INVESTIGATION OF SELF-MONITORING INTERVENTIONS ON INDEPENDENT PERFORMANCE OF MATH WORKSHEETS BY CHILDREN WITH ATTENTION-DEFICIT HYPERACTIVITY DISORDER

A THESIS

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ABSTRACT

The purposes of this two-experiment study were to (a) assess the influence of reinforcer dimensions (rate, quality, immediacy, and response effort) on the academic choices of 2 students with ADHD, and (b) to examine the differential effectiveness of the most influential versus the least influential dimensions in an intervention used with self-monitoring procedures to increase academic accuracy, rate, and on task behavior. In study 1, I examined the students’ choices between two concurrent response alternatives with varying dimensions. Reinforcer dimensions of rate, quality, effort and immediacy were presented in competition with one another. Results showed that choices were consistently influenced by impulsivity and reinforcer quality (i.e., quality and immediacy for Mallory; for Milton, quality and low effort (suggesting impulsivity because of the shorter delay in receiving answer feedback). In study 2, I examined the effectiveness of a self-monitoring intervention based on the assessment of most and least influential reinforcer dimensions in improving the students’ academic accuracy, rate, and on task behavior during independent math seat work. For Milton, we compared low effort (most influential), low rate (least influential) to high effort, high rate and for Mallory, we compared high quality (most influential), high effort (least influential) to low quality, low effort problem completion. Each participant completed a packet of math facts,
self-checking as they worked, and upon completion, recorded the number correct, incorrect, total number problems attempted, and points earned on a data recording sheet. Results for both students showed both interventions produced an improvement in academic accuracy, rate, and on task behavior relative to baseline.
I would like to dedicate this thesis to my husband, James “Steele” Armstrong, whom I love dearly and who has been very supportive throughout this project.
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CHAPTER 1

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) refers to a family of related chronic neurobiological disorders that interfere with an individual's capacity to regulate activity level, inhibit behavior, and attend to tasks in developmentally appropriate ways. The primary behavioral characteristics that define attention-deficit/hyperactivity disorder (ADHD) in children are hyperactivity, impulsivity, and inattention (American Psychiatric Association, 1994). Hyperactivity is defined as excessive inappropriate physical motion or activity. Children exhibiting this characteristic always seem to be in motion, can't sit still, may talk nonstop, and may feel very restless. Impulsivity involves actions without regard to the consequences. Children with this characteristic often act before they think things through. For example, they may blurt out answers, run into the street without looking, or be impatient in waiting their turn. The term inattentive describes persons who are easily distracted and who have trouble paying attention and focusing on what is important in a situation. Distractibility is the extent to which a person's attention is diverted by extraneous stimuli.
Review of the literature

Children with ADHD often experience difficulty keeping their attention on tasks, especially those that are repetitive and require a lot of time. In a comparison of the motivational styles of 38 children with ADHD and 25 normally functioning children, Carlson, Booth, Shin, and Canu (2002) found that the children with ADHD demonstrated motivational problems. The children with ADHD preferred easy work, less enjoyed learning, and had less persistence than the control group.

Mathematics is an academic area in which students with ADHD often have difficulty keeping up with their normal functioning peers. Math achievement for students with ADHD is usually lower than that of their peers. (Barkley, DuPaul, & McMurray, 1990; Marshall, Hynd, Handwerk, & Hall, 1997; Zentall & Ferkis, 1993). Zentall (1993) reported that students with ADHD demonstrated slower computational and visual motor speed when calculating math problems, which directly affected the number of problems they attempted. Zentall and Ferkis (1993) found that the performance of students with ADHD and learning disabilities (LD) was slower and less accurate ($M=68\%$ correct) relative to that of typically developing peers ($M=80\%$ correct). This study also found that if basic computational skills were mastered to an automatic level, students were then able to direct their attention to the more complex mathematic operations. Two problem areas in math for students with ADHD are accuracy and rate. Students with ADHD who have deficits in math may begin to demonstrate off-task, disruptive behavior which may not only affect their own performance, but also negatively impact the performance of those around them.
"The disruptive behavior displayed by students with ADHD frequently interrupts the concentration of their peers and often results in poor peer relations. In addition, these problems often are accompanied by other associated problems (e.g., low self-esteem, depression) that may further affect these students' academic performance." (Gardill, DuPaul, & Kyle, 1996, p. 89). Barkley (1994) stated that this disorder can be described as a general inability to delay responding to the environment. "A child with ADHD is often impulsive and impulsive responding can produce academic errors. Inability to delay responding often leads to poor test taking performance, poor planning skills, and failure to read directions carefully, because this requires waiting." (Zentall, 1993, p. 147).

Impulsivity is difficult to measure. Structured parent interviews and behavior rating scales such as the Conner’s Rating Scale (Conners, 2000) are often employed to either diagnose or evaluate the effects of treatments for children with ADHD characteristics. Although these forms of assessments may help to identify a child with ADHD, they are subject to problems with reliability and validity. Criticisms of these types of assessments include possible bias, one environment perspective, surface definitions of constructs associated with the disorder, problems with interobserver agreement, the use of cutoff scores to identify students as ADHD, and the potential for over or under-diagnosing the disorder (Reid & Maag, 1994).

Because most scales use Likert-type descriptors, scoring the magnitude and intensity of the behavior is difficult. A ranking scale format is often used (e.g. on a scale of 1 to 5 with 1 being very likely and 5 being very unlikely, does the child play with
objects in or around his/her desk?). Scales such as these do not accurately depict or measure the frequency and duration of the behavior. Teachers have also stated that these assessments are not always sensitive in measuring the behavior of medicated children versus non-medicated children (Carlson et al., 2002). These scales do not help much in determining which treatment may be most appropriate (Reid & Maag, 1998). The three constructs of ADHD, hyperactivity, inattention, and impulsivity, as outlined in the DSM-IV, are weakly defined, lacking in objectivity, and topographical in nature (Reid & Maag, 1994). McBurnett, Lahey, and Pfiffner (1993) also note that every new edition of the DSM has included a major revision of ADHD criteria, which also complicates the validity and reliability of assessments. Low reliability across observers exists because the scales are continuously being revised and observers may be unsure what constitutes an occurrence and nonoccurrence of the target behavior (Barkley, 1998; Conners, 2000). Problems with observers can create a high variance in the scoring. One rater’s tolerance and standards for disruptive behavior may differ from the next. The presence of one behavior sometimes will cause an observer to score another behavior as present, whether it really is or not (Reid et al., 1994).

Because these scales do not take into account environmental factors, an implication is that the problem exists within the student. Overall, these assessments are not always precise and may not always pick up the unique characteristics and choices of a child with ADHD.
Websters Dictionary (1979, p. 572) defines impulsivity as “a sudden spontaneous inclination or incitement to some unpremeditated action; a force so communicated as to produce motion suddenly, having either a stimulating or inhibitory effect.” Simply stated, the spontaneous action gains immediate access to reinforcement, whether positive or negative. While impulsivity yields immediate reinforcement with smaller benefits, self-control (its opposite) reaps higher benefits by delaying reinforcement. For example, a boy who is impulsive and his brother who practices self-control earn $1.00 a day for chores. The impulsive boy spends his dollar at the end of the day on a yo-yo that breaks the same day he buys it. However, his brother saves his chore money for several days to buy a more expensive, quality-made yo-yo that is the envy of all the neighborhood boys. While the impulsive brother gained access to his toy immediately after being paid, his yo-yo only lasted a short time. The brother who practiced self-control delayed his reinforcement to the end of the week, but got a much nicer yo-yo that still works.

Assessing impulsivity (choices governed mainly by the immediacy of reinforcement) can be uniquely measured. Neef, Mace, and Shade (1993) examined impulsivity in students with serious emotional disturbances (SED) in a 2-part study. For study 1, the performance of concurrently presented math sets was examined under unequal rates of reinforcement to equal versus unequal delays to reinforcement. Results showed that when access to reinforcers was the same for both response alternatives, the time allocated to each was proportional to the earned reinforcement. Yet, when access to reinforcers was different for each response alternative, more time
was allocated to the response alternative that provided the most immediate reinforcement. In study 2, the interactive effects of reinforcer rate (R), quality (Q), and delay (I) were studied to determine the influential dimensions of reinforcers for participants. Because gaining immediate reinforcement was shown to be more influential than rate of reinforcement, impulsivity was implied.

Neef, Shade, and Miller (1994) looked at reinforcer rate, quality, delay, and response effort (E) in determining the influential dimensions of reinforcers on choice with children with SED. Two concurrent sets of math problems (equal on 2 dimensions but unequal on 2 other dimensions) were presented to each participant (e.g. high quality versus low effort). Results showed that each student’s choices were differentially affected by the reinforcer dimensions and that choices are determined by the unique response alternatives presented. Extending the focus on single reinforcement contingencies to concurrent contingencies for competing alternatives took into account that the effect of a particular reinforcer is always context dependent. The study also extended the examination of various reinforcement contingencies that maintain behavior to assessing the most influential reinforcement dimensions.

