AN EXPERIMENTAL ANALYSIS OF PREFERENCE PROBLEMS IN A SELF-CONTROL CHOICE PROCEDURE BY ADULTS WITH MENTAL RETARDATION

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The original purpose of this study was to determine if Tegretol has an effect on the impulsive behavior exhibited by people with mental retardation. This was to be accomplished through a replication of the self-control choice procedures used by Ragotzy, Blakely, and Poling (1988). The procedure involved three stages. First, subjects chose between stimuli that provided either one or three edibles. Then the stimuli associated with the smaller and larger edibles were reversed. Following this, the procedure required the implementation of successively longer delays to the larger reinforcer. However, none of the subjects who participated was able to make the discriminations necessary to proceed, i.e., the subjects did not systematically select the stimulus associated with the larger magnitude edible choice. The identification and rectification of these errors in discrimination became the focus of this study. Various procedures were used to enhance discrimination, including fading, adjusting the magnitude of the edibles, and stimulus changes. None of these changes was successful in teaching the subjects the necessary discriminations.
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INTRODUCTION

Over the past several decades, self-control exhibited by humans and nonhumans has been of paramount interest to researchers. Out of this research emerged a standard definition of self-control. Self-control and impulsivity may be viewed as behaviors that lead to opposite outcomes. The process of self-control involves the choice of delayed access to a larger or more potent reinforcer rather than immediate access to a smaller or less potent reinforcer when both are available simultaneously. Impulsive behavior, on the other hand, involves the choice of immediate access to a smaller or less potent reinforcer rather than delayed access to a larger or more potent reinforcer when both are available simultaneously (Ainslie, 1974; Logue, 1988; Rachlin & Green, 1972; Solnick, Kannenberg, Eckerman, & Waller, 1980). Because nonhumans, specifically pigeons, exhibit impulsive behavior in choice situations of this type and because humans tend to exhibit self-control under similar conditions, much of the research has focused on the variables responsible for these differences in responding.

Many studies have been conducted to determine the variables responsible for the impulsive behavior exhibited by pigeons in the self-control paradigm. Green and Snyderman (1980) demonstrated that under a concurrent-chain procedure, pigeons exhibited self-control when the ratio of reinforcement was 3:2 and when the delay associated with the larger reinforcer was three times greater than the delay associated with the smaller reinforcer. However, these authors also
found that when the ratio of reinforcement was 6:1 or 3:1, pigeons behaved impulsively. These authors concluded that one variable that may be responsible for pigeons exhibiting self-control, and not impulsive behavior, is the delay associated with the reinforcer and not the amount of reinforcement. Other studies have demonstrated that pigeons exhibited self-control when the delay associated with the smaller reinforcer was faded out while the delay associated with the larger reinforcer remained the same (Logue, Rodriguez, Pena-Correal, & Mauro, 1984); when the amount of time available associated with the larger reinforcer was too brief to allow consumption of the reinforcer (Hall-Johnson & Poling, 1984); and when a reversal of choice was allowed during the delay associated with the larger reinforcer (Logue & Pena-Correal, 1984).

According to Logue (1988), most studies of humans under choice conditions have demonstrated that subjects will exhibit self-control. An exception to these findings was reported by Solnick, Kannenberg, Eckerman, and Waller (1980) who demonstrated that human subjects behaved impulsively when it served an escape function from aversive noise. Additionally, Logue, Pena-Correal, Rodriguez, and Kabela (1986) found that human subjects behaved impulsively when the contingencies were arranged so that a choice of the smaller, more immediate reinforcer produced a greater overall amount of reinforcement. These authors concluded that one variable that may account for the impulsive behavior observed in pigeons and the self-control observed in humans under similar choice conditions is the use of primary reinforcers with pigeons and the use of conditioned reinforcers with humans. Ragotzy, Blakely, and Poling (1988)
followed up this suggestion and demonstrated that adolescents with mental retardation exhibit impulsive behavior as a function of the amount and the delay of reinforcement when a primary reinforcer (breakfast cereal) was used. An initial preference for the larger reinforcer amount was changed by adding delay increments to that choice until the delay was long enough to generate preference reversal (a switch in preference to the smaller, more immediate reinforcer).

The original purpose of this study was to replicate Phase One of the Ragotzy et al. (1988) study to determine if Tegretol had an effect on the impulsive behavior exhibited by adults with mental retardation. Tegretol (Carbamazepine) is often clinically used for impulse control, but there is little experimental support for this practice. Because the Ragotzy et al. (1988) procedure could produce preference reversal, the plan was to compare subjects' performance in this procedure before and during the Tegretol treatment to see if the drug enhanced self-control preference by altering the point at which preference reversal occurred. A pilot study was initiated to determine whether a modified procedure could produce a more rapid preference reversal. This procedure will be described below because the results altered the entire direction of the thesis research.

