcer 2 out of 4 times. In contrast with the preassessment, the postassessment demonstrated an increase in choice of the large rewards during delays of 5 and 30 seconds but not beyond that.

Subject E.'s preassessment revealed some variability in responding as well. The randomization of colors for the box tops began during session 7. Stability was considered achieved when the subject chose the larger reinforcer 80% or more of the time in the 0 second delay phase for the larger reward versus the 0 second delay for the smaller reward, for three separate sessions. From 6 to 40 trials were required to reach criterion, until the 20 second delay phase was reached. The subject never reached criterion for 25 seconds, despite 47 trials. The
delay interval was then reduced to 22.5 seconds, and after 20 trials with this interval, the criterion was still not achieved. The interval was further reduced back to 20 seconds and after 18 trials criterion was reached again. However, the criterion for delays beyond 20 seconds was not reached again during subsequent trials. At this point, the experimenter decided to begin the postassessment.

Subject E's selection of the large reward between delay intervals of 60 and 90 seconds, was somewhat greater during the preassessment. By 90 seconds the child's choice of the larger reinforcer decreased by 20%.

Indifference Points

Figure 8 shows the changes in indifference points during pre and postassessment for each child. The points were determined by linear interpolation. The indifference points are the delays at which subjects choose either alternative equally often. [For example, during preassessment Subject E chose the delayed reward 50% of the time at delays to 1.67 seconds. After training, he chose the larger reinforcer 50% of the time at delays of 37.5 seconds.] Indifference points after training were not found for Subjects A, B, and C. This was because postassessment checks only included delays up
Figure 8. Delays at which subjects chose either alternative equally often (indifference points). Numbers below the bars indicate the indifference points arrived at by linear interpolation. The ranges on the X axis represent the data points bracketing the indifference point. (When "*" appears, the value of the indifference point was not found.)
to 60 seconds for Subjects B and C and 90 seconds for Subject A. Due to the time constraints imposed by the ending of the school year, it was not possible to complete any more sessions and test additional delays beyond 60 or 90 seconds. More than one indifference point is plotted on the figure for Subject D because his data were more variable and crossed the 50% line more than once.

Data for Subject F continued to be variable over 17 sessions. Upon examination of her data no abrupt changes in the choice pattern can be seen.

**Informal Behavior Observations**

Appendix 3 shows a sample of behaviors observed during the pre and postassessment phases, by the experimenter and her research assistants.
CHAPTER 4

Discussion

The results indicated that gradually increasing delay periods, is an effective method of teaching young children to choose larger, delayed reinforcers over more-immediate, smaller reinforcers. After training, Subjects A, B, and C selected the larger, delayed reinforcer, even at durations exceeding the values used during training. Subjects D and E, for whom the procedure was the least effective, showed signs of satiating on the rewards. For example, occasionally, these children would put the stickers they had earned, back in the box, and push it toward the experimenter. They would then remark that the stickers were for her. (These subjects were restricted to receiving peel-off pictures as rewards throughout the study.) Subjects A, B, and C, showed their greatest change from their pre- to post-test for delay values they experienced during training, even though on occasion, they did select the multiple reinforcers at durations beyond those used during training. Subject E was able to reach criterion up to a 20 second delay during training. A comparison of his pre- and post-test responding shows that although he changed the proportion of his choices up to delays of
between 60 and 90 seconds, the bulk of the change after training, were for delays of 20 seconds or less.

**Methodological Changes**

**Controlling For History Effects**

The experimenter found it necessary to make a few procedural changes during the preassessment phase of the study. When the study began, the colors of the box tops were consistently yellow and blue, remaining so for Subject A throughout the preassessment phase, while for Subject C they were randomized throughout. The researcher suspected that choices were being influenced as a result of history effects (i.e., the pairing of the color of the box tops with the delays from previous sessions). Evidence for those influences was most pronounced when Subjects selected the small as often as the larger reward, despite equal delays for the two. Furthermore, several children told the experimenter they knew that the delay for the box with the larger reward (the yellow box top) was going to be long, in spite of having had contrary experience during forced trials during that particular session. Consequently, the experimenter changed the procedure during the preassessment by introducing new colors for the box tops and indicator lights, and randomly varying them from
session to session.

It is possible, but unlikely, that keeping the colors stable for some sessions, but not others, confounded the data. Furthermore, it may make it difficult to compare portions of the preassessment to the randomized postassessments. This is particularly true for Subject A's data, since throughout her pretest the colors of the box tops remained the same. With this Subject, (as well as the others) the greatest discrepancy was found for equivalent delays and if there was any confounding, it would have occurred during those testing sessions. Her selection of large reinforcer choice under the 5 sec versus 5 sec delays varied from 20%-89%. With Subject A, (and in general with the others) whether or not the box colors were randomized, as the preassessment progressed, the percentage of choice of larger reinforcers increased and became more stable during sessions when delay periods for the larger and smaller rewards were the same. Furthermore, there was an increase in stability in the percentage of large reinforcer choices when both delays, were equal, after the color change was instituted for Subjects B-F. It is most likely that the change in the colors made it easier for the children to discriminate the new delays from one
session to another.

There was an additional modification in the preassessment procedure. The presentation of delays from session to session, was changed from descending, to randomized order. During the preassessment, Subject A experienced 5 delay periods in descending order, for the first 5 sessions; Subject D for the first 5 sessions; Subject E for the first 4 sessions; and Subject F for the first 3 sessions. Originally, the preassessment had been planned to allow time differences between each delay interval to be fairly large. This change was also done to decrease the effect of the delays from the prior assessment. The same procedure was followed for the postassessment phase. In subsequent sessions, after the color of the box tops was varied and the delays randomized, responding seemed to be more affected by the length of the delay.