Neef, Bicard, and Endo (2001) examined a combination of reinforcer dimensions and delay fading to encourage the development of self-control with 3 students with ADHD. Here, each dimension (mentioned above) competed with another dimension (e.g. RvQ) in a concurrent presentation of math problems. All 3 students were influenced most by immediacy of reinforcement, suggesting
impulsivity. Then a self-control procedure was used where reinforcer immediacy competed with another influential dimension (RV1, QV1). The delay with the higher rate or quality reinforcer alternative was gradually increased. Students demonstrated self-control by delaying their access to reinforcement up to 24 hours in allotting more of their time to the math sets giving high rate or high quality reinforcement.

Neef and Lutz (2001a) used the same computer-based assessment of reinforcer dimensions affecting choice to design an intervention for classroom disruptions of 2 students. Concurrent sets of math problems with competing reinforcer or response dimensions (R, Q, I, E) were presented to each student. Different levels of influential dimensions were presented to examine the response alternatives on which the students chose to spend more time. Results showed that choice was uniquely influenced by the reinforcer or response dimensions.

Interventions informed by the assessment were examined to determine the effectiveness in reducing classroom disruptions. Results showed a decrease in the rate of disruptions in the conditions where favorable levels of the influential dimension were applied, which confirmed the usefulness of the assessment information.

Purpose of study

In part 1 of this study, we examined the choices made by students with ADHD when dimensions of reinforcement varied. Both students demonstrated off-task, impulsive behavior that their teachers qualified as being highly disruptive and not conducive to the total learning environment of the classroom. Using the same
computer-based assessment described in Neef, Bicard, and Endo (2001); Neef and Lutz, (2001a); Neef, Mace, and Shade (1993), and Neef, Shade, and Miller (1994), reinforcer dimensions of rate (R), quality (Q), effort (E), and immediacy (I) were presented in competition with one another. This study extended the Neef and Lutz (2001a) research by comparing the most influential dimension against the least influential dimension as demonstrated by the assessment. By doing so, the examiner could customize an intervention based on each participant's most and least influential dimensions as well as address factors that negatively impacted the student in the classroom.

The dependent variable was the response choice on which each participant chose to allocate the most and least amount of time, that is the most and least influential response dimensions. The variables involved the manner in which the dimensions were arranged to compete with one another, in terms of schedules of reinforcement in place, the effort level of the problems presented, the quality of reinforcers presented, and the delivery time of the reinforcement per problem set.

Based on the assessment results, the students participated in an intervention designed to increase their math fluency and accuracy, and decrease their off-task, disruptive behaviors exhibited in the classroom. Because children with ADHD usually do not self-regulate their behavior, they lack skills in organizing, checking their work, monitoring, and assessing their work. A behavioral technique that has been widely used for helping students who have problems staying on task in the classroom, especially during independent seat work, is self-monitoring or
self-management, which is both an instructional and behavioral intervention (Kauffman, 2001). To self-manage, one must exhibit self-control in behavioral responding. Teaching self-monitoring can assist the child with ADHD in successful performance of self-regulating skills. Because many parents of children with ADHD express concern about their child’s academic performance, the use of self-monitoring can be a very effective way to improve student outcomes, as well to increase on-task behavior, and reduce disruptive behaviors.

In Study 1, each student completed a computer based assessment of reinforcer dimensions affecting choice. Based upon information from a choice paradigm in the computer assessment to find the most and least influential dimensions, individualized interventions (Study 2) were designed using self-monitoring procedures. Each participant completed a packet of math facts, self-checking as they worked, and upon completion, recorded the number correct, incorrect, total number problems attempted, and points earned on a data recording sheet. We examined the effectiveness of self-monitoring on the students’ academic performance in the general education classroom to determine if there was a relationship between the use of the self-monitoring check list and math problems being completed more accurately and more fluently, as well as increased on-task performance. Thus, the purpose of the entire study was to extend research on examining the extent to which interventions based on the results of choice assessments were differentially effective in completing math problems more accurately, more fluently, and with increased on task performance.
Summary and Research Questions

In summary, the purpose of the present investigation was to extend research on choice responding to determine the effectiveness of these individual-specific interventions in improving math fluency, accuracy, and on-task behavior, and reducing classroom disruptions. The following research questions were examined:

(1) How do the dimensions of reinforcer rate, immediacy, quality, and response effort interact to affect the students' choices between concurrently presented academic tasks?

(2) To what extent are the choices of students with ADHD influenced by immediacy of reinforcement and response effort relative to other dimensions, reflecting impulsivity?

(3) To what extent are self-monitoring procedures based on an assessment of influential reinforcer dimensions differentially effective in increasing on task behavior, academic accuracy and productivity?

(4) To what extent do the teachers view the procedures and results as socially valid?

Because both participants were diagnosed with ADHD, implementing a successful intervention based from a more sensitive assessment procedure, will extend research on effectively treating the problems associated with this disorder.
In 1991, the Department of Education added ADHD as a potentially disabling condition for the purposes of special education. ADHD is a neurobehavioral disorder that affects a person's ability to regulate his/her activity level (hyperactivity,) inhibit his/her behavior (impulsivity,) and/or concentrate on tasks (attention) to a greater degree than for most children at the same age or developmental level. Children with this disorder are typically characterized as being inattentive, impulsive, overactive, and exhibiting a variety of problems within the school setting. They have difficulty paying attention, staying seated, following directions, and working independently in the classroom.

*Behavioral characteristics of ADHD.* Behavioral characteristics of ADHD include: high activity level (fidgets, squirms, constantly moving, plays with or puts items nearby in his/her mouth, difficulty remaining in seat), impulsivity and lack of self-control (interrupts, excessive talking, blurs words out, gets in trouble frequently, often engages in physically dangerous activities without considering the consequences which also leads to a high incidence of injuries), low self-esteem and high frustration, socially immature, aggressive behavior, and difficulty transitioning from one activity to the next (American Psychiatric Association, 1994).
Prevalence data. ADHD affects 3 to 5% of school age children, and about 3 times as many boys as girls. (American Psychiatric Association, 1994). For a diagnosis of ADHD, a child must show some impairment from the symptoms in two or more settings with onset before age 7. The symptoms cannot be better defined by another mental disorder. The frequency and severity of the symptoms must be significantly greater than their peers, and there must be clear evidence of an impairment in social, academic, or occupational functioning (American Psychiatric Association, 1994).

Diagnostic criteria. Most children are diagnosed with ADHD using the criteria set by the Diagnostic and Statistical Manual of Disorders (the DSM-IV, American Psychiatric Association, 1994). Six or more of the symptoms must be present for at least six months to a degree that is maladaptive and inconsistent with the child’s developmental level. Some of the symptoms describing inattention include: forgetfulness, easily distracted, loses things, doesn’t listen when spoken to directly, and makes careless mistakes. The symptoms describing hyperactivity include: fidgeting, squirms in seat, excessive talking, acts as if “driven by a motor,” and leaves seat during required at seat times. For impulsivity, descriptive symptoms include: blurting out answers before the question is completed, difficulty waiting their turn, and interrupting or imposing on others.

Assessments

Assessments for children with symptoms or characteristics of ADHD serve two purposes. One is to determine the existence of the diagnosis and the other is to decide upon the most effective treatment for that child. Currently, there is no specific
acceptable measure to diagnose ADHD. Typically, a diagnosis is made based from responses on teacher/parent rating scales such as the Conners Rating Scale. As mentioned previously, however, problems with validity and reliability may exist with these scales. The assessments usually consist of a short form with questions that the teacher or parent must answer, in a ranking format, from their perspective of dealing with the child. Thus, the answers can be very biased, plus only the surface of the problem is addressed, without explanation. Anchors are not operationally defined. In addition, these types of assessments provide a gross measure of the effect of a treatment. These assessments are not very helpful in providing precise information about treatment effects.

Alternate assessments based on the operational definitions of constructs associated with ADHD may be used to ensure the in depth problem of each individual is addressed in a more specific manner. “ADHD refers to a family of related chronic neurobiological disorders that interfere with an individual’s capacity to regulate activity level (hyperactivity), inhibit behavior (impulsivity), and attend to tasks (inattention) in developmentally appropriate ways.”

(http://www.nimh.nih.gov/publicat/adhdqa.cfm) Each individual is unique in how ADHD affects them. While some may be more hyperactive than others, others may be more impulsive, while others yet may be more easily distracted. Identifying reinforcers specific to the individual is very important in developing effective behavioral plans. Northup, George, Jones, Broussard, and Vollmer (1996) compared three methods of stimulus preference assessments for ADHD children. A reinforcer survey, a verbal-stimulus-choice questionnaire, and a pictorial stimulus-choice
procedure were all evaluated with 4 verbal participants. The verbal and pictorial stimulus-choice assessments displayed more accurately high and low-preference reinforcers for 3 of 4 participants. The survey results were the least sensitive measure in differentiating between high and low preferences, and were more subject to false positives. Neef, Shade, and Miller, (1994) observed reinforcer rate, quality, delay, and response effort in an alternate assessment. The assessment was developed to determine differential responsiveness to these reinforcer and response dimensions. Results noted that each student was differentially affected by the reinforcer dimensions and that choices were determined by the unique response alternatives presented. Extending the focus from single to concurrent reinforcement contingencies for competing alternatives took into account that the effect of a particular reinforcer is always context dependent. The study also extended the examination of various reinforcement contingencies that maintain behavior to assessing the most influential reinforcement dimensions.