To produce impulsive behavior with their subjects, Ragotzy et al. (1988) utilized the following procedures in Phase One of their study. All of the subjects received five sessions of pretraining in which a pointing response was established. This was accomplished by presenting two familiar objects and delivering social reinforcement for touching the requested stimulus. Following pretraining, the
subjects were exposed to a discrimination procedure in which they were presented with two stimuli (a purple circle and a yellow square) where the choice of one produced one edible and the choice of the other produced three. Each session consisted of 10 forced trials followed by 10 choice trials. Forced trials consisted of the presentation of one stimulus and choice trials consisted of the presentation of both stimuli. Initially, the reinforcers were delivered immediately after the subject touched a stimulus. Once the subject reliably chose the stimulus associated with the larger reinforcer, a reversal of stimuli occurred to assure that choice was controlled by reinforcer amount rather than by a stimulus color or shape preference. This reversal consisted of the stimulus associated with the larger reinforcer now being associated with the smaller reinforcer and vice versa. When performance became stable, implementation of the delays began.

Ragotzy et al. (1988) began the delays associated with the larger reinforcer at 5 s and increased the delay by 5-s increments until the subject chose the stimulus associated with the larger reinforcer 20% or less of the trials across three consecutive sessions. The change to this degree of impulsive preference constituted a preference reversal. Ragotzy et al. (1988) reported that it took three subjects 31, 39, and 53 sessions to show preference reversal. Because of time constraints, it would be advantageous for the mentally retarded subjects who participate in this thesis study to reverse their preference sooner than did the Ragotzy subjects. Therefore, the procedure was modified so that 10-s delay increments were used instead of the 5-s delay increments used by Ragotzy et al. (1988).
During this pilot study, it appeared that the subjects were not discriminating between the stimuli associated with the smaller reinforcer and the larger reinforcer when no delays were involved. They did not consistently touch the stimulus associated with the larger amount of reinforcement or they exhibited a position/stimulus bias so the procedure could go no further. Thus, these problems became the focus of the thesis research. Because some or all of the problems might be due to discrimination problems, a review of discrimination learning in the mentally retarded follows.

**Problems in Discrimination Learning by People with Mental Retardation**

The way in which people with mental retardation learn has been of interest to both researchers and practitioners over the past several decades. Inherent in this interest has been a focus on how people with such deficits learn to make discriminations because discriminative behavior is a necessary prerequisite for most learning to occur. Catania (1992) defined the process of discrimination as, "...any difference in responding in the presence of different stimuli" (p. 372). Although Ross (1966) concluded that people with developmental disabilities fail to learn because they are unable to make the necessary discriminations, an alternative view (Olson, 1971; Meador, 1974) holds that they are able to make discriminations but it may be necessary for their behavior to come under the control of variables that are different than those that typically comprise standard learning procedures.

There have been several theories proposed to explain why people with mental retardation have difficulty making discriminations under standard learning
procedures. One such hypothesis is that people with such deficits are unable to make discriminations under standard learning procedures because of stimulus overselectivity. Wilhelm and Lovaas (1976) defined this phenomenon as, "...responding to only a few cues from a range of cues..." (p. 26). Lovaas, Koegel, and Schreibman (1979) further defined stimulus overselectivity as responding to, "...only part of a relevant cue, or even to a minor, often irrelevant feature of the environment" (p. 1237). These authors hypothesized that this population may attend to only one component of a complex task if this attending is enough to produce a sufficient amount of reinforcement.

Several studies have been conducted demonstrating that people with mental retardation fail to attend to all of the relevant stimuli in a learning task. Meador (1984), for example, presented lexigrams on black and various colored backgrounds to men and women with severe and profound mental retardation. During the test trials, this author found that the black background produced learning of the lexigram; whereas, the colored backgrounds produced learning of the colors, thus demonstrating that the subjects had not attended to all of the relevant stimuli in the learning task. Other studies have demonstrated that people with severe mental retardation learned a matching task more efficiently when the stimuli had compound features (McLean, 1978) and through the use of within-stimulus prompts (Wolfe & Cuvo, 1978).

Another theory as to why people with mental retardation fail to learn discriminations under standard learning procedures is that they have difficulty remembering information. Stinnet and Prehm (1970) compared the retention of a
paired-associate task by children with mental retardation and normal children and found that the children with mental retardation not only learned the task at a slower rate than the normal children, but were also unable to remember what they had learned the day before. Ellis et al. (1982) compared the learning of discrimination problems by adults with mental retardation and found that there was a direct correlation between forgetting and IQ level. However, these authors also found that once the lower IQ subjects began to learn the task, their learning occurred at the same rate as the higher IQ subjects. Additionally, Mackie and Mackay (1982) found that although adults with mental retardation attended to two and three relevant features of stimuli that comprised a learning task, the subjects were unable to maintain the discrimination when the component dimensions were increased.

Because the current trend is to teach people with mental retardation to be as independent as possible, there has been a proliferation of research published on how to teach such people to make discriminations and, ultimately, to learn the skills necessary for independence. According to Lancioni and Smeets (1986), the focus of research has been, "...(1) developing new techniques of errorless discrimination training, (2) extending their use over different discriminations tasks, and (3) testing their efficacy with a variety of developmentally impaired (mentally retarded, autistic, and multihandicapped) individuals" (p. 136).

Lancioni and Smeets (1986) justify the use of errorless discrimination training tasks because the use of such procedures allow the learner to make an initial response that easily produces a reinforcer, learning to discriminate is
gradual, and these procedures can be tailored to the individual’s specific learning needs. Etzel and LeBlanc (1979) also recommended using discrimination learning techniques because, "When the procedures are unnecessarily complex, the probability that they will universally or successfully applied by persons with diverse backgrounds and knowledge is reduced" (p. 362). Walls, Zane, and Thvedt (1980) compared systematic training procedures with trainers’ personal methods and found that the most effective learning occurred when the systematic training procedures were utilized.