History effects may have been more powerful with children than they had with pigeons (Mazur & Logue, 1978) as a result their verbal capabilities. As research by Catania, Matthews, and Shimoff (1982) shows, under some conditions, verbal subjects are relatively insensitive to changes in contingencies. (Although, the subjects in the Catania et al. study were college students, and their
responding may have been even more "insensitive" than that of younger children, who have less sophisticated verbal skills.) The researcher can offer no hypothesis as to why Subject A's data did not seem to reflect history effects as strongly as those of Subjects D and E.

Although, the history effects may have been strong during portions of the preassessment, they cannot totally negate the responsibility of the training procedure, for the change seen in responding from the pre to the postassessment. First, Subject C's preassessment was randomized (colors and presentation of delays) and yet there was a major change between her pre and posttest responding. Furthermore, Subject B also increased his large reinforcer choice, for delays that were, and were not randomized during the pretest. However, to clarify this issue recommended that the study be replicated, using a randomization of colors and order of delays, throughout both assessments. Such a replication should provide stronger evidence that the training procedure was responsible for the change in responding.

In addition, it may be useful to include a control group to minimize uncontrolled variance in future studies.
Influence of Time Constraints

Working with subjects in applied settings often adds constraints to a study. One of the greatest is that of time. Four of the children were in pre-school settings and collection of data on their choice behavior terminated when their school year ended (except for Subject C, whose parents brought her in for additional sessions until she left for a family trip). Therefore, time limitations determined, somewhat, when the postassessment phase ended for Subjects B and C.

The smaller number of sessions during the postassessment than in the preassessment phase were also affected to some extent by time constraints; however, the data were more stable during this phase, and therefore, fewer data points were needed to reveal a stable pattern of responding. The increased stability during the final phase may have been influenced by an increase in the experimenter's proficiency in carrying out the procedure and to the procedural changes noted above.

Potential Alternative Interpretations of Results

One potential alternative explanation for the subjects' shift in choice, from the pre to the postassessment phase is that the results were produced by some time-dependent process, such as duration of exposure
to the contingencies or subject maturation. Another, is one proposed by researchers working with pigeons (Logue, Rodriguez, Pena-Correal, & Mauro, 1984; Mazur & Logue, 1978), that the large number of trials used during training could have been responsible and actually may have been necessary to produce an increase in the number of choices of larger, more-delayed reinforcers. [Mazur and Logue (1978) also suggested the gradual change in the small reinforcer delay as a possible factor.] However, it is unlikely that the processes mentioned above could alone account for the change in responding. Such variables as those mentioned above probably would have been revealed in the baselines of the subjects. The modified multiple baseline helped control for such uncontrolled variation, such as maturation. Data from Subject F (this Subject only participated in the assessment) also should have reflected the effects of such uncontrolled variables. Furthermore, had it been a confounding factor, time alone should have produced a greater effect on the training and postassessment responding of Subjects D and E because those subjects remained in the experimental setting for 10 1/2 and 11 weeks, respectively. Yet, although they participated in the experiment for about the same or longer than other
subjects, their preference for the larger reward did not increase as it did with the others. Presumably, then, factors such as maturation, time, or number of trials probably were unlikely to have produced changes in preference. Subject E's data also helps to refute the proposition that time alone could significantly change choice of rewards. Subject E participated in the training phase for quite a long time. The postassessment phase began after 40 trials, spanning 9 sessions, since he reached the original 20 second delay criterion. Subject E's data reveals that his responding failed to reach criterion, despite the many training trials and time involved in the experiment. This suggests, that time in a training setting alone is insufficient to account for the change in responding from pre to postassessment, along other delays and with other subjects. Furthermore, the factor Mazur and Logue propose--that the number of trials might account for differences in choice, is an unlikely explanation here because the median number of trials presented to reach criterion during training sessions for Subjects A, B, and C were 5, 4.5, and 4.0 trials, respectively.

Another factor that must be considered when interpreting this study is that subjects did not have the
opportunity to reverse their preferences once they selected a box. The results might have been different had that opportunity been available. It is possible that subjects could have altered their choices from the larger, to the smaller reward during long delays. This irreversibility may have made it easier for subjects to delay. While in this experiment subjects could not change their selection, organisms sometimes have the opportunity to do so in everyday situations. Therefore, for the future it would be important also to assess responding under conditions in which subjects have the opportunity to reverse their selections.

Differences in Studies Using Adult Humans and Pigeons as Subjects

The findings in this study are consistent with those found in investigations employing pigeons as subjects in delay and "self-control" studies (Logue & Mazur, 1981; Logue, Rodriguez, Pena-Correal, & Mauro, 1984; Mazur & Logue, 1978). As did the children, the pigeons frequently chose the smaller, less-delayed reinforcer. Furthermore, after training, the pigeons preferred the larger more-delayed reinforcers. However there is no evidence to support that pigeons would have responded as the children did in choosing delays longer than those
they had experienced during the training sessions.

Other researchers have examined the responding of humans in self-control paradigms, in an attempt to obtain indifference points. Research by Logue, Pena-Correal, Rodriguez, and Kabela (1986) showed that adult human responding tends to follow a maximization strategy, rather than distributing choices by following a matching strategy. Those authors define maximization as the consistent choice of the larger, more-delayed reinforcer (i.e., demonstrating self-control). Logue (1986) suggests that the matching law, which is often used to describe differences in choice behavior, is adequate for descriptive purposes, but inadequate for predictive purposes. Unlike the Logue et al. research (1986), a few other experiments have obtained impulsive responding (and since the responding is impulsive, it is not considered maximized responding) which could fit the matching law better. Impulsive responding was found with children (Burns & Powers, 1975) and in adults using negative reinforcement (Navarick, 1982; Solnick, Kannenberg, Eckerman, & Waller, 1980).