A computer based assessment of reinforcer dimensions affecting choice was used in a study by Neef and Lutz (2001) and interventions for the participants were designed based upon their individual assessments. Different levels of influential dimensions were examined to determine if the students would discriminate between the reinforcer dimensions and to examine the response alternatives on which they chose to spend more time. Results showed that choice was uniquely influenced by the reinforcer or response dimensions. Interventions informed by the assessment were examined to determine the effectiveness in reducing classroom disruptions.
Results noted a decrease in the rate of disruptions in the conditions where favorable levels of the influential dimension were applied, which confirmed the usefulness of the assessment information.

The results of these alternate assessments pinpointed more accurately the student’s characteristics and choices. Thus, interventions designed specifically to address the child’s needs yielded successful results. Fisher and Mazur (1997) examined how variables such as response effort and reinforcer rate, immediacy, and quality affect choice responding. Choice responding was defined as the way in which a person allocated his/her time or responding when response options were presented. The results of recent research where choice responding was used was more precise than other measures in determining an appropriate intervention because the participant’s specific choice allocations were identified. Fisher and Mazur (1997) explained that through concurrent schedules, an experimenter could evaluate the student’s choice of one response over another and how that response might affect the overall consequences. Concurrent arrangements also allowed for a more precise means of evaluating a person’s choice of one reinforcer over another because it forced the participant to choose between the concurrently presented options. Thus, the examiner obtained a direct measure of the participant’s specific preferences and then designed a more effective intervention based directly on the results of the assessment.

Treatments for ADHD

Medication and behavioral interventions are most commonly employed to treat students with ADHD who exhibit off task behavior and low academic performance in the classroom. “Almost all clinic-referred children with ADHD are
doing poorly at school” (Barkley, 1998, p. 99). Of these children, 56% require remedial tutoring for basic skills, 30% may repeat a grade, 46% may be suspended, 10%-35% fail or drop out of school, and are at a higher risk for substance abuse and violating the law. They usually score lower on IQ tests and standardized achievement tests of math, reading, and spelling than their typical peers (Barkley, 1998). Purdie, Hattie, and Carroll (2002) examined 74 studies in which an intervention had been used to improve the behavioral, cognitive, and/or social functioning of people with ADHD. The range of interventions used included pharmacological, school-based psychological services, non-school-based psychological services, parent training, and multimodal interventions. Some of the results of their findings follow, as well as those of other researchers.

**Medical Interventions.** Stimulants are the most widely used medication for treating ADHD. Currently, Ritalin or Methylphenidate is the most prescribed drug. Concerta is a recently introduced medication for ADHD, gaining a popularity among doctors due to its longer duration for staying in the patient’s system.

Stimulants are mood altering drugs that help to regulate the levels of certain chemicals in the brain. By regulating these levels, a person is able to block out distractions in the background and pay attention to what they need to focus on. The dosage of the medication is adjusted by the doctor, based on the patient’s response to the drug. Stimulants have been found to have an effect on attention, concentration, and motivation, but no clear effect on academic performance or learning (Purdie et al., 2002). There was no evidence showing long-term academic gains for medicated students. The Purdie et al. (2002) study also noted the number of side effects
associated with medication such as weight loss, dry mouth, appetite loss, shakiness, and bodily effects of treatment, all of which could negatively impact academic performance.

**Multimodal Interventions.** The National Institute of Mental Health (1999) funded a multimodal treatment study using six different university medical centers and hospitals and 18 nationally recognized authorities in ADHD who worked together to determine the most effective treatments for ADHD. The study consisted of 579 children with ADHD, ranging in age from 7 to 9, who were from seven different areas of the United States and Canada. These children were randomly assigned to one of four treatments: (1) medication only (2) intensive behavioral treatment only (3) a combination of both medical and behavioral treatments or (4) routine community care. The study lasted 14 months. Results suggested that treatment plans involving medication and behavioral therapy were the most beneficial for the children. “Results published in December 1999 indicate that long-term combination treatments as well as medication-management alone are both significantly superior to intensive behavioral treatments and routine community treatments in reducing ADHD symptoms.” (www.nimh.nih.gov/events/prmta.cfm> (March 2001.) This combination also didn’t require as high a dose of medication as the medication only treatment. Both treatments used together helped more in the areas of academics, anxiety, performance of tasks, uncooperative behavior, parent-child relations, and social skills. The study also demonstrated that on the average, carefully monitored medication treatment with monthly check-ups is more effective than intensive behavioral treatments in reducing symptoms of ADHD. However, medication alone
isn't the best treatment for every child, and it was suggested that families seek out the best treatment or combination of treatments specifically for their child. The study by Purdie et al., (2002) noted mixed reviews of the effectiveness of multimodal interventions. While some studies researched claimed that combining treatment strategies were the most effective, other studies found that combinations were not superior to stimulant medication alone.

Behavioral Interventions. In many cases, ADHD involves a combination of behavioral characteristics such as difficulty sustaining attention, motivation, hyperactivity, impulsivity, and making socially inappropriate responses (Kauffman, 2001). Thus, many different strategies have been attempted. The three most common behavioral approaches include positive reinforcement, punishment, and response cost, which can either be used alone or in combination with one another to aid in establishing behaviors conducive to classroom learning (Purdie et al., 2002). Positive reinforcement has been found to be an excellent method for reducing impulsive activity and improving on task behavior and academic performance (Chesapeake Institute, 1994; Fiore, Becker and Nero, 1993; Reid, 1999). Fuchs and Fuchs (2001), provided guidelines for designing interventions for students exhibiting difficulties in mathematics. They stated that educators can make adaptations to student math programs that are (a) feasible to implement within the natural classroom environment, (b) not disruptive to the target child, (c) not intrusive for classmates, and (d) can be effective in addressing individual student difficulties. Adaptation strategies included goal setting, self-monitoring of task completion and work quality, computer-assisted instruction, and reinforcement. Fuchs and Fuchs (2001) examined adaptations to help
students with learning disabilities learn more significantly. Each student in their study made meaningful progress.

*Educational interventions.* Educational interventions are focused around classroom management or arranging the environment to optimize learning for the ADHD child. This may include front row seating, frequent breaks between academic subjects, reducing noise levels, increased structure, social skills training, peer tutoring, etc. Visual stimulation, such as the use of color, has been used to improve the academic performance of children with ADHD (Zentall, 1993.) In another study, the use of novel sounds, such as music, was researched. For unfamiliar, complex, or newly introduced tasks, the use of sounds was found to produce inattention and increase errors (Zentall, 1983.) However, during simple tasks, Scott (1970) used the Beatles' music as background noise for four ADHD boys completing basic math problems. Productivity was increased with this background stimuli in place.

Classroom design has been another method of trying to increase fluency. Arranging the room in a structured manner has been shown to promote increased on task behavior (e.g. seating a child with ADHD up front surrounded by model peers). Greenweald and Walsh (1996) demonstrated a reduction in the frequency and duration of off task behavior, using classroom design as the intervention.

It is important to determine if the change in the educational design is going to have a positive impact on the student and if it is a strategy that will generalize to the school or home setting before implementing it. Purdie et al., (2002) stated that one of the three constructs of ADHD (inattention, hyperactivity, and impulsivity) needs to be
addressed to achieve any gains in educational performance because appropriate behaviors in these areas are necessary prerequisites for successful learning.

Cognitive Behavioral Interventions. With the knowledge that students with ADHD have difficulty managing their own behavior and maintaining their attention during academic activities in class, various methods and techniques have been used to assist them and students with other disabilities (learning disabled, oppositional deviant disorder, etc.) in building fluency in math and other academic areas, and/or in decreasing disruptive or off task behavior. In cognitive behavior therapy, children are taught to use self-talk, self-instruction, self-monitoring, and self-reinforcement as problem solving and motivational strategies to develop self-control of their attention and impulse behavior problems (Purdie et al., 2002). Those that are contingency based include self-monitoring, self-evaluation, and self-reinforcement.

Rhode, Morgan, and Young (1983) examined the use of a self-evaluation procedure based on a contingency management system to decrease the frequency of inappropriate behavior. The use of rewards has been used to cultivate interest in an academic activity (Cameron, Banko, and Pierce, 2001). Here, the use of rewards was studied to determine if it affected intrinsic motivation and found no detrimental effects of rewards on intrinsic motivation. One implication of the findings of Cameron et al. (2001) was that rewards could be used to instill motivation and increase performance on low-interest activities. It was also noted that rewards given for meeting a goal were strongly tied to level of performance. Because children with ADHD have problems with motivation, this study produced useful information for educators, parents, and other related professionals.
Cognitive behavioral interventions are most effective when used with behavioral contingencies in the natural environment focusing on specific training that models the desired target behavior (Purdie et al., 2002). The research on cognitive behavioral treatments with ADHD children has typically been examined in clinical settings and not in classrooms, where the behavior is actually occurring. Their study suggested that treatment should be based on teaching ADHD children to delay their responses and it must take place in the setting and at the time when the problem behavior occurs. Contingencies must be used to inspire children with ADHD to delay responding and to apply cognitive strategies. “Consequences or contingencies for ADHD children need to be more immediate, powerful, tangible, and frequent than those that teachers often use in their everyday work with other children in the classroom” (Purdie et al., 2002, p. 67).