There are two types of procedures that are typically used to teach discriminations: trial-and-error learning and errorless discrimination training. Etzel and LeBlanc (1979) defined trial-and-error learning as, "...following instructions on how to solve a problem, correct responses to stimulus materials are reinforced and incorrect responses are corrected but not reinforced" (pp. 362-363). In contrast, errorless discrimination training techniques have been defined by Alberto and Troutman (1986) as, "An instructional procedure that arranges discriminative stimuli and prompts to occasion only correct responses" (p. 402).

Several studies have demonstrated that errorless discrimination training procedures produce more efficient learning than trial-and-error procedures. In an early study, Sidman and Stoddard (1967) attempted to teach two groups of severely and profoundly mentally retarded children to discriminate between and ellipse and a circle using either trial-and-error learning or errorless discrimination techniques in the form of stimulus fading. Seven of the 10 children who were taught using the errorless training techniques learned the discrimination; whereas
only one of the subjects who was exposed to the trial-and-error learning techniques learned the discrimination. Other studies have demonstrated that stimulus fading was more effective in teaching developmentally disabled children sight words than trial-and-error learning procedures (Walsh & Lamberts, 1979) and that stimulus fading was more effective than paired association techniques in teaching children with mental retardation reading vocabularies (Dorry & Zeaman, 1975). Additionally, Touchette (1968) demonstrated that stimulus fading techniques were more effective in teaching retarded boys a position discrimination, and that the subjects first exposed to the trial-and-error learning procedures had poorer retention of the discrimination.

As stated, the original purpose of this study was to replicate Phase One of the Ragotzy et al. (1988) study to determine if modifying the delays associated with the larger reinforcer would produce preference reversal in fewer sessions than these authors reported. However, because the subjects in the pilot study did not make the discriminations necessary to implement the delays associated with the larger reinforcer, the purpose of this thesis was to isolate the variables responsible for these errors in discrimination and to rectify these errors using various training techniques.

METHOD

Subjects

The subjects who participated in this study were recruited through Parsons State Hospital, Parsons, KS which serves people with mental retardation. Prior to
the start of the study, a research proposal was submitted to the pertinent research committees and all required consents were obtained.

Four male subjects participated in this study. At the start of the study, the subjects ranged in age from 30 to 40 years of age and had been institutionalized between 15 and 30 years. Subject 1 was considered to have profound mental retardation and Subjects 2, 3, and 4 were considered to have severe retardation. All of the subjects maintained a medication-free status throughout the study.

Apparatus

Because this study replicated, in part, procedures utilized by Ragotzy et al. (1988) to study impulsive behavior exhibited by people with mental retardation, most of the experimental apparatus was identical to the apparatus used by these authors. Because of space constraints, the study was conducted in one of two rooms located in the subjects' home. One room was the recreation room and was 10' by 15' and contained a window, a couch, a television, two chairs and a 36" round table. In this setting, the subjects sat at the table with the experimenter sitting across from them. The second room was the subjects' bedroom and contained four beds and four dressers. The subjects sat in a folding chair at a 2' by 4' table with the experimenter sitting across from them. For Subject 1, sessions 1 through 6, 10, 16, and 19 through 36 were conducted in the first room and sessions 7 through 9, 11 through 15, 17, 18, and 37 through 72 were conducted in the second room. For Subject 2, sessions 1 through 10, 12 through 21, 23 through 27, 30, 33, and 35 were conducted in the first room and sessions 11, 22, 28, 29, 31, 32, 34, 36, and 37 through 65 were conducted in the second room. For Subject 3,
sessions 1 through 15, 18 through 20, 22, 23, and 27 were conducted in the first room and sessions 16, 17, 21, 24 through 26, and 28 through 56 were conducted in the second room. For Subject 4, sessions 1, 2 through 15, 17, and 21 were conducted in the first room and sessions 16, 18 through 20, and 22 through 30 were conducted in the second room.

The subjects responded by touching either a purple circle (14 cm diameter) or a yellow square (14 cm on a side) which were 9 cm apart on a white paper card (24 cm by 40 cm). During the trials, the card was centered 15 cm in front of the subject as indicated by small pieces of tape on the table. However, during discrimination training for Subjects 2 and 3, the card was placed flat on the table with the front edge of the card being 15 cm in front of the subject.

During each session, the experimenter placed a 5" by 3" plastic timer box and the edible reinforcers on a chair under the table out of sight of the subject. In the second setting, these materials were placed in a storage area of the table which faced the experimenter and was out of the subject's view. The timer box indicated delays in 1-s increments up to 99 s through the activation of a green light. This light was activated when the experimenter depressed a button and terminated when the preset delay elapsed. Part of the way through the study the timer began to malfunction and a digital watch was used to time the delays and the intertrial intervals. The digital watch began to be used during session 26 for Subject 1, during session 20 for Subject 2, during session 12 for Subject 3, and during session 9 for Subject 4. Data were recorded on data sheets scored by the experimenter during each session.
The experimenter escorted each subject to the experimental room. All materials were set up prior to the subject entering the room. The experimenter interacted with the subject only through a verbal prompt to choose a stimulus and through the delivery of a reinforcer. Additionally, when Subject 1 left his seat, he was verbally prompted to sit down. All of the subjects were initially exposed to the procedures used by Ragotzy et al. (1988) in Phase One of their study. However, during the discrimination training phase (choice between stimuli associated with either one or three edibles with zero delays), procedures were revised as necessary to implement the delay phase. The procedures and results will be discussed together in the next section because of the number and reasons for the procedural changes.