Possible Explanations for the Differences Found Between Responding in Adults, Children, and Pigeons

The differences in the responding of young children
and pigeons, (i.e., failing to "maximize") in comparison to adults, could be due to several factors. The adult subjects in the Logue, et al. (1986) study, who did maximize, worked for points in exchange for money, which could not be spent until after a session was over. The children in the present study received their rewards immediately after a trial was over, making the rewards more salient as reinforcers. Additionally, the children may have been more similar to the pigeons in terms of deprivation. Most childrens' access to rewards is much more limited than that of an adult. If a child wants a sticker or cheese cracker, he usually depends upon an adult to acquire it. In a situation such as in this study, if a child were deprived he/she may have "preferred" the smaller, more-immediate reinforcer, whereas an adult, may have been less deprived, and therefore, opted to wait for a larger reinforcer.

Another factor to be considered, is the likelihood that these subjects responded more impulsively in this specific setting than typical children would have. This is likely, since a criteria for selection was the teacher's identification of the child as behaving impulsively in classroom settings. It is possible that typical children of this age would "maximize" their
reinforcement in this situation. Therefore, future studies should study differences between the responding of children considered typical and those identified as impulsive.

An additional explanation for discrepant adult and child responding may lie in the ability of adults to produce verbal cues. Logue, et al. (1986) suggest this as a reason for the differences obtained between research with humans and nonhumans. As an example, adults in the Logue, et al. study reported that they counted time to find the strategy that would maximize reinforcement. As Logue (1986) notes, the conclusion that verbal behavior could be responsible for the differences found between between species and children and adults, gains support from research performed with humans that shows performance can be affected by instructions or other forms of overt or covert verbal behavior (i.e., Baron & Galizio, 1983; Lippman & Meyer, 1967; Lowe, Harzem, & Bagshaw, 1978; Matthews, Catania, & Shimoff, 1985; Matthew, Shimoff, Catania, & Sagvolden, 1977; Shimoff, Catania, & Matthew, 1981). All of the children in this study had verbal skills, but most were unable to count as high as they would have needed to in order to reach the end of the interval required during the longest delay.
Occasionally a child would try to count accurately but usually stopped after a few numbers and those were often out of sequence (e.g., 1, 2, 3, 5, 40, 13, 5, etc.).

Again, Logue et al. (1986) suggest that adult humans show self-control because they "are sensitive to events as integrated over whole sessions and tend to maximize total reinforcement over whole sessions" (p. 172). If this is an accurate hypothesis, then the strategies, or skills used by the adults to integrate over the sessions must have been acquired through experiences, since children, at least in this study, did not maximize, while in the Logue, et al. research adults did. Some research suggests that developmental differences exist with respect to whether a child will choose to delay reinforcement. The majority of these studies show that older children are more likely to demonstrate self-control ("maximization") in laboratory task situations (Miller, Weinstein, & Karniol; 1978.) The research suggests that the ability to delay increases around five years of age (Mischel & Mischel, 1983). However, as Crooks (1977) reports, differences in the ability to demonstrate self-control are highly related to the magnitude of the reinforcers used in the studies. Also, the ability to delay very likely relates to the level of
verbal sophistication a child has attained. The sample size in this study was too small and the individuals differed in too many ways to note any developmental differences in the results.

**Interpretation of Shift to Greater Self-Control**

There are several possible explanations for why the procedure of gradually increasing delays was effective with some subjects. The variables affecting responding may have been effective singly, or in conjunction with each other. It is likely that the procedure shaped or strengthened behaviors during the delay times. Furthermore, responding may have come under the control of nonverbal stimuli (i.e., indicator lights) and/or verbal stimuli (i.e., rules) within the experiment. The following section details these interpretations.

**Shaping and Strengthening of Intervening Behaviors**

The procedures employed in the present study may have been effective because the larger rewards served as powerful reinforcers to shape and strengthen intervening behaviors during the delays. Previous research with children (Mischel & Ebbensen, 1970; Mischel, Ebbensen, & Zeiss, 1972; Yates & Revelle, 1979) and pigeons (Grosch & Neuringer, 1981) suggests that when alternative responses are available during delay times, organisms will be more
likely to delay. Anecdotal reports indicated that the participants in this study may have "discovered" overt and covert behaviors to perform during delay times, such as, humming, talking to the apparatus, or attempting to take it apart. These unmeasured mediating behaviors have their own schedule of reinforcement. The stimulus consequences of these intervening behaviors may have become reinforcing on their own and by increasing the delays the behaviors may have been shaped and strengthened. If this were so, the choice would no longer have been between an immediate small reinforcer and a delayed large reinforcer, but, between an immediate small reinforcer and reinforcing delay behaviors + a delayed large reinforcer. People perform reinforcing mediating behaviors all the time. Adults in supermarkets often read the covers of magazines while waiting in the check out line. At times they appear more interested in the cover story than in loading their groceries on the check out stand. Generally, when we see people using environmental stimuli to help them tolerate waiting, such as skimming the magazines, we say that they are showing self-control.
**Conditioned Reinforcement**

In their research with pigeons, Mazur and Logue (1981) demonstrated the significance of stimuli used during delay times. The authors examined the consequence of removing delay lights used during the delay intervals. After their removal, the pigeons began to choose the more immediate reinforcers a greater percentage of the time than they had previously. The present study also employed lights during delay intervals. As the rewards consistently followed the lights, it is plausible to assume that the lights functioned as conditioned reinforcers. If so, the nominal delay would be removed, since both lights are immediate. The subjects may prefer the light that is the same color as the box with the greater amount of reinforcement. As Nevin (1973) states "It seems reasonable to expect that the amount of $S^R$ paired with $S_1$ during training will determine the effectiveness of $S_1$ when it functions as $S^C$; "(p. 174).