Self-Monitoring

One such contingency-based technique that has not been used as much with ADHD children, but for the general population is self-monitoring, or self-management, which is both an educational and cognitive behavioral intervention. To self-manage, one must exhibit self-control in behavioral responding. “The self-evaluation process involves the decision to act, consideration of the outcomes of not responding, as well as envisioning the potential consequences of responding. Clearly, this process requires that an individual wait before responding, a capability that is deficient in children and adolescents with ADHD. Therefore, the lack of self-management skills can be viewed as a core deficit among individuals with this disorder” (Shapiro, Bradley-Klug & DuPaul, 1998). The child with ADHD may not
be capable of choosing appropriate strategies or may use none at all when doing classroom work. They are usually not skilled in performing self-regulating skills such as organizing, checking their work, monitoring, and assessing their work. Teaching self-monitoring can assist the child with ADHD in performing these skills successfully.

As previously stated, parents of children with ADHD often express concern about their child’s performance academically. Self-monitoring has been found to be an effective means of improving student outcomes, as well as increasing on task behavior, and reducing disruptive behaviors. Self management refers to actions that a person takes to change or maintain a behavior (Shapiro & Cole, 1994). “Self monitoring, self-recording, self-observation, and self-assessment all refer to an individual’s systematically observing his own behavior and responding to the occurrence or nonoccurrence of a specified target response. Self monitoring has been called the lifeblood of effective self control methods (Thoresen & Mahoney, 1974) and has been the subject of more research and clinical application than any other self-management strategy” (Cooper, Heron, & Heward, 1987, p. 524).

Self monitoring is a two-part self-management procedure. It involves self-evaluation and self-recording. Self-evaluation occurs when the student has determined whether or not he/she has performed the target behavior. Self-recording is where the student records the occurrence or non-occurrence of the target behavior (Digangi, Maag, & Rutherford, 1991). Hallahan et al. (1983) suggested that there are 3 characteristics of self-monitoring. One is that it usually changes behavior in a positive way. Secondly, it bridges the delay between the target behavior and any
positive consequences. Thirdly, the student’s awareness of the target behavior and possible consequences are heightened. A self-monitoring system should include:

1. Regular behavior checks during which the student focuses on their behavior.
2. An individual data sheet for recording.
3. An audible or visual cue to signify the behavior check.
4. An operant response to the cue (for e.g. the bell rings and the students hold up their recording sheets).

Advantages of Self-Monitoring. There are several advantages of using self-management procedures:

1. It is educationally more efficient than traditional teaching procedures. Students can manage their own learning and by doing so, can free up the teacher’s time by them not having to provide continuous feedback to his/her students.
2. It is transportable and inexpensive to implement.
3. By students learning to correct, count, record, and evaluate their work, they are learning and applying functional skills. (Lovitt, 1973).
4. Students take an active role in their learning and academic outcomes. There is no loss of opportunity to respond or that the student will go unnoticed. It makes the student accountable for
their outcomes. They also spend more time on-task, which
defined is the amount of time a student is attending to an
instructional activity.

(5) Students increase their level of motivation and confidence when
they are permitted to take responsibility for parts of their
educational learning. By recording their own performance, they
are able to see any change in their performance, no matter how
small. This may encourage them to become more motivated to
improve and then start relying on their own ability for their
academic outcomes. By doing so, they develop greater
independence and self-reliance.

(6) Through self-monitoring, a student may become more
independent and productive. Monitoring helps a student know if
goals are or are not being met and helps them to know what they
should be doing next.

(7) Desired behavioral changes can be obtained (McLaughlin, 1976.)

(8) It can be used with a wide range of populations, settings, and
dependent measures.

(9) Self-monitoring provides strong, immediate consequences.

Increases or decreases in target behavior are often difficult to
achieve. Change is hard because the status quo proves to be more
immediately reinforcing to the student. Consequences for
preferred behavior are too delayed to be effective.

Self-monitoring is a good strategy to use to combat this (Cooper et al., 1987).

(10) Generalization is promoted. Cooper, Heron, and Heward (1987) stated that when students become aware of the target behavior and its possible outcomes, then they may be more likely to act appropriately in another setting and generalization will take place. Baer (1981) described 6 steps to promote generality of behavior change. The last step given is to teach self-management techniques. Baer stated that self-management is considered to be the most potentially effective approach to produce behavior change because the procedure focuses on the learner, who is the common element to each environment.

Studies using Self-Monitoring Procedures. There have been numerous studies on the effects of self-monitoring or self-management procedures on improving academic performance and increasing on-task performance. Many have focused on having the students monitor their on-task behavior or a combination of both their on-task behavior and academic performance. Not only did these studies show how beneficial self-monitoring procedures are to students in terms of increasing on-task behaviors and academic fluency and rate, but they also found that self-monitoring promoted independence, motivation, and self-confidence. Hallahan and Lloyd (1987) found self-monitoring procedures particularly effective for students with attentional problems. They found that self-monitoring tends to be very helpful in getting these
students to stay on task and work independently. This study also noted that it proved
to be more effective when the students were simply practicing, not acquiring a new
skill, and that the amount and immediacy of feedback influenced the effectiveness of
the procedure.

Snider (1987) compared the effectiveness of individual versus teacher
assessment. On task behavior increased for both conditions, but was much higher for
the self-assessment. The results suggested that the self-recording procedure
possessed motivational properties. McLaughlin, Krappman, and Welsh (1985) had
students record the number of talk-outs during class. When the students recorded
their own behavior, the number of talk-outs decreased. This study demonstrated that
just merely having the student record the occurrence of the behavior was enough to
reduce it. Self-monitoring was effective in modifying the behavior and also found to
be more effective if implemented by someone outside the classroom such as a
counselor or another school professional.

A self-management strategy in a general education classroom was used to
reduce the disruptive behaviors of three ADHD or ODD students. Students were
asked to rate their own behavior for three 5 min intervals using a 5-point scale.
Teachers also rated each student’s behavior. At the end of the session, if the teacher
and student matched in their results, then students were rewarded points earned plus a
bonus point. Results found that disruptive behavior decreased, even in the teacher’s
absence (Hoff & DuPaul, 1998).

McDougall and Brady (1998) used initiating and fading self-management
interventions to increase math fluency in general education classes. An increase in
math fluency and time on task was demonstrated in both training and fading of the self-management intervention. Immediate and significant gains in math accuracy scores were the results of another study by Dunlap and Dunlap (1989). Here, a self-monitoring checklist for 3 students with learning disabilities was implemented for the students to complete, correct errors as needed, and earn points given for correct answers.

In another study by Shimabukuro, Prater, Jenkins, and Edelen-Smith 1999, three male students with ADHD and learning disabilities were taught to self-monitor and self-graph their performance in reading comprehension, math and written expression. They self-monitored on academic productivity, accuracy, and on-task behavior. A single group, multiple baseline design across three academic areas was used to access the effectiveness of the intervention. Students made gains in academic productivity, accuracy, and their on-task behavior improved.

A male high school student with learning disabilities and behavior disorders used visually cued self-monitoring to increase his problem completion and test scores in math (Prater, Hogan, & Miller, 1992.) Hall and Zentall (2000) studied the effects of a learning station for middle school students in their completion and accuracy of math homework. Using self-attention with a mirror and self-monitoring, and stimulation, two students tripled their accuracy and productivity. Another study used self-management with sixth grade students to raise their homework completion and accuracy (Olympia, Sheridan, Jenson, & Andrews, 1994.) Three male students with learning disabilities and ADHD were taught to self-monitor and self-graph their
performance in reading comprehension, math, and written expression. Students made gains in reading productivity, accuracy, and on task behavior.

Self-charting is used in precision teaching techniques and has also proven to be successful in improving fluency in math and other academic areas. In one study, a high school drop-out successfully charted his own progress in math problems completed, and in doing so, increased his fluency from 12 correct problems per minute to 55 correct problems per minute (Kaiser, 1988.) A nine year old boy with ADHD was also successful in increasing fluency and on task endurance using self-graphing in precision teaching (McDowell & Keenan, 2001.)

Results from these various studies demonstrate that self-monitoring is an effective technique for helping students improve their academic scores and decrease negative behaviors. As mentioned previously, self-monitoring offers several advantages. A major benefit is that the student manages his/her own behavior, which may be more likely to generalize to other settings more readily (Fantuzzo & Polite, 1990.) It also increases the likelihood that performance will be maintained independently (Hoff & DuPaul, 1998.)

Treiber and Lahey (1983) expressed that behavioral interventions designed to reduce disruptive behaviors do not necessarily result in improved academic performance. They stated that interventions should focus on improving academic behaviors rather than off-task disruptions. The use of an intermittent schedule of reinforcement with a self-monitoring intervention could be particularly helpful in achieving consistent, steady rates of response, resulting in improved accuracy and rate, as well as a decrease in off-task behavior.
Intermittent Schedules of Reinforcement

“A schedule of reinforcement is a rule that establishes the probability that a specific occurrence of a behavior will produce reinforcement (Cooper et al., 1987, p. 276).” The two types of schedules of reinforcement that other schedules are based from are continuous reinforcement and extinction. Continuous reinforcement (CRF) is where a response is reinforced every time it is emitted. Extinction is where the specific behavior is not reinforced at all. An intermittent schedule of reinforcement falls in between these two schedules. In this schedule, a certain behavior is not reinforced every time, but rather here and there to ensure that the target behavior continues to be emitted. While continuous reinforcement is used to strengthen or reinforce newly acquired behaviors, an intermittent schedule is used to maintain or practice an already-learned skill.