**PROCEDURES AND RESULTS**

**Edible Preference Test**

Prior to the start of the study, all of the subjects were given 20 choice trials to determine preferred edibles. This procedure consisted of 20 trials of four edibles with each edible presented in a quasi-randomly determined position for each trial with no edible appearing in any one of the four positions for more than two consecutive trials. Each trial began with the experimenter placing the four edibles in the appropriate positions and telling the subject to "pick one." The subject selected an edible by picking one up. If a subject tried to take more than one edible, the experimenter blocked his hand and stated "only one." During the sessions, all of the edibles were immediately consumed. For Subjects 1 and 2, the
the four edibles were Skittles, M&Ms, cheeseballs, and Cocoa Puffs. For Subjects 3 and 4, the edibles were M&Ms, cheeseballs, Cocoa Puffs, and 1" chocolate chip cookie squares (staff reported that these were preferred edibles for these subjects). A preference for a particular edible was considered demonstrated when a subject chose one edible 70% of trials or more. Subject 1 was exposed to these procedures once prior to the start of the study and chose cheeseballs 70% of the trials. Subject 2 was exposed to these procedures once prior to the start of the study and chose Skittles 90% of trials and M&Ms 10% of the trials. Skittles were used during pretraining but because it took too long for the subject to chew these, the edible was switched to M&Ms for the rest of the study. Subject 3 was exposed to these procedures once prior to the start of the study and chose cookies 80% of the trials. Subject 4 was exposed to these procedures twice prior to the start of the study and chose cookies 40% and 70% of the trials, respectively.

Pretraining

All of the subjects received pretraining until they were able to make the correct response of pointing to one of two stimuli presented simultaneously 100% of trials across two consecutive sessions. Subject 1 received four sessions of pretraining and Subjects 2, 3, and 4 received two. During this condition, a session consisted of 20 trials. Two familiar objects (paper cup and keys) were placed on the table and the subject was asked to put his hands down, to look at the experimenter, and to point at one of the two objects ("point to the keys" or "point to the cup"). Verbal praise was delivered for a correct response and correction was used for an incorrect response. Because the subjects received edibles during
the first phase of the study, the subjects received the same edibles on the way to
and on the way back from the experimental room during this condition. This
served to demonstrate that the edibles were desirable and would be consumed by
the subjects in a different setting. This made it appear plausible that the edible
would function as a reinforcer in the experimental setting.

**Zero Delay Choice Phase**

Once pretraining was completed, the subjects were exposed to the
experimental procedures designed by Ragotzy et al. (1988). Although this phase
involved a preference procedure, it also utilized trial-and-error learning
procedures. That is, under this procedure, responding to either stimulus produced
reinforcement although the choice of one of two stimuli produced a greater
number of edibles. For Subjects 1 and 4, the stimulus associated with the larger
reinforcer was the purple circle and for Subjects 2 and 3, it was the yellow square.
All of the sessions were conducted once a day between 4:00 and 5:00 p.m.
between four and seven days a week. However, because of difficulty in subject
availability during this time, the time was switched to between 2:00 and 3:00 p.m.
beginning with session 36 for Subject 1, session 32 for Subject 2, session 32 for
Subject 3, and session 15 for Subject 4. Subjects usually received a snack between
2:00 and 3:00 p.m. and dinner was normally scheduled for 5:00 p.m. None of the
subjects received their snack until after they had participated in the experiment
for the day.

Initially, each session consisted of 20 trials, 10 of which were forced trials
and 10 of which were choice trials. During the choice trials, the white paper card
containing the stimuli was placed in front of the subject. The location of the purple circle and the yellow square varied quasi-randomly with no stimulus appearing on the right or on the left for more than two consecutive trials. After the card was presented, the subject was verbally prompted to "pick one" concurrent with the card presentation. During the forced trials, one stimulus was available with the other being covered with a white sheet of paper. Once the subject touched the stimulus, the response card was removed and the reinforcer was immediately delivered.

The 10 choice trials immediately followed the 10 forced trials. Choice trials were identical to forced trials except that both stimuli were presented simultaneously. During this condition, one or three edibles were delivered immediately contingent upon a subject's choice of stimulus. This condition was to remain in effect until stability was achieved. Stability was defined as choosing the larger reinforcer 80% or more of the choice trials while not varying more than 10% across five consecutive sessions.