D'Amato's study (cited in Nevin, 1973) examined the relationship between the magnitude of primary reinforcement and the effectiveness of conditioned reinforcers with rats in a T-maze. During the training trials, they received either five pellets of food in a white goal box, or one pellet in a black goal-box. The
rats were tested after 70 training trials in a T-maze that had a white box on one side and a black box on the other side. During 15 test trials, the rats went toward the white box an average of 8.80 times and 18 out of 20 rats showed a preference for the white box. These results suggest that stimuli paired with larger magnitudes of reinforcement function as stronger conditioned reinforcers than those paired with smaller amounts of reinforcement. In addition, Lattal (1984) has shown that the use of a signal (which may be functioning as a conditioned reinforcer) can aid the maintenance of responding during delay periods. Therefore, the light that was paired with the larger reinforcer may have become an effective conditioned reinforcer.

**Rule-Governed Behavior**

Another possibility, not incompatible with those mentioned above, is that since these children were verbal, they may have been extracting rules after exposure to the contingencies, stating rules overtly or covertly, and then following the rules. In essence, these children may have developed some form of rule-governed behavior in this limited setting. As Palmer (1986) writes, "A rule, then, is an $S^D$ in one contingency whose response term satisfies a second contingency and
which has been presented because of its demonstrated effect in producing the reinforcer of the second contingency." Several of the children in this study tried to describe the contingencies. This was most evident before the procedure changed, when the colors of the box tops remained consistently blue or yellow (blue always contained one reward and yellow always had three rewards) and the delay times were presented in a nonrandom fashion. The children often stated "you have to wait a really long time for the yellow". They also began to ask how long they had to wait for each color during each session. At one point, when the delays were both set at zero during a session, and before the colors and delays were randomized, one child went so far as to tell the experimenter several times during the session that she was making a mistake. The child stated "You're supposed to pull the yellow box back, I have to wait for it a long time." It is possible that the children learned to state the rule that if you wait a longer period of time you will receive a larger reinforcement. Their rules may also have facilitated their learning that what they experienced during the forced-choice trials related to conditions they would experience for the remainder of a particular session, rather than during
previous sessions. However, it is likely that they also developed some inaccurate rules. This may explain why they did not consistently choose the larger reward when both delays were set at zero.

The development of rule-governed behavior may have depended upon the reinforcement of intervening behaviors during the delay times, and/or the establishment of events or stimuli (i.e., the delay lights) as conditioned reinforcers, to mediate the delay times during the intervals. In order for a subject to have derived rules that described the contingencies, (that is, rules that controlled appropriate behavior in those contingencies) it was first necessary for the subject to be exposed to those contingencies and behave appropriately in them. The forced-choice trials may have been sufficient for this purpose. It is more likely, however, that the training procedure was necessary, since it contributed to the acquisition of appropriate behavior (i.e., intervening behaviors) under the control of the multiple discriminative stimuli of the choice situation over repeated sessions. Therefore, the capability of formulating a description about a contingency relationship, and following it, was probably dependent upon being in the choice situation and learning how to
use intervening behaviors during the delays.

**Implications for Teaching Children in Natural Settings**

The results of this study have implications for the treatment of children who tend to frequently respond impulsively and perhaps even for those exhibiting hyperactive behavior and conduct problems in school and home settings. It is important to assess the extent to which the "self-control" learned in this procedure might generalize to other settings. Presumably cross-setting of generalization from this particular procedure would be unlikely because this study was conducted under very circumscribed conditions. Learning to select delayed choices probably was controlled by the presence of the apparatus, the experimenter, the setting, or all three. Nevertheless, the paradigm may well be relevant to actual life experiences. The section below describes several situations.

**Examples of Childrens' Self-Control Situations in Natural Settings**

The majority of choice situations facing children are usually comprised of not only a choice between a more immediate or delayed reinforcer, but one of a different quality also. Although research is also needed on that paradigm, the delay procedure tested in the present study
could be employed in applied settings. An example is offering a child the option of working on math problems for 5 minutes followed by 5 minutes of games on a computer versus 5 minutes of math and 20 minutes on the computer. The time required to do math problems in order to gain access to the 20 minutes with the computer, would be gradually increased. Of course, it is not necessary to have a choice situation. In the classroom, teachers could simply select a target behavior and systematically, gradually increase the requirement based on some aspect of the target behavior (e.g., time involved, number of correct, or pages completed) before the reinforcer is delivered. Clearly, this is analogous to procedures typically used in classrooms.

Another familiar choice situation that children encounter involves continuing to play with less desirable toys until more desirable ones become available. In a classroom, a child could inform a teacher that he wanted to play with a particular toy (the more desirable one) and the teacher could set a timer for a specified duration. When the time had expired, the child currently playing with the coveted toy would then give it to the child who had requested it, provided the latter child was behaving appropriately during the delay. While waiting
for the preferred toy, the child could be redirected to other toys or activities. The delay interval for access to the preferred toy could be gradually increased on the timer.

The present research could be particularly pertinent to teaching children diagnosed hyperactive, or "attention deficit disordered", since impulsive behavior is considered one of their primary deficits (Douglas, 1975). The paradigm could be incorporated within treatment plans for such children, since researchers have postulated that their difficulties lie in their inability to mediate delays in reinforcement. Support for this is provided by research that found that hyperactive children use less self-speech in mediating delayed reinforcement schedules than typical children (Gordon, 1979). Barkley (1976) believes impulsive behavior is a deficit in the development of rule-governed behavior, and states, "In ADDH children, it appears that rules do not come to serve effectively as discriminative stimuli for behavior relative to normal peers, particularly under circumstances of sparse consequences for doing so" (p.20). In designing treatment programs, Douglas (1975) recommends teaching rules and self-verbalization to children. It may be more beneficial, however, to find a
way to teach children how to develop rules, and how to follow them.

Future Research

The results of this study suggest several projects in experimental and applied areas of research. Many of the areas to be explored overlap or influence each other. All involve variables that could possibly make a difference in the success of a treatment program. Furthermore, findings from the applied sector should help determine future directions for experimental research.