Advantages of intermittent schedules of reinforcement. An intermittent schedule of reinforcement has several advantages:

(1) Behavior is maintained.

(2) A behavior is more resistant to extinction than those using a CRF.

(3) It can encourage a high rate of response because performance of the specified behavior has become reinforcing for the person.
(4) Satiation (too much reinforcement causing response rates to decrease) is less likely to occur.

(5) It is more cost effective to reward students occasionally, rather than continually.

Four basic schedules of intermittent reinforcement. The use of reinforcers to increase desired behaviors can be very effective. Prater, Joy, Chilman, Temple, and Miller (1991) successfully used reinforcers with self-monitoring and self recording procedures to increase on-task behavior.

There are four basic schedules of intermittent reinforcement: fixed ratio, variable ratio, fixed interval, and variable interval. In a fixed ratio schedule, a set number of responses must be emitted before reinforcement occurs (e.g., FR5 means that every 5th response is reinforced.) In a study by McDowell and Keenan (2001), a fixed ratio schedule was used successfully to increase letter sounds. The student had to match or beat his previous session’s score before he could choose a prize from a bag of small toys and edibles. In a variable ratio schedule, the number of correct responses before reinforcement varies. In a VR5, on the average, every 5th correct answer is reinforced.

A fixed interval schedule is where the first correct response after a specified amount of time passes is reinforced. A variable interval schedule is where the first correct response is reinforced after the passage of time (which varies in a random order.)

In a VI schedule, slow to moderate responses are given, producing more consistent, stable behavior. A VR schedule produces consistent, steady, high rates of
response because the student doesn’t know when the next reinforced response will be. In the present study, a VI schedule was used in the computer assessment phase and a VR schedule of reinforcement was used during intervention.

**Summary**

This study aimed at approaching self-monitoring from both a behavioral and an instructional view. The focus was placed on self-monitoring of academic accuracy and rate to improve on-task behavior. This was done with the hope that the improvement in academic performance and fluency would have a reciprocal effect on the students’ disruptive behaviors as well. In a study by Rooney, Polloway, and Hallahan (1985), a relationship between increased accuracy and increased attention of behavior was found. They studied the effects of self-monitoring for academic performance in addition to attention to task versus on task behavior. An alternating treatment design was used to present both conditions to four students with low IQs and with learning disabilities. For the on-task monitoring, a tone was sounded and the students recorded whether or not they were on-task. In the combined condition, specific problems were marked and students were to check those problems for correct responses and then record the number of those problems correct or incorrect. For two of the four participants, both conditions demonstrated improvement in attention to task. Neither condition was superior to the other. However, in the phase with both conditions, three of the four students increased their accuracy in the percentage of math problems correct and all four participants showed consistent, improved behavior.
In another related study, self-monitoring of attention vs. self-monitoring of performance was compared using students with learning disabilities. Both had a positive impact on the students' on-task behavior and accuracy. Two of the four participants were more productive when using self-monitoring and all four subjects preferred this procedure to others. Neither self-monitoring intervention was superior to the other (Harris, Graham, Reid, McElroy, & Hamby, 1994).

Another similar study by Maag and Reid (1993), found that self-monitoring academic accuracy or productivity with six elementary-school LD students in a general education classroom was generally superior to self-monitoring of attention (on-task behavior).

Self-monitoring of attention and self-monitoring of productivity are two ways to self-monitor. Part 2 of this study (study 2), used self-monitoring of productivity and accuracy to assist students with ADHD in successfully completing a curriculum-based math worksheet with improved accuracy, fluency and on-task performance. The intervention designed was based on the choice responding assessment used in Study 1.

Impulsivity defined in the studies below offers a more precise and conceptually systematic measure than traditional methods. In traditional methods (rating scales, parent/teacher interviews, medical examination, etc.) the three constructs of ADHD, hyperactivity, inattention, and impulsivity, as outlined in the DSM-IV, are often weakly defined, lacking in objectivity, and topographical in nature (Reid and Maag, 1994). Studies where choice responding and choice procedures have been implemented and the use of conceptually systematic methods that narrow
the choice representatives down to be specific to the individual’s own personal preferences have been found to be more effective and sensitive in measuring and treating students with ADHD (Fisher & Mazur, 1997; Neef & Lutz, 2001a; Neef & Lutz, 2001b; Neef, Mace, & Shade, 1993; Neef, Mace, Shea, & Shade, 1991; Neef, Mace, Shea, & Shade, 1992; Mace, Neef, Shade, & Mauro, 1994; Northup et al, 1996.)
CHAPTER 3: METHOD

STUDY 1: ASSESSMENT

Participants

Two fifth-grade students (1 male and 1 female) diagnosed with ADHD served as participants. They had no other identified disabilities. The students attended a large, inner city public elementary school. The school had a diverse cultural and ethnic student population. The majority of the students attending this school received free lunch. The two students were invited as participants in the study because they had academic deficits in the area of math problem solving strategies, exhibited off-task behavior, and often failed to complete school assignments. Each participant had a significant history of behavioral problems at school. Parents of the two participants consented to their child’s participation in the study. Assent from the individual students was also obtained after providing them with a full explanation as to what the study involved (Appendix A). A student demographic information sheet (Appendix B) was also completed, which included information regarding medication, achievement tests and scores, diagnostic information, other diagnosed disabilities, and classroom performance/concern (Table 3.1).
<table>
<thead>
<tr>
<th>PARTICIPANT:</th>
<th>MILTON</th>
<th>MALLORY</th>
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<td>20 mg. Ritalin before school 5 mg. Ritalin at noon</td>
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<td>IQ</td>
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<td>Low average</td>
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<td>Math scores</td>
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<td>200 of 218 on 4&lt;sup&gt;th&lt;/sup&gt; proficiency test</td>
</tr>
<tr>
<td>Grade equivalent in math</td>
<td>1.8 grade equivalent</td>
<td>3.8 math reasoning; 2.7 numerical operations</td>
</tr>
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Table 3.1 Student demographic information across participants.
Milton was an 11-year-old Caucasian male. He was reported to be functioning within the low average range of intelligence. He took 5 mg. of Ritalin at 8 a.m. and at 1 p.m. His cumulative file indicated a chronic history of time-outs, suspensions, and in school suspensions. Since the first grade, Milton had been suspended ten times over a 4 year period for misbehavior. Although his behavior had been reported as improved in the 8 months since medication had been prescribed, his current teacher had expressed that she had never had a student who was “so unmotivated,” and that he rarely attempted even simple assignments.

Milton had a record of consistently poor academic performance from the time he began school. On the 4th grade proficiency test, he scored in the weak range (169 of the 218 score needed to pass the mathematics portion.) This indicated a strong need for intervention. On the Metropolitan Achievement Test, his math scores were well below average, with a total stanine score of 1 (of a possible 9.) He was functioning at a late first grade, early second grade level in math.

Mallory was a 10 year old Caucasian female. Her school records indicated that she began to show symptoms of ADHD in the third grade, which affected her academic performance in the classroom. Areas of concern for her included: attention, organization, work completion, classroom behavior, poor achievement, and impulsivity. She frequently blurted out answers, was easily distracted, very disorganized, and had difficulty following directions. She was taking 20 mg. of Ritalin before school and 5 mg. at noon. After she was placed on medication in the third grade, her teachers reported a noticeable change in her behavior. She was reported to exhibit more on-task behavior, fewer disruptions, and to be more
successful in keeping her materials organized. However, her fifth grade teacher still expressed that Mallory was in need of further assistance in these areas.

Mallory scored a 3.8 grade equivalent in math reasoning and a 2.7 grade equivalent in numerical operations on the WIAT. On the Fourth Grade Proficiency Test, she scored 200, thereby failing to meet the 218 established proficiency standard score necessary to pass the mathematics portion of the test.

Setting

The study was conducted in a Columbus City School, serving children in grades kindergarten through grade 5. The school served both regular and special education students of diverse cultural and ethnic backgrounds, and provided pull-out services for students with learning disabilities or multiple disabilities. Although the participants were all in general education classrooms, part of the study took place in the special education classroom, where the experimenter was the special education teacher. She had 7 years experience teaching students with multiple disabilities in a public elementary school. Training took place in a self-contained special education classroom that served children with multiple disabilities in third through fifth grades. The classroom had eight students with multiple disabilities, one teacher, and two instructional assistants. The classroom was furnished with eight student desks which were located in the center of the room in front of a long chalkboard and two teacher desks. The experimenter and each participant worked together at a small table between the time-out room and the teacher’s desk.
Conditions and Procedures

Each student participated in one or two 10-min sessions per day, two to five days per week, for a period of 16 weeks. Each session involved the use of a mathematics program installed on a Dell computer laptop. The program was identical to that described in Neef, Mace, and Shade (1992) and Mace, Neef, Shade, and Mauro (1994).