Intertrial intervals were utilized. Intertrial intervals were 10 s if the stimulus associated with the larger reinforcer was selected. However, if the stimulus associated with the smaller reinforcer was selected, the intertrial interval was 10 s plus the amount of the current delay of the larger reinforcer. The intertrial interval length was increased from 10 s to 20 s for Subject 3 at the start of session 35 and at the start of session 5 for Subject 4 because they were still consuming the edibles through the intertrial intervals.
Additionally, Subject 4 crumbled the cookies and then consumed them. During session 6 the experimenter wiped the crumbs away which resulted in the subject not consuming the majority of the edibles. During session 7, the edibles were presented on a paper plate and the subject consumed the cookies without crumbling them. Using a paper plate with this subject remained in effect throughout the rest of the study.

**Stimulus Reversal and Delayed Choice Phase**

Following the zero delay choice phase, the stimuli were to be reversed so that the stimulus associated with the larger reinforcer would be associated with the smaller reinforcer and vice versa to demonstrate control by the stimulus associated with the greater magnitude of reinforcement. Again, all reinforcer deliveries were scheduled for immediate delivery until the stability criterion defined above was met. Once that occurred the larger reinforcer was to be delayed by the addition of 10-s increments until 20% or fewer choices were made toward the stimulus associated with the larger reinforcer for three consecutive sessions. At this point, preference reversal would have been demonstrated.

All of the subjects were exposed to the zero delay choice phase. Because the experimental procedures that were utilized for the subjects following this phase differed, procedures for each subject will be discussed separately.

Data were collected during each session by the experimenter on a printed data sheet immediately following each response made by the subject. Data were collected on each choice of stimulus that the subject made for each trial, the delay of reinforcement delivery for the trials, and the length of the intertrial intervals.
for the session. The percentage of choices directed toward the stimulus associated with the larger reinforcer was calculated for each session.

**Subject 1**

The data for Subject 1 are presented in Figure 1. This subject was unable to meet the stability criterion in the zero delay choice phase across 22 sessions. At the start of session 19, the three edibles associated with the larger reinforcer were delivered one at a time instead of all at once to enhance the discriminability of the reinforcer magnitudes. This procedure was in effect for the rest of study except for sessions 23 through 25. During these sessions, the subject was given 20 choice trials of edibles only; no choice stimuli were used. The ratios of small to larger reinforcer amounts were 1:3, 1:6, and 1/2:3 for sessions 23, 24, and 25, respectively. Under these conditions, the subject chose the larger amount of edibles 0%, 10%, and 0% of the choice trials. The subject was still unable to meet the stability criterion in sessions 26 through 33. During sessions 35 through 37, the subject chose the stimulus associated with the larger reinforcer 70% of choice trials. Although this responding was below the defined criterion, this appeared to be the highest and most consistent preference that this subject would exhibit.

In the next phase, choice of the stimulus associated with the larger reinforcer produced a 10-s delay in the delivery of the reinforcer while the choice of the stimulus associated with the smaller continued to produce immediate reinforcement. Although the subject chose the stimulus associated with the larger
reinforcer 40% of choice trials across three consecutive sessions (38-40), he did not meet the criterion for initiating the preference reversal phase.

During the delay, the subject often left his seat and rummaged through drawers and exhibited self-stimulation by manipulating objects he found in the experimental room. Although the experimenter delivered verbal prompts for the subject to sit down, he did not comply until the experimenter signaled the beginning of the next trial by holding up the card containing the stimuli.

The delay was then increased to 20 s for the next five sessions (41-45) and the subject chose the stimulus associated with the larger reinforcer between 40 and 60% of choice trials. Again, the subject either left his seat or exhibited self-stimulation during the delay. Following this, a return to the zero delay choice phase was implemented and the subject was still unable to meet the defined stability criterion in 11 sessions (46-56).

For the next four sessions, the delay associated with the larger reinforcer was 5 s. During this and following conditions, the subject continued to leave his seat or to exhibit self-stimulation during the delay. The subject chose the stimulus associated with the larger reinforcer 70% or more of choice trials.

The delay was then increased to 10 s and the subject chose the stimulus associated with the larger reinforcer 30% or more of choice trials. The last phase of this study consisted of the delay being increased to 15 s. Under this condition, the subject chose the stimulus associated with the larger reinforcer 60% of choice trials. Because the experimenter had to leave the state, the experiment was terminated at this point for this subject.
Figure 1. Preference of Subject 1 for larger reinforcer across sessions.

Seven days following the completion of Subject 1’s participation in the experimental procedures, an edible preference test was given which used the procedures described previously. The subject chose cheeseballs 50% (more than any other single edible) of the trials whereas he had previously chosen cheeseballs 70% of the trials.

**Subject 2**

The data for Subject 2 are presented in Figure 2. This subject did not reach criterion performance in the zero delay choice phase. In the next phase, the zero delay choice procedures remained in effect but the multiple edibles that comprised the larger reinforcer were delivered one at a time rather than all at once. This occurred during sessions 15 and 16 for Subject 2. The subject chose the larger reinforcer only 40% of the choice trials, and this suggested the possibility that he was not discriminating between one and three edibles. Following this phase, there were six sessions (17-22) during which Subject 2 was presented with 20 choice trials of one or three edibles (without the stimuli) to determine if he was able to discriminate between one and edibles. The subject chose the larger reinforcer 80% or less of trials. During the last session of this phase, Subject 2 chose stimuli on the right side 100% of choice trials. Because Subject 2 was not responding discriminatively between one and three edibles, he received four sessions of 10 forced trials and 10 choice trials of the edibles being presented without the choice stimuli. During the forced trials, only three edibles were available and during the choice trials one and three edibles were available. Under these conditions, the subject appeared to have learned the discrimination
as he chose the larger amount of edibles 100%, 80%, 100%, and 80% of choice trials.