Future Experimental Research

Experimental research should explore more closely, what variables were responsible for the effectiveness of the training. First, a more thorough examination of the behaviors occurring during the delay periods is suggested. It seems likely that some behaviors were shaped and strengthened during the delays. Future projects should systematically measure those behaviors and directly manipulate them. An example of such a study, could involve supplying subjects with tasks to perform during delays. This includes, examining the effectiveness of teaching children particular mechanisms (i.e., counting, singing, relaxing) to perform during delays.
Second, the role of conditioned reinforcers \( (S^R) \) and delay behaviors should be investigated. Mazur and Logue (1984) demonstrated the effects of manipulating \( S^R \)s with pigeons. Children's responding is also probably influenced by \( S^R \)s. With humans, however, there may be a greater number and variety of stimuli that come to serve as \( S^R \)s (e.g., an experimenter, an activity, a room). In teaching a child to delay in an applied setting, there is a preference for a number of stimuli to serve as \( S^R \)s. The greater number of accessible stimuli should help promote generalization of appropriate delay behaviors across situations. Researchers could manipulate the accessibility of stimuli available during delays. In addition, they should search for effective reinforcers that are the most likely to generalize and reinforce responding.

It would also be interesting to examine children's ability and accuracy in describing contingencies within the paradigm used here. This should include an investigation of the correspondence of a child's behavior to the rules. If the results of such studies were promising, training programs where children were taught to develop accurate rules from contingencies, and follow them, would be worthwhile. With direct training,
in following rules derived from experienced
contingencies, children may be more likely to follow
them. It would seem necessary, however, that children
would need to "fill" those delay periods with intervening
behaviors, even if they could develop accurate rules.

Another related area that requires investigation, is
teaching children to discriminate between choices where
it is "worthwhile" to choose to delay, and situations
where it is more "profitable" to choose the more
immediate alternative. Delayed choices are not always
optimal, and future research should explore how children
learn to make the best choice, and whether children with
particular repertoires of behavior find this
discrimination more difficult.

Future Applied Research

This study, as well as those described above, has
implications for applied research projects. First,
researchers should determine whom this training is most
likely to benefit. Few training programs are available
for preschool-aged children identified as hyperactive.
Furthermore, the effectiveness of cognitive training (an
approach that has enticed many researchers and teachers)
has failed to be supported by the results of controlled
studies of that method for improving the behavior or
academic skills of such children (Abikoff, 1986). In addition, the common practice of using drug treatment unaccompanied by training, has been called into question, since many professionals working in the field concede that the benefits of stimulants end almost immediately once the drug is discontinued (Douglas, 1975). Training programs incorporating reinforcement of increasing delays in choice situations may be particularly useful in treating such children.

Additionally, this procedure may be valuable as a type of assessment tool for diagnosing children considered to have impulsive behaviors, or attention deficit disorders. It would be useful to examine the correlation between responding on this task and other assessment methods used to identify these children.

The components most relevant to the effectiveness of this procedure in applied settings must be identified. This would include examining such variables as what stimuli or events could be used during delay times in applied settings, how long delays should be for specific activities, to what activities or events the procedure is best suited, how much training is needed, and so on. The maintenance of improved self-control must also be assessed. If maintenance of responding in pigeons is any
indication of how likely the effects of this self-control procedure are to endure, then there is room for optimism. Logue and Mazur's (1981) pigeons continued to choose larger, more-delayed reinforcers 11 months after training. Of course, the research by Mazur and Logue (1984) demonstrated the importance of conditioned stimuli, during the delay interval.

As discussed earlier, generalization is one other aspect of this procedure that requires further exploration. This procedure was performed in a structured setting and probably a child would not readily transfer the skills to another setting. However, if the procedure were implemented, for treatment purposes, in an applied setting, generalization would be more important. But, even in applied settings generalization rarely happens spontaneously. Specific programming is often required. Therefore, it is important to consider what components are necessary to promote generalization. One method that may work would involve setting up artificial situations in an environment where a child would be required to exhibit "self-control". This would be done by having parents and various teachers and children, present opportunities in the home, or during classes, and games, in which choosing to delay would be more liberally
reinforced than selecting less delayed options.

One unexpected result of this study also requires further exploration. In some cases, subjects chose larger rewards under delay periods that were longer than those in the training condition. This indicates that training may have been able to progress faster than it did. The variables that influenced behavior under longer delays should be identified. It may be that the children learned intervening behaviors that were highly reinforcing (i.e., taking apart the apparatus) and that once they learned those, they were capable of waiting for even longer periods of time.

Through probes, the experimenter discovered that children would choose delay periods longer than those in training. The probes could be useful in determining a rate of progression for a training program. A probe session of 4 forced-choice and 4 choice trials could be given throughout training to determine subsequent delays. If this training procedure were to be implemented, probes should be included as a component of the program.

In this experiment, self-control was conceptualized as the choice of larger, more-delayed, over smaller, more-immediate rewards. The purpose of this research, was to determine if a procedure could increase children's
self-control choices in a circumscribed setting. The results demonstrated that in a choice situation, a systematic procedure of gradually increasing delays to larger rewards, can alter the subsequent behavior of preschool-age children, identified as impulsive. However, the variables that accounted for the effectiveness in increasing the selection of greater rewards remain still to be determined.
References


of Massachusetts Medical Center, Department of Psychiatry, Worcester.


Reports, 40, 1215-1219.


Dear Teachers:

I am currently a doctoral student in the Developmental Disabilities Training Program, directed by Dr. Beth Sulzer-Azaroff, at the University of Massachusetts. The purpose of this letter is to communicate my interest in the areas of impulsivity, attention span, and hyperactivity in preschool children. Currently, I am in the process of evaluating self-control procedures in these children (i.e., procedures that may decrease future behavioral and academic difficulties due to impulsivity). Children that would benefit the most from these procedures are those often characterized by parents, teachers, or babysitters as follows:

- Acts before thinking; needs a lot of supervision;
- Frequently calls out in class; and, has difficulty awaiting turns in games or group situations.
- Other descriptions cite the appearance of excitability and low frustration tolerance which may result in temper tantrums and fits over insignificant matters. Some also seem to lack a sense of danger, and disciplinary efforts that are successful with other children fail with them. Difficulties are more likely to show up in a structured play situation.