Each participant selected one mathematics problem from two options presented on the screen. Problems were presented within two separate, large, tinted boxes (light blue and light orange) located side by side on the screen. The math problems were specific to each participant’s individual skill level. From the program menu, the experimenter selected the specifications for both sets of problems. The type of problems (addition, subtraction, multiplication, or division), the level of difficulty (easy, medium, or hard), the VI schedules of reinforcement (30, 60, or 90), and reinforcer delivery schedules (end of session, end of day, or next session) were included in the specifications. The problems competed on various reinforcer dimensions, which included rate, effort, quality, and delay. During each session, the problems were equal on two dimensions but competed on two other dimensions. For example, one set presented higher effort and high quality of reinforcement than the other, but both were equal in rate of reinforcement and delay to reinforcer exchange.

Each 10-min session throughout the study was preceded by a 5-min practice session where the student was required to try both sets of problems in order to gain exposure to the respective reinforcement schedules. The student could work on either set of problems at any time during each 10 minute session. The computer monitor
showed the number of points (reinforcers) accumulated under each problem set, labeled as Store A or Store B. The problems presented clearly dictated the response effort needed for problem completion. Using a mouse, the student clicked on the problem set he/she chose to work. At that point, only that problem appeared on the screen with a small clock to display the amount of time left to work the problem. If the student answered incorrectly, the words “try again” appeared on the screen. The problem stayed on the screen until the child entered the correct response or the allotted time of 30-s ran out. Then, two new problems appeared on the screen and this same procedure was repeated. Reinforcer delivery for each set was signaled with an auditory stimulus, according to the schedule in effect for that set.

*Dependent variable.* The dependent variable was the percentage of time allotted to each problem set. Computer records stored this information which the examiner accessed at the end of each session and recorded on the session summary sheet (Appendix C). The assessment produced specific measurable responses that indicated the reinforcer dimensions which were influential for each participant.

*Reinforcer quality.* Reinforcer quality (Q) refers to the type of reinforcers associated with the two presented problem sets. These reinforcers were individually selected for each student, based on his/her personal preferences. Initially, prizes were presented to the student which he/she was asked to rank in order of preference. Rankings from this session determined high, medium, and low quality reinforcers. Before beginning each session, the experimenter used a forced choice procedure to identify reinforcers. The experimenter asked each student to rank 10 items in order of preference with one being most preferred and 10 being least preferred. These items
were then listed on the session summary sheet (Appendix C) in the same order. High
quality items were the five highest ranked from among ten preferred prize options.
Low quality reinforcers were five ranked prizes that the student chose from ten low
preference items. Points earned from the respective problem set could be used to
purchase any item(s) from the specified store. All items were assigned the same point
values. Students typically earned one to three items during a session. Prizes or
reinforcers that Milton ranked as being highly preferred included: chips, pop, candy,
army men, sports cards, small toys and novelty items, and time playing on the
computer. Reinforcers that Mallory ranked as being highly preferred included:
cosmetic items, such as lip gloss or face glitter, hair accessories, snack items such as
candy, chips, and pop/juice, and small toys and novelty items.

*Rate of reinforcement.* Rate of reinforcement (R) refers to the amount of
reinforcement available for each problem set. Concurrent schedules of reinforcement
were set up for each set of problems in each session. A VI 90 s schedule was used for
the “low” value, VI 60 s for the “medium” value, and VI 30 s for the “high” value.

*Reinforcer immediacy.* Reinforcer immediacy (I) referred to the time of
access to the reinforcers earned from Store A or Store B in any one session. Some
problems were set up for the student to obtain the backup reinforcers at the end of the
session (immediate) while others were set up on a delayed delivery schedule (end of
the day, next session, or the next day).

*Response effort.* Response effort was the amount of effort a student needed to
expend on each set of problems presented. This was assessed by the rate of problem
completion and the accuracy of problems completed. Low effort problems were
problems completed at the highest rate with the highest accuracy, and those problems that the teacher used as review. High effort problems were those problems that were completed at a lower rate with at least one half the problems correct. These problems were identified by the teacher as aims for mastery.

Data Collection and Experimental Design

Assessment phases included baseline, initial assessment, and replication. After each session was completed, information regarding the amount of time the student spent on each of the two sets of math problems (Store A or Store B), as well as how many points the student earned from each set of problems, could be obtained from computer records. The experimental design used in this study was adapted from a design used by Cooper et al. (1990) for brief functional analyses. Both students completed a brief initial assessment to determine their skill level, followed by a baseline condition, and then an assessment phase of the various conditions. During the brief initial testing phase, different levels of problems, from easy to most difficult, were presented to each student for 2-min sessions. Once the primary investigator determined an easy, medium, and difficult level for each student, then baseline followed. During baseline, high and low levels of the four dimensions competed against each other (high rate competed against low rate, high quality against low quality, high effort against low effort, and delay against immediacy). The purpose of baseline was to observe if the participants discriminated between the favorable level of the dimension and to what extent. Then, students completed an assessment phase where the conditions competed against each other. "The set of experimental conditions arranged the counterbalanced presentation of each dimension in relation to
every other dimension. Each dimension was presented three times in competition
with another dimension (at unequal values) and three times at equal values across the
response alternatives” (Neef & Lutz, 2001b, p. 243). Six different experimental
conditions were assessed and the competing dimensions for the two sets of problems
varied, depending on each participants’ individual problem selections. One session
for each of the experimental conditions was completed during the assessment phase
(conducted in random order). These six conditions were: RvQ, RvE, RvI, QvE, QvI,
and IvE. Certain conditions, including the most influential, were replicated to ensure
internal validity. Any conditions that had conflicting data were also replicated, to
determine what the most and least influential dimension was for each participant.
CHAPTER 4: RESULTS

STUDY 1

Figures 4.1 and 4.2 show the percentage of time Milton and Mallory spent on each problem set (Set 1 versus Set 2) linked with competing dimensions. Conditions of the initial assessment are shown in the same order for both participants to aid in interpretation. Quality is represented on the graph by the dotted bars, effort by the dark solid bars, delay by the gray bars, and rate by the clear bars.

Results for Milton are shown in Figure 4.1. During baseline, he spent 81% of his time on problems which yielded high quality reinforcers (HQvLQ) when they competed with problems that yielded low quality reinforcers. He spent 57% of his time on high rate (of reinforcement) problems versus 43% on low rate problems (HRvLR). He allocated 100% of his time on low effort problems when they competed with high effort problems (LEvHE). In the Delay v Imm. condition, he spent 94% of his time on problems that produced immediate reinforcement when they competed with problems that had delayed reinforcement.
Figure 4.1  Data for Milton, Study 1.

Figure 4.2  Data for Mallory, Study 1.
During the assessment phase, Milton allocated 97% (RvQ) and 100% (QvI) respectively, of his time to problems yielding high quality reinforcers when they competed with problems producing a high rate of reinforcement and problems producing immediate reinforcement. However, when high quality problems competed against low effort problems (QvE), Milton designated only 2% of his time to the quality problems and 98% to low effort. He also allocated 90% and 100% of his time, respectively, to low effort problems when they competed with a high rate of reinforcement in the RvE condition and immediacy in the EvI condition. In the IvR condition, he spent 100% of his time on the problems producing immediate reinforcement, as opposed to the problems producing a high rate of reinforcement. In the replication phase, the most influential dimension (effort) was presented again in competition with rate, the least influential dimension (RvE) and immediacy (IvR). In the RvE condition, he allocated 100% of his time to the low effort problems, which was consistent with the results of the initial assessment phase. In the IvR condition, he spent 100% of his time on problems producing immediate reinforcement as opposed to those yielding a high rate of reinforcement. Across all sessions combined, (a total of at least 4 evaluations of each dimension) he allocated a mean of 98% of his time on low effort problems, 94% to problems yielding higher quality reinforcers, 79% of his time to the problems providing immediate access to reinforcement, and 12% of his time to the higher rate of reinforcement dimension.
Mallory

Results for Mallory are shown in the Figure 4.2. During baseline, Mallory spent 98% of her time on problems yielding high quality reinforcement versus 2% on low quality problems (HQvLQ). For HRvLR, Mallory spent 97% of her time on problems producing a high rate of reinforcement vs 3% on low rate problems. She allocated 62% of her time to low effort problems when they competed with high effort problems (LE v HE). In the Delay v Imm. condition, Mallory designated 100% of her time to problems producing immediate reinforcement. During the assessment phase, quality proved to be the most influential dimension. Mallory expended 96% of her time on quality in the RvQ condition, when quality competed against rate of reinforcement. She spent 77% (QvE) and 52% (QvI) of her time, respectively, on problems yielding high quality reinforcers when they competed against low effort problems and problems providing immediate reinforcement. Immediacy was second most influential for Mallory. She worked on the immediacy side in the EvI condition 93% of the time, when effort competed with immediate reinforcement. Rate of reinforcement was third influential for Mallory. She spent 59% of her time on rate vs. 41% on effort in the RvE condition, and 58% of her time on rate of reinforcement when it competed with immediacy in the IvR condition. In the replication phase, the two most influential dimensions (quality and immediacy, respectively) were presented again in competition with the least influential dimensions (rate and effort, respectively). Mallory again allocated most of her time (68%) to the problems yielding high quality reinforcers when they competed against low effort problems (QvE). In the IvR, she spent 58% of her time on problems producing immediate
reinforcement when it competed with rate of reinforcement. Across all sessions, (a total of 5 evaluations of each dimension) she allocated a mean of 78% of her time to the problems producing higher quality reinforcers, 71% to the immediate reinforcer access alternative, 70% to the higher rate of reinforcement dimension, and 40% to the lower effort alternative (Table 4.1).