Following these procedures, Subject 2 was exposed to errorless discrimination training techniques in the form of stimulus fading. The purpose of this phase was to train control by the choice stimuli. The first portion of this condition consisted of the card being placed flat on the table with the edibles being placed directly on top of the choice stimuli until the subject chose the stimulus associated with the larger reinforcer 90% or more of choice trials for three consecutive sessions. Subject 2 met this criterion after 10 sessions. During the ninth session (session 35) of this procedure, the intertrial interval was increased from 10 s to 20 s as the subject was consuming the edibles through the intertrial interval. The 20-s intertrial interval remained in effect throughout the remainder of the study.

The next portion of the fading procedure consisted of placing the edibles on the card 2 cm directly behind the stimuli. Subject 2 met the defined criterion in three sessions (37-39). The subject then received 3 sessions of the edibles being placed in the experimenter's open hands 12 cm directly behind the stimuli. Subject 2 met the defined criterion in three sessions (40-42). Following this condition, the edibles were again placed out of sight until a response had occurred. Under this condition, the subject was unable in nine sessions to meet the criterion necessary to implement the delay. In fact, in 40% of these sessions, the subject chose the stimulus on the right side 100% of choice trials which further served to demonstrate that he was not making the desired discriminations or was under the
control of different variables. Following this condition, the edibles were placed in the experimenter's open hands which were placed directly over the stimuli. Subject 2 met the stability criterion in 8 sessions (52-59).

Because of time constraints, it was decided to implement a delay of 5 s if the subject chose the stimulus associated with the larger reinforcer. This phase was implemented during sessions 60 through 63 for Subject 2. During this phase, the experimenter continued to present the edibles in her open hands directly over the stimuli concurrent with the presentation of the stimuli. Whichever stimulus the subject chose during the choice trials, the experimenter closed the hand holding the reinforcer associated with the opposite stimulus. The criterion for demonstration of preference reversal was no more than 20% of choices directed toward the larger delayed reinforcer for three consecutive sessions. Subject 2 was unable to meet the defined criterion in four sessions. An increasing trend of preference for the stimulus associated with the larger reinforcer was noted, so the delay was increased to 10 s during sessions 64 and 65. Because the experimenter had to leave the state, the experiment was terminated at this point for this subject.

Six days following the completion of Subject 2's participation in the experimental procedures, an edible preference test was given which used the procedures described previously. Although Subject 2 had chosen Skittles 90% of trials and M&Ms 10% of trials prior to the start of the study (M&Ms were used because it took the subject too long to chew the Skittles), he chose cheeseballs 100% of trials during the edible preference test.
Figure 2. Preference for Subject 2 for larger reinforcer across sessions.

Subject 3

The data for Subject 3 are presented in Figure 3. Subject 3 did not reach criterion performance in the zero delay choice procedures. In the next phase, the zero delay choice procedures remained in effect with the edibles of the larger reinforcer being delivered one at a time instead of all at once. This occurred during sessions 7 and 8 for the subject. It appeared that Subject 3 was either not discriminating between one and three edibles or that he preferred the smaller amount of edibles or that he preferred the purple circle as he chose the stimulus associated with the larger reinforcer 0 and 10% of choice trials. Following this phase, Subject 3 was presented with 20 choice trials of one or three edibles without the stimuli to determine if he was able to discriminate between one and three edibles (session 9). The subject chose the larger reinforcer 90% of choice trials which demonstrated that, under these conditions, he was able to discriminate between one and three edibles and appeared to prefer the larger amount of edibles.

Subject 3 was then exposed to the errorless discrimination training techniques used with Subject 2. In session 10 the card was placed flat on the table with the edibles placed directly on top of the choice stimuli. Subject 3 received only one session (session 10) under this condition, and he chose the stimulus associated with the larger reinforcer 100% of choice trials.

The next portion of the fading procedure consisted of placing the edibles 2 cm directly behind the stimuli on the card. Subject 3 met the stability criterion in eight sessions after some initial disruption in performance. The next phase for
Subject 3 consisted of the edibles being placed on the table 8 cm directly behind the stimuli (19-21). The subject met the stability criterion in three sessions. Subject 3 was then exposed to conditions where the edibles were placed in the experimenter's open hands 12 cm directly behind the choice stimuli. Because the subject had begun to attempt to take the edibles without first touching a stimulus, during the ninth session of this portion of the fading procedure the experimenter verbally prompted him to wait 5 s prior to making a response once the stimuli had been presented. This change, made in session 31, remained in effect for the remainder of the experimental procedures. The subject was unable to meet the stability criterion in 19 sessions.

The next portion consisted of Subject 3 being presented with the edibles in the experimenter's open hands which were placed directly over the appropriate stimulus. Subject 3 was unable to meet the stability criterion in nine sessions. Because of time constraints, it was decided to implement a delay of 5 s if the subject chose the stimulus associated with the larger reinforcer. This was implemented during sessions 50 through 53 for Subject 3. During this phase, the experimenter continued to present the edibles in her open hands directly over the stimuli concurrent with the presentation of the stimuli. Whichever stimulus the subject chose, the experimenter closed the hand holding the reinforcer associated with the opposite stimulus. The criterion for preference reversal to be considered demonstrated was no more than 20% of choices directed toward the larger reinforcer for three consecutive sessions. Subject 3 was unable to meet the stability criterion so the delay was increased to 10 s for session 54 through 56.
Figure 1. Preference of Subject 3 for larger reinforcer across sessions.