Enclosed is a typical parent consent form which provides an overview of the study I am conducting. I will follow-up this letter with a phone contact in mid-January to see if you feel any of the children in your program could benefit from the procedures I am investigating. However, if you would like any further information and/or clarifications please do not hesitate to contact me at the following numbers: Office-545-0794 or 545-0683; home-665-3249.

Sincerely,

Julie Schweitzer

p.s. Feel free to disseminate this information to any parents.
APPENDIX B
RECRUITMENT PACKETS FOR PARENTS

UNIVERSITY OF MASSACHUSETTS
AT AMHERST

Tobin Hall
Amherst, MA 01003
(413) 545-2383

Dear Parents:

This note is to inform you of an opportunity to participate in a program teaching 3-5 year old children patience during specific situations. All of us benefit in some circumstances in being patient, and we are interested in finding how children learn to wait. The purpose of this letter is to describe our project and invite you to consider your child’s participation. During our study, children make decisions while playing a game. The procedure consists of the child choosing between boxes, and after a varying amount of time has passed, opening the boxes. Inside the boxes will be objects, such as colorful stickers, that the child may keep. Before we start the game, the parents and child will select these objects. Throughout the session, your child’s behavior will be videotaped for later observation. From the tapes we will record choice of box and other information concerning each youngster’s personal style of behavior seen while passing time and making decisions.

Children that would get the most out of these procedures seem to behave in a certain manner, or be in the following situations, more often than others:

- Acting before thinking
- Frequently calling out in groups and interrupting others
- Not taking turns in games or group situations
- Staying with or completing tasks is difficult
- Lacking a sense of danger at times
- Easily distracted
- Easily excitable and a low frustration tolerance which may result in temper tantrums and fits over insignificant matters
- Disciplinary efforts that are successful with other children fail with them
- Involvement in structured play situations is more difficult

Most children do the things listed above, but children who tend to be in these situations more frequently than others, would gain the most from involvement in this program.

As a way of expressing our appreciation to parents willing to have their children participate, we will be pleased to offer some type of educational activity of the parents’ choice after the completion of the study. This may be in the form of a consultation, lecture, or workshop on the topic of “You and Your Developing Child” or “Child Management Skills”. There is no risk to your child, and you or your child may terminate involvement at any time. We anticipate this project taking approximately 2 months and it will require 4 hours per week of your child’s time. We have found that previous participants have enjoyed this activity immensely.

The University of Massachusetts is an Affirmative Action/Equal Opportunity Institution.
If you would like any further information on the study or wish to arrange a meeting, please call Julie Schweitzer at 545-0794 or 545-0083 (day/evening) or 565-3249 (evening). Thank you very much for your consideration of our project.

Beth Sulzer-Azaroff, Ph. D.
Professor

Julie Schweitzer
Project Director
Informed Consent Form

This research project focuses on teaching children self-control. Many children have a difficult time waiting for large delayed rewards when a smaller more-immediate reward is available. This investigation may help us discover strategies that enable children to wait longer for a larger payoff.

During the project the child and experimenter will sit across from each other at a table. A light will signal the beginning of each trial. During the procedure the child will be asked to choose between 2 boxes. After a changing amount of time has passed, the child will open the box and take out plastic chips that lie inside of it. The chips will be exchangeable for various rewards from an array of the child's choice. The parents, child, and experimenter will select the array of rewards before the study begins. The procedure will then be repeated from 14-28 trials per day. Each session will be recorded on videotape for scoring the choice of the box at a later time.

The project will last for approximately 2 months and would require about 2 hours per week of your child's time. Participation is voluntary and your child will be asked before each session begins if they wish to participate. They will be able to leave the study and session at any time.

This research project will be used by the author as partial fulfillment of requirements for the Master of Science degree, and perhaps presentations at professional conferences and/or publication in professional journals. All records are kept confidential and the participants' names or any identifying characteristics will be kept private. Once it is completed, parents of the participants will receive a summary of the project. If you have any questions regarding this research project please call me at the numbers below.

I have read the above and agree to allow my son/daughter

(child's name)
to participate.

Parent's Signature

Julie Schweitzer-Investigator

Phone: 545-0794
545-0083
Dear Parents:

I am interested in teaching youngsters patience in specific situations. It would help greatly if I could have information about your child in his/her home. I have enclosed a form for you to complete that will give me much of the information I need. This questionnaire will help me determine the effectiveness of my study.

I have also included a list of items that many youngsters enjoy receiving during the sessions. Please check off any items that you think your child would like. If you can think of any others that I have not listed, please place them on that sheet. Thank you very much for your time and cooperation.

Sincerely,

[Signature]

Julie Schweitzer
Items

Paper money
Stickers
Raisins
Popcorn
Marshmallows
Crackers (specify type)
Potato Chips
Cheese Puffs
<table>
<thead>
<tr>
<th>Child's Name</th>
<th>Completed By:</th>
<th>Code</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mother</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Father</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. During meals, is the child up and down at the table?  
2. During meals, does the child interrupt others without regard for what they are trying to say?  
3. During meals, does the child fiddle with things?  
4. During meals, does the child wriggle?  
5. During meals, does the child talk too much?  
6. When watching television, does the child get up and down during the program?  
7. When watching television, does the child wriggle?  
8. When watching television, does the child play with objects or his or her body?  
9. When watching television, does the child talk too much?  
10. When watching television, does the child do things that interrupt others?  
11. Is the child unable to play quietly?  
12. When at play, does the child keep going from one toy to another?  
13. When at play, does the child seek the attention of an adult?  
14. When at play, does the child talk too much?  
15. When at play, does the child disrupt the play of other children?  
16. Does the child have difficulty settling down to sleep?  
17. Does the child get too little sleep?  
18. Is the child restless during sleep?  
19. Is the child restless during travel?  
20. Is the child restless during shopping (including touching everything)?  
21. Is the child restless during church or at the movies?  
22. Is the child restless while visiting relatives?  