<table>
<thead>
<tr>
<th>PARTICIPANT</th>
<th>LE vs. HE</th>
<th>HQ vs. LQ</th>
<th>Immediacy vs. Delay</th>
<th>HR vs. LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milton</td>
<td>98% vs. 2%</td>
<td>81% vs.19%</td>
<td>94% vs. 6%</td>
<td>57% vs. 43%</td>
</tr>
<tr>
<td>Mallory</td>
<td>62% vs. 38%</td>
<td>98% vs. 2%</td>
<td>98% vs. 2%</td>
<td>97% vs. 3%</td>
</tr>
</tbody>
</table>

Table 4.1 Overall session percentages with respect to choice allocations per condition.
In summary, the results of Study 1 support those of Neef and Lutz (2001) and Neef et al., (1994) in that each participant’s choices were uniquely influenced by one or more reinforcer or response dimensions and relative sensitivity to those dimensions differed for each student. Milton’s teacher had expressed that he was lazy and didn’t like to challenge himself at all. Based on his computer assessment, Milton indeed chose to work problems that were easiest for him. Low effort was the most influential dimension, quality was next influential and rate of reinforcement was the least influential dimension. Milton usually opted to work on the easy problems, regardless of the rate of reinforcement and the rate of points given per set. The results of Milton’s assessment were effort (low), quality, immediacy, and rate (most influential to least influential.) It was decided that the two dimensions that would be manipulated in the intervention phase were effort and rate, his most and least influential.

Mallory’s assessment resulted in quality, immediacy, rate, and effort (from most to least influential dimensions.) Her most and least influential dimensions, respectively, were problems producing high quality reinforcers and low effort problems, both of which were chosen to be manipulated during the intervention phase. She would work for the higher quality prizes, regardless of the difficulty level of the problems presented. There were even some sessions that she did not earn enough points to get a prize because she was working so hard on one side to get the higher quality prize and the rate of reinforcement was slower because she was not as proficient at computing more difficult problems.
CHAPTER 5: METHOD

STUDY 2: INTERVENTION

Participants and Setting

The same participants in Study 1 (assessment) participated in Study 2 (intervention). Training sessions began in the special education classroom and intervention was observed in each participant’s general education 5th grade classroom. Milton’s classroom had a total of 26 students. The classroom had two teacher desks and 26 student desks that were located in the center of the room. During intervention, the experimenter and second observer sat in the back of the room at an extra desk or in the second teacher’s desk, located in the back left corner of the room.

There were 28 students in Mallory’s classroom. The students’ desks were located in the center of the classroom, in three rows of seven desks side by side, and one row of seven alongside the three rows. During intervention, the experimenter and second observer sat at an oblong table by the coat room, near the entryway.

The teachers were concerned about the students’ failure to complete independent worksheets and their disruptions during that time. For Milton, disruptive behavior involved being off-task, including doing something other than he had been instructed to do, bothering or talking to neighbors during quiet class time or instructional time, playing with objects inside his desk, being out of his seat without
permission, being non-compliant, and not doing his work during independent seat work. Mallory’s disruptive behaviors included blurting out frequently without raising her hand, talking to her neighbors during quiet class time or instructional time, being out of seat without permission, being disorganized with her papers and school belongings, playing with objects inside her desk or on the floor, not following directions, and not doing her assigned seat work during independent seat work time (doodling or drawing, talking, etc.)

Mallory was observed between the times of 9:00 and 9:30 when the teacher stated Mallory behaved worst. Data were collected two to five times per week. Milton was observed during 10-min periods between 9:00 to 9:30 and 1:00-1:45, two to five days per week, when he was to work independently at his desk on school assignments. The teacher expressed that Milton did not complete any work during these times and never turned in work voluntarily.

Response Definitions, Dependent Measures, and Recording Procedures

Prior to the experiment, the experimenter met with the two classroom teachers of the participants. The teachers of each participant defined the target behaviors. Definitions of target behaviors were developed based on the teachers’ descriptions of what each child needed to improve upon.

The dependent variables that were measured for both participants included: on-task behavior, academic accuracy, and academic productivity. For both participants, on-task behavior during independent seatwork was observed. This was defined as eyes toward worksheet only, working on the specified task assigned. Off task behavior was defined as eyes anywhere but on their paper or engaging in motor
activities or paper manipulation unrelated to task requirements. On and off task behavior was measured using a 30 second momentary time sampling procedure over a duration of 10-min. Academic accuracy was defined as the percentage of problems completed correctly (calculated as the total number of items completed correctly each session, divided by the total number of items attempted, multiplied by 100). Academic productivity was defined as the number of items completed correctly per 10-min session. Rate was used to measure academic productivity, and was calculated by dividing the total number of items completed correctly each session by 10 (the total number of minutes in each session). Observations were conducted during times that the teachers had indicated that independent seatwork was scheduled and the participants were more likely to be off task.

**Interobserver Agreement**

Interobserver agreement data were collected by the experimenter and a second observer (graduate and doctoral students at The Ohio State University) on 32% and 27% of the sessions for Milton and Mallory, respectively, during each phase of the study. The experimenter trained a second observer to independently observe and score the student’s work during each session. For on task behavior, an agreement was scored if both observers recorded on-task behavior during the same interval. After each session, agreement was calculated according to the formula: the number of agreements divided by the number of agreements plus the number of disagreements, multiplied by 100%. Mean agreement was 98.7% (range, 90% to 100%) for Milton and 97.8% (range, 86% to 100%) for Mallory. Agreement on academic accuracy and productivity was determined by comparing observer records with participant data on
the self-monitoring sheet (described below). Agreement on academic accuracy and productivity was 100% on all sessions in which interobserver agreement was assessed.

**Stimulus Materials**

Materials used for both participants included: invisible markers (Crayola Color Changeables), a pencil, specific math worksheets depending upon which condition was in effect, a data recording sheet, a timer, and reinforcers as described above. For Mallory, cards numbered one to 10 were used at the end of each session to choose her prize(s).

The problems were separately presented on a mathematics worksheet that had two boxes below each problem (Appendix D). The first box was for the student to write the answer. The box below had the correct answer written in invisible ink. After each problem, each participant rubbed a marker over the box to reveal the correct answer. He/she would circle the problem if it was incorrect. Asterisks were placed intermittently according to the condition in effect. The asterisks indicated to the student that a point was earned if he/she answered the problem correctly. After each session, the student recorded the following information on the tally sheet (Appendix E): date, number problems correct, number of problems incorrect, total number problems attempted, and total number of points earned.

**Experimental Conditions and Procedures**

During baseline, both participants were observed in their general education classroom under typical conditions. Disruptions were usually followed by the teacher verbally reprimanding, warning, or redirecting the student(s) involved. Sometimes
disruptions were ignored, more so in Milton’s classroom, unless the noise level rose to an unacceptable level by the teacher’s standards.

During intervention phases, an intervention was presented to each student in the same setting, in each student’s regular education classroom, with no changes of teaching procedures on the part of their classroom teacher. In each classroom, there were established classroom rules, with the application of reward contingencies and at times, the use of aversive consequences. Reward contingencies set up in both rooms included computer time, extra free time, being teacher’s helper, candy, stickers, and certificates. Aversive consequences included loss of free time and extra privileges, a lecture, being reprimanded by the teacher, a call home to parents, or being sent to the principal’s office or the peak room (an in-school time-out room where students were sent for repeated misbehavior). Students sent to the peak room lost their recess and other classroom privileges, and had to complete their school work in peak before returning to class. The use of aversive consequences was used more frequently in Mallory’s classroom, usually in the form of teacher reprimands and losing recess.

Preference Assessments. Before the beginning of each session, the experimenter did a preference assessment. For both conditions with Milton, this involved presenting him with 10 medium to high quality reinforcers and asking him to rank them in order of preference from one to 10. These items were then listed from one to 10 on the summary sheet. At the end of the session, prizes were given in order according to the list, for every four points earned.

For the low quality, low effort condition with Mallory, the experimenter conducted a preference assessment of 10 items (teacher selected) of low quality.
These items were then listed from one to 10 on the summary sheet. The first five items (most preferred) were removed altogether from the pool of prizes. The last five (items six to 10) were placed to the side within Mallory’s view. Then the experimenter explained to her that she would be working for these regular prizes during that session, and that for every three points earned, could draw a card numbered six through 10 to determine which prize she would earn. Whichever number she drew, she received the reinforcer that corresponded to the number on the preference assessment. For example, if she drew the number 6, then she would earn the prize that was listed by number 6 on her preference assessment session summary sheet. If she earned 6 or more points to gain an additional prize, she would repeat this same procedure. If she drew the same number card as before (e.g. number 6), then she would not get an additional prize. The prize exchange took place at the close of the session.