Subject 3 did not meet the stability criterion. Because the experimenter had to leave the state, the experiment was terminated at this point for this subject.

Six days following the completion of Subject 3’s participation in the experimental procedures, an edible preference test was given which used the procedures described previously. The subject chose cheeseballs 100% of the trials where previously he had chosen cookies 80% of the trials.

Subject 4

The data for Subject 4 are presented in Figure 4. This subject was able to meet the criterion necessary to implement the stimulus reversal. In the stimulus reversal phase, the choice stimuli associated with the reinforcers were switched. However, during the stimulus reversal phase, it became evident that the subject's behavior was under the control of either the color or the form of the choice stimuli because he chose the stimulus associated with the larger reinforcer 10% or less of the choice trials. That is, he kept choosing the same stimulus even when it switched from producing three edibles to one edible.

Prior to the stimulus reversal, the stimulus associated with the larger reinforcer was the purple circle. To determine if this subject was responding under the control of a color or a form preference, the next phase consisted of the presentation of a yellow circle which was associated with the larger amount of reinforcement and a purple circle which was associated with the smaller amount of reinforcement. Under this condition, the subject chose the stimulus associated with the larger reinforcer 100% of choice trials for six consecutive sessions. Because it appeared that the subject was under the control of form and not under
the control of color, the next phase of the study consisted of the subject being presented with a black circle and a white circle on a red background. Under this condition, the choice of the white circle produced three edibles and the choice of the black produced one. Under these procedures, the subject chose the stimulus associated with the larger reinforcer 100%, 60%, and then 50% of choice trials for four consecutive sessions. The subject appeared to have developed a position bias during this condition as during the last five sessions of this phase, he chose right side stimuli 90% then 100% of choice trials. To confirm that the subject had developed a position bias, the next phase consisted of the choice of the black circle producing zero edibles with the choice of the white producing three. Under these conditions, the subject chose right side stimuli 100% of choice trials for four consecutive sessions. Because the subject's behavior failed to come under the control of the reinforcers, he was dropped from the study.

Eleven days following the completion of Subject 4's participation in the experimental procedures, an edible preference test was given which used the procedures described previously. The subject chose cheeseballs 40% and cookies 20% of the trials in contrast to prior to the start of the study where he chose cookies 40% then 70% of the trials. Another edible preference test was given 25 days following the subject's exposure to the experimental procedures and he chose cheeseballs 40% of the trials.
Figure 1. Preference of Subject 4 for larger reinforcer across sessions.

A = zero delay choice phase. B = Stimulus reversal. C = Yellow circle = three edibles and purple square = one edible. D = White circle = three edibles and black circle = one edible. E = White circle = three edibles and black circle = zero edibles.
DISCUSSION

Subjects 1, 2, and 3 had difficulty meeting the stability criterion under the zero delay choice condition. Subject 4 also had difficulty because his responses were based on a shape preference. These results differ from the Ragotzy et al. (1988) study where no problems were reported with their retarded subjects. One difference between their subjects and the subjects who participated in this study was that the subjects who participated in this study were all adults all over the age of 30. Level of retardation, however, did not significantly differ as all of Ragotzy et al. (1988) subjects had severe mental retardation and two out of the three subjects (Subjects 2 and 3) who had difficulty with the zero delay choice condition in this thesis were considered to be severely mentally retarded. Subject 1, however, was considered to be profoundly mentally retarded which may account for the differences in his responding.

All of the subjects who participated in this study may have had difficulty under the zero delay choice phase because of the edibles that were used as reinforcers. These edibles may not have been potent enough or the ratio of 3:1 may have been too small. Even when Subject 1 was briefly exposed to a ratio of 6:1, however, he did not prefer the larger quantity. Although an effort was made to avoid conducting the sessions after the subjects had eaten, the sessions were still conducted within six hours of the last meal. Additionally, the home where
these men lived used edible reinforcers at a high rate and these subjects were observed on several occasions being given small amounts of edibles every 15 minutes or so prior to and after sessions.

Although an edible preference test was given prior to the start of the study, this test did not allow for the demonstration that a given edible was functioning as a reinforcer. All this test served to do was to demonstrate that out of a pool of four edibles, a subject seemed to prefer one over the others. In fact, when edible preference tests were given after the completion of the experimental procedures, Subjects 2, 3, and 4's preferences had switched to other edibles. If the edibles used in the study were not functioning as reinforcers or if the preference for the edibles decreased over the course of the study, the effect on responding under the zero delay choice condition would be negative.