*Not Applicable
# APPENDIX C

## CHILD BEHAVIOR CHECKLIST FOR TEACHERS

### CHILD BEHAVIOR CHECKLIST - TEACHER'S REPORT FORM

<table>
<thead>
<tr>
<th>CHILD'S AGE</th>
<th>CHILD'S SEX</th>
<th>RACE</th>
<th>CHILD'S NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Girl</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GRADE</th>
<th>THIS FORM FILLED OUT BY</th>
<th>DATE</th>
<th>SCHOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teacher</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Counselor</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Other (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Parents' Type of Work (Please be specific — for example, auto mechanic, high school teacher, homemaker, laborer, lathe operator, shoe salesman.)

<table>
<thead>
<tr>
<th>FATHER'S TYPE OF WORK</th>
<th>MOTHER'S TYPE OF WORK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I. How long have you known this pupil?

II. How well do you know him/her?  □ Very Well  □ Moderately Well  □ Not Well

III. How much time does he/she spend in your class per week?

IV. What kind of class is it? (Please be specific, e.g., regular 5th grade, 7th grade math, etc.)

V. Has he/she ever been referred for special class placement, services, or tutoring?
   □ No  □ Don't Know  □ Yes — what kind and when?

VI. Has he/she ever repeated a grade?
   □ No  □ Don't Know  □ Yes — grade and reason

VII. Current school performance — list academic subjects and check appropriate column:

<table>
<thead>
<tr>
<th>Academic subject</th>
<th>Far below grade</th>
<th>Somewhat below grade</th>
<th>At grade level</th>
<th>Somewhat above grade</th>
<th>Far above grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>3.</td>
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<td></td>
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<tr>
<td>4.</td>
<td></td>
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<tr>
<td>5.</td>
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<tr>
<td>6.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Thomas M. Asher, Ph.D., University of Vermont, Burlington, VT 05405

129
VIII. Compared to typical pupils of the same age:

<table>
<thead>
<tr>
<th></th>
<th>Much less</th>
<th>Somewhat less</th>
<th>Slightly less</th>
<th>About average</th>
<th>Slightly more</th>
<th>Somewhat more</th>
<th>Much more</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How hard is he/she working?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. How appropriately is he/she behaving?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. How much is he/she learning?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. How happy is he/she?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IX. Most recent achievement test scores (if available):

<table>
<thead>
<tr>
<th>Name of test</th>
<th>Subject</th>
<th>Date</th>
<th>Percentile or grade level obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

X. IQ, readiness, or aptitude tests (if available):

<table>
<thead>
<tr>
<th>Name of test</th>
<th>Date</th>
<th>IQ or equivalent scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

XI. Please feel free to write any comments about this pupil's work, behavior, or potential, using extra pages if necessary

---

PAGE 2
Below is a list of items that describe pupils. For each item that describes the pupil now or within the past 2 months, please circle the 2 if the item is very true or often true of the pupil. Circle the 1 if the item is somewhat true or sometimes true of the pupil. If the item is not true of the pupil, circle the 0.

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Description</th>
<th>0 = Not True (as far as you know)</th>
<th>1 = Somewhat or Sometimes True</th>
<th>2 = Very True or Often True</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2</td>
<td>Acts too young for his/her age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Argues a lot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Fails to finish things he/she starts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Behaves like opposite sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Defiant, talks back to staff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Bragging, boasting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Can't get his/her mind off certain thoughts: obsession (describe:)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Can't sit still, restless, or hyperactive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Clings to adults or too dependent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Complains of loneliness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Confused or seems to be in a fog</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Cries a lot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Fidgets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Cruelty, bullying, or meanness to others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Daydreams or gets lost in his/her thoughts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Deliberately harms self or attempts suicide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Demands a lot of attention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Destroys his/her own things</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Destroys property belonging to others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Difficulty following directions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Disobedient at school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Disrupts other pupils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Doesn't get along with other pupils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Doesn't seem to feel guilty after misbehaving</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Easily jealous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Eats or drinks things that are not food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(describe:)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Feels certain animals, situations, or places other than school (describe:)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 2</td>
<td>Fears going to school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0 = Not True</td>
<td>1 = Somewhat or Sometimes True</td>
<td>2 = Very True or Often True</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------------</td>
<td>--------------------------------</td>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>Physically attacks people</td>
<td>58</td>
<td>Picks nose, skin, or other parts of body (describe):</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>Sleeps in class</td>
<td>60</td>
<td>Apathetic or unmotivated</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Poor school work</td>
<td>62</td>
<td>Poorly coordinated or clumsy</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Prefers being with older children</td>
<td>64</td>
<td>Prefers being with younger children</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>Refuses to talk</td>
<td>66</td>
<td>Repeats certain acts over and over; compulsions (describe):</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Dianaupsclass discipline</td>
<td>68</td>
<td>Screams a lot</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Secretive, keeps things to self</td>
<td>70</td>
<td>Sees things that aren't there (describe):</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>Self-conscious or easily embarrassed</td>
<td>72</td>
<td>Messy work</td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>Behaves irresponsibly (describe):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>Showing off or clowning</td>
<td>75</td>
<td>Shy or timid</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>Excessive and unpredictable behavior</td>
<td>77</td>
<td>Demands must be met immediately, easily frustrated</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>Inattentive, easily distracted</td>
<td>79</td>
<td>Speech problem (describe):</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>Turns blank</td>
<td>81</td>
<td>Feels hurt when criticized</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>Steals</td>
<td>83</td>
<td>Stores up things he/she doesn't need (describe):</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>Strange behavior (describe):</td>
<td>85</td>
<td>Strange ideas (describe):</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>Stubborn, sullen, or irritable</td>
<td>87</td>
<td>Sudden changes in mood or feelings</td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>Sulk a lot</td>
<td>89</td>
<td>Suspicious</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>Swearing or obscene language</td>
<td>91</td>
<td>Talks about killing self</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>Underachieving, not working up to potential</td>
<td>93</td>
<td>Talks too much</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>Teases a lot</td>
<td>95</td>
<td>Temper tantrums or hot temper</td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>Sees preoccupied with sex</td>
<td>97</td>
<td>Threatens people</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>Tardy to school or class</td>
<td>99</td>
<td>Too concerned with neatness or cleanliness</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Fails to carry out assigned tasks</td>
<td>101</td>
<td>Truthful or unexplained absence</td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>Underactive, slow moving, or lacks energy</td>
<td>103</td>
<td>Unhappy, sad, or depressed</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>Unusually loud</td>
<td>105</td>
<td>Uses alcohol or drugs (describe):</td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>Overly anxious to please</td>
<td>107</td>
<td>Dislikes school</td>
<td></td>
</tr>
<tr>
<td>108</td>
<td>Is afraid of making mistakes</td>
<td>109</td>
<td>Whining</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>Unclean personal appearance</td>
<td>111</td>
<td>Withdrawn, doesn't get along with others</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>Worrying</td>
<td>113</td>
<td>Please write in any problems the pupil has that were not listed above:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PLEASE BE SURE YOU HAVE ANSWERED ALL ITEMS
APPENDIX D
IN VIVO DATA SHEET