For Mallory’s high quality, high effort condition, the experimenter completed a preference assessment with 10 items of high quality that Mallory had selected from among the available prizes. She ranked these in order from one to 10, with one being the most preferred and 10 being the least preferred. These items were then listed from one to 10 on the session summary sheet. The first five items were then placed before Mallory and the experimenter stated that she would be working for these special prizes for that session. At the completion of the session, Mallory would redeem her points for prizes in the same manner as described before, except she drew from the cards numbered from one to five.
**Low effort, Low Rate Condition (Milton).** Low effort problems were paired with a low rate of reinforcement. The low effort problems were addition problems, sums zero to 30. Correct problem completion was reinforced on a variable ratio (VR) 10 (i.e., on the average, 1 point was given after every 10th problem completed). One of the experimenters read the protocols to Milton prior to the beginning of each session (see protocols, Appendix F). Once Milton was seated and ready to begin, the experimenter noted the time and nodded to Milton to begin. An asterisk placed beside every 10th problem on average on the worksheet (see stimulus materials) indicated that the student would earn a point for that problem if the answer was correct. He completed the worksheet as described previously. Then he turned it in to the primary investigator to check and reward him with his prize(s) depending on the number of points earned. Each prize cost 4 points.

**High Effort, High Rate Condition (Milton).** High effort problems were associated with a high rate of reinforcement. The high effort problems were multiplication problems zero to nine. Correct problem completion was reinforced on a VR 3 schedule (i.e. one point was given after an average of every 3rd problem). Procedures were otherwise identical to those described in the low effort, low rate condition.

**Concurrent Presentations of HE, HR and LE, LR (Milton).** During the final phase, HE, HR and LE, LR problems were presented concurrently. Each condition was presented on a different colored worksheet at the beginning of the session. The
examiner told Milton he could work on either or both sets of problems during the 10-min session. Procedures were otherwise identical to those described under each condition.

*Low Quality, Low Effort Condition (Mallory).* Low effort problems were paired with low quality reinforcers. Low effort problems were addition problems, sums zero to 30. These problems were presented on white paper. Correct problem completion was reinforced on a VR 11 schedule (i.e., one point was given after an average of every 11th problem). Then one of the experimenters read the protocol instructions (Appendix G) to Mallory and after doing so, gave her a marker, a pencil, a math packet, and a data recording sheet. She completed her worksheet in the exact manner as Milton’s was described previously. For every 3 points earned, she earned 1 prize.

*High Quality, High Effort Condition (Mallory).* In this condition, high effort problems were associated with high quality reinforcers. High effort problems were single digit division problems through session 41, and then the level of difficulty was increased to double and triple digit division problems. These problems were presented on yellow paper. The level of difficulty for the high effort problems was adjusted once Mallory’s rate for her high effort problem completion increased to the point of fluency. Procedures were otherwise the same as described in the LQ, LE condition.

*Concurrent Presentations of HQ, HE and LQ, LE (Mallory).* During the final phase, HQ, HE and LQ, LE problems were presented concurrently. Each condition was presented on a different colored worksheet at the beginning of the session. The
examiner told Mallory that she could work on either or both sets of problems during the 10-min session. Procedures were otherwise identical to those described under each condition.

**Experimental Design**

A multielement design or alternating treatments design, as well as a reversal design was used. "The alternating treatments design provides both an experimentally sound and an efficient method for comparing two or more treatments." (Cooper, Heron, and Heward, 1987, p.179) In this design, two or more conditions are presented alternately in rapid succession, in order to assess their effects on the target behavior. Often, a discrete stimulus such as different colored worksheets, oral directions, or a sign may be used with each treatment to help the participant distinguish which treatment is in effect during an intervention session. Different colored worksheets and verbal instructions were both used with Mallory and Milton to aid in their discrimination of which treatment was in effect. The experimental arrangement for Milton was A B1 A C A D B2 in which A was baseline; B1 was alternating high effort, high rate (HE,HR) versus low effort, low rate (LE,LR); C was HE,HR; D was LE, LR; and B2 was concurrent presentations of HE,HR and LE,LR. The experimental arrangement for Mallory was A B1 C A D A C A B2 in which A represented baseline; B1 was alternating high quality, high effort (HQ,HE) versus low quality, low effort (LQ,LE); C was HQ,HE; D was LQ, LE; and B2 was concurrent presentations of HQ, HE versus LQ,LE.
Procedural Integrity

For both participants, the primary observer was observed by a second observer for procedural integrity for five sessions (11% and 8% of Milton’s and Mallory’s intervention sessions respectively) (Appendix H). Three of the sessions observed were the HE,HR condition for Milton and the HQ,HE condition for Mallory. Two of the sessions were for the LE,LR condition for Milton and the LQ,LE condition for Mallory.

There were seven items that were checked for procedural integrity. For Milton, these were: (1) Experimenter completed preference assessment with 10 items of medium-high quality. (2) Experimenter read student the rules for the condition in effect. (3) Experimenter gave a marker and a stapled packet of low effort or high effort problems, depending upon the condition in effect, to the student and once the student was seated, nodded for him to begin. (4) Experimenter stopped student once 10-min were up. Student tallied up his points, recorded them, and gave the packet to the experimenter. (5) Experimenter checked the student’s total points earned, and compared the data sheet to the actual packet to insure it was correct. (6) Experimenter had student choose a prize for every 4 points earned at the end of the session. (7) Experimenter gave the prize(s) at the end of the session.

For Mallory, these items were: (1) Experimenter completed preference assessment with 10 items of high quality for high quality, high effort condition or low quality for low quality, low effort condition. (2) Experimenter pulled last (least preferred) 5 items (items 6-10) for low quality condition or for high quality, high effort, pulled first 5 (most preferred) 5 items. (3) Experimenter read the student the
rules for the condition in effect. (4) Experimenter gave a marker and a stapled packet of either low or high effort problems, depending upon which condition was in effect, to the student. Once the student was seated, the experimenter nodded for her to begin. (5) Experimenter stopped the student once 10-min were up. Student tallied up her points, problems correct, incorrect, and total number attempted, and recorded this information on the self-monitoring data sheet. She then gave the packet to the experimenter. (6) Experimenter checked the student’s data sheet, comparing it to the actual packet to insure that the information she recorded was correct. (7) For every 3 points earned, the experimenter had the student choose from cards 6-10 for a low quality, low effort condition prize or from cards 1-5 for a high quality, high effort condition prize. If more than 1 prize was earned, the student selected a card and got the prize that corresponded to that number. Experimenter placed that card back into the deck, reshuffled, and allowed the student to choose again. Experimenter repeated this procedure until all points were redeemed. If the student drew the same number card again, she did not get another prize.

Marks that were used to record if these procedures were observed were: ‘+’ for Observed, ‘-’ for Not Observed, and ‘NA’ for Not Applicable.

On all five sessions, 100% accuracy was observed in implementing the intervention for both participants.

Social Validity

At the end of the study, both participating teachers were given a questionnaire asking them to rank their perspective on the interventions using a Likert-type format, with “1” being strongly agree to “5” being strongly disagree (Appendix I). There
were opportunities for comments below each question. The last question was an open ended one that asked "What would you change about this intervention? The other questions were as follows: (1) Did you see an improvement in the student’s on-task performance during intervention? (2) Did you see an improvement in the student’s on-task performance, in general, during the school day? (3) Did you see an improvement in the student’s mathematics skills in the areas of accuracy and rate? (4) Regarding the self-monitoring procedures used, do you feel that the procedures helped the students improve in skills of self-management in other academic areas? (5) Do you feel that the schedules of reinforcement in place were appropriate and effective? (6) Did you feel that any aspect of the study interfered with the structure of your classroom environment? (7) Would you feel comfortable implementing or using this intervention in your classroom with other students with similar problems? (8) Did you like the intervention? (9) Would you recommend this intervention to other teachers or professionals? Results of the questionnaire are discussed in Chapter 6.
CHAPTER 6: RESULTS

STUDY 2: INTERVENTION

Percentage of Intervals On Task (Milton)

Figure 6.11 shows the percentage of intervals on task across experimental conditions for Milton. Milton’s mean baseline performance was 44% on task (range, 25% to 58%). During the first condition (high effort, high rate vs. low effort, low rate problems offered alternately), the mean percentage of intervals of on task behavior increased to 98% for both dimensions (range, HE,HR, 90% to 100%; LE,LR, 95% to 100%). A brief return to baseline showed a return to a low mean of 40% on task behavior (range, 35% to 45%). When high effort, high rate problems were presented alone (to control for carry over effects), Milton’s mean on task behavior increased to a mean of 97% (range, 90% to 100%). Another brief return to baseline showed a decrease in on task behavior to a mean of 45% (range, 40% to 50%). When low effort, low rate problems were presented alone, the percentage of intervals of on task behavior increased to a mean of 96% (range, 90% to 100%). During the final condition, both dimensions were presented concurrently. Although Milton had access to both packets, he chose to work solely on the low effort, low rate problems for all 5 sessions, with a mean of 100% on task behavior (range, 100%).
Percentage of Intervals On Task (Mallory)

Figure 6.12 shows the percentage of intervals on task across experimental conditions for Mallory. Mallory's baseline mean for on task behavior in the special education classroom was 45% (range, 30% to 63%). In the general education classroom, her baseline mean was 46% on task (range, 30% to 65%). An overall mean baseline for both environments was 46% on task (range, 30% to 65%). When both high quality, high effort (HQ, HE) and low quality, low effort (LQ, LE) problems were alternately presented, on task behavior increased substantially. The mean was 87.5% for HQ, HE (range, 85% to 90%), and 95% for LQ, LE (range, 90% to 100%). When HQ, HE problems were presented alone, the mean for on task behavior increased to 98% (range, 95% to 100%). A brief return to baseline showed a dramatic drop with a mean of 41% on task (range, 25% to 50%). In