One solution to this problem would be to run edible preference tests throughout the study. Another solution would be to actually determine if a given edible will function as a reinforcer. This could be accomplished by presenting a task and measuring the rate of responding using a particular edible as a reinforcer. Because it cannot be determined if these edibles were functioning as reinforcers or the point at which Subjects 2, 3, and 4 apparently switched their preference, some of the variability in responding could be attributed to weak reinforcers. If the edibles were weak reinforcers, this may account for the development of stimulus control over choice by irrelevant features such as the shape or position of the choice stimuli. Subject 4, for example, showed a shape bias by choosing the circle stimulus. When both choices became circles, he
developed a position bias. The fact that choice of either stimulus produced edibles would have contributed to the problems observed under the zero delay choice condition.

Another reason why three of the subjects who participated in this study had difficulty in the zero delay choice phase is because they might have been unable to make the necessary discriminations. Even when the edibles were delivered one at a time under the zero delay choice phase, Subject 1 consistently chose the stimulus associated with the larger reinforcer 70% of choice trials. Although Subjects 2 and 3 improved their discriminations when the stimulus fading techniques were implemented, neither subject was able to maintain the discrimination when the stimuli were again placed out of sight (Subject 2) or when the stimuli were moved 12 cm away from the choice stimuli (Subject 3).

This problem may have occurred because the procedure required the subjects to make two distinct discriminations. The first was magnitude of reinforcement. These subjects were exposed to a 3:1 edible ratio which is the same used by Ragotzy et al. (1988). Although Subject 1 was briefly exposed to different magnitudes of reinforcement, he did not make the necessary discriminations. This variable should have been examined more in depth to determine whether larger ratios of reinforcer magnitude would have made a difference. The second discrimination was between the choice stimuli. The use of choice stimuli that were compounds of color and shape provided subjects with the potential to develop bias to either dimension. At a minimum, an improved procedure should restrict the choice stimuli to one dimension.
Given mentally retarded people's tendency to respond to selected dimensions of compound stimuli (Lovaas, Koegel, & Schreibman, 1979; Wilhelm & Lovaas, 1976), the choice format used by Ragotzy et al. (1988) and in this study seems likely to produce this problem. The choice stimuli for Subject 4 were changed to a black circle and a white circle late in the experiment. It appeared that the shape bias was so strong by this point in the experiment, and the control by magnitude of reinforcement so weak, that this procedure change was ineffective and led to indifference. Perhaps if the experiment had started with stimuli differing in one dimension only, the results would have been different. In this light, it seems puzzling that Ragotzy et al. (1988) reported no problems with this procedure.

The fading procedure used with Subjects 2 and 3 was effective in generating discrimination with respect to the stimulus associated with the larger reinforcer only in the initial fading steps. Later steps in which the food was removed from the choice stimuli led to deterioration in preference. Perhaps an improved fading procedure with more gradual steps would have improved performance. It is also possible that exposure to the trial-and-error learning procedures in the initial zero delay choice phase may have had a negative impact on performance under the errorless discrimination condition (Touchette, 1968).

These problems in the zero delay choice phase left very little time for the delayed choice phases. Subject 1 had the most exposure to the delayed choice. A 10-s delay to the larger reinforcer did lead to an impulsive preference, but a 20-s delay produced a paradoxically greater self-control preference. This may have
occurred because the subject was able to produce an alternative form of reinforcement by engaging in self-stimulation during the delays. Exposure to the delays to the larger reinforcer of 5 or 10 s for Subjects 2 and 3 was very brief. It is hard to interpret the results for Subject 2, but Subject 3 engaged in a high degree of impulsive choice under both conditions. Had time permitted, more sessions under these conditions might have led to impulsive preference that was large enough to meet the criterion for preference reversal.

Several weaknesses in the conduct of this study must be acknowledged. Some phases were not run to stability or phases were concluded without the defined criterion being met. In retrospect, if stability had been allowed to occur or the criterion never violated, this study may have been stronger experimentally which may have directly had an effect on the results obtained. For example, Subject 1 was only exposed to different magnitudes of edibles for a session at a time. It would have been advantageous to run these phases until stability was achieved. If stability had been achieved, I would have been able to determine if any of these magnitudes enhanced the discrimination or if different magnitudes or additional training was needed in order for the subject to demonstrate the discrimination. Subject 3 was only exposed to two sessions of the edibles being delivered one at a time, and one session of edibles only. These phases should have continued until a defined criterion or stability achieved. Additionally, Subject 3 received only one session of the first phase of the fading condition and his responding may have remained at the same rate or decreased if more sessions had occurred. If his responding had decreased, perhaps the later fading steps
would have been more gradual. It is also difficult to determine if Subject 2 and Subject 3 would have reversed their preference to criterion during the stimulus fading because the phases were too short.

Perhaps the most important error made was not implementing the stimulus reversal phase prior to implementing the delays for Subjects 1, 2, and 3. If this had occurred, as it had for Subject 4, it would have been possible to determine what variables were controlling the subjects' behavior. If these problems were evident, additional training procedures could have been introduced prior to implementing the delays. Unless the subjects' behavior was clearly under the control of both magnitude of reinforcement and the stimulus reinforcer relationship, a reversal in preference under the delay may not have been an indication of impulsive behavior.

In summary, the difficulties with the choice procedure proved largely intractable. Various changes and adjustments were made with little success. Further investigation would be necessary to isolate the causes of all of the problems. If these could be remedied, then and only then could research proceed to the original experimental question: whether Tegretol has any effect on impulsive behavior in a choice paradigm.
REFERENCES