Name __________________________
Date __________________________

<table>
<thead>
<tr>
<th>Trial</th>
<th>Delay</th>
<th>Reinforcer Amount</th>
<th>Choice</th>
<th>Delay</th>
<th>Reinforcer Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Red)</td>
<td></td>
<td></td>
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APPENDIX E

Behaviors Observed During Preassessment and Postassessment

Subject A

Preassessment
Talking to self
Counting to self
Talking to experimenter

Postassessment
Singing
Moving in chair
Looking through cracks in apparatus
Talking out loud
Picking her nose
Tapping hands on table
Playing games with hands
Whispering to self
Making sounds with mouth
Looking at her fingers
Talking to experimenter
Subject B

Preassessment
Running around room
Talking to experimenter
Unscrewing top of reward box
Playing drums on top of boxes
Tapping top of boxes

Postassessment
Running around room
Blocking reward box from coming out with hands
Bending over in chair
Playing with parts of the apparatus
Sticking tongue through cracks in apparatus
Banging hands on table
Picking nose
Singing
Talking to self
Talking to experimenter
Subject C

Preassessment
Looking around apparatus to look at experimenter
Talking to experimenter
Talking to self

Postassessment
Talking to experimenter
Talking to self
Counting out loud
Looking through delay lights
Touching delay lights and other parts of the apparatus
Subject D

Preassessment
Playing with boxes
Looking through cracks of apparatus
Getting up from chair
Talking to self
Talking to experimenter
Singing
Making sounds with mouth
Putting head down on table
Leaning against apparatus
 Pretending to smoke a cigarette
Holding fingers to imitate a gun
Playing with hands
Scratching self
Closing eyes
Moving feet
Pushing table

Postassessment
Talking to experimenter
Talking to self
Singing
Noises with mouth
Getting up from chair
Head down on table
Playing with chair
Looking at camera
Trying to look through delay lights on apparatus to see experimenter
Preassessment
Talking to experimenter
Talking about stickers
Talking to self
Looking at experimenter through apparatus cracks
Moving fingers

Postassessment
Watching teacher moving around room
Tapping fingers
Turned chair away from apparatus
Singing
Playing games with hands
Touching apparatus
Leaning on table
Talking to experimenter
Talking to self
Assessment

Talking to experimenter
Talking to self
Clicking noises with mouth
Tapping feet
Getting up from chair
Running around room
APPENDIX F

Glossary of Terms

Choice-Differential behavior with respect to two stimuli, manifested by pointing, pecking, verbalizing, or some other response, in the presence of those stimuli.

Crossover point—When the organism switches from choosing the larger, more-delayed reinforcer rather than the smaller, more-immediate reinforcer. The same as an indifference point.

Delay period—The time between the choice response and the delivery of the reward.

Forced-choice trial—A trial consisting of the presentation of one box. These occurred at the beginning of each new session.

Impulsive responding—The selection of smaller, more-immediate reinforcers over larger, more-delayed reinforcers.

Indifference point—See crossover point.

Intertrial interval (ITI)—The time between the onset of successive trials.

Preassessment—An assessment of indifference points consisting of varied delays, before training. The preassessment sessions consisted of presenting four forced-choice trials, followed by 10 choice trials.

Postassessment—An assessment of indifference points consisting of varied delays, after training. The procedure was the same as that during the preassessment.
Matching-A hypothetical model that states that the relative rate of responding equals the relative rate of reinforcement.

Maximization-The consistent choice of larger, more-delayed reinforcers over smaller, more-immediate reinforcers. This is in contrast to a matching model.

No-choice trials-See forced-choice trials.

Self-control-When an organism makes the probability of a response more or less likely by modulating the response's controlling variables. A subcomponent of self-control is responding in a situation in which a choice must be made between alternatives available at the same or different times.

Session-This was composed of four forced-choice trials, followed by ten choice trials. Each phase of the study was composed of several sessions.

Trial-The presentation of a box(es), the selection of a box(es), a delay period, and the presentation of rewards. Each session was composed of four forced-choice and ten choice trials.

Two choice trial-The presentation of two boxes during the selection period of a trial. One box had a single reward while the other had triple rewards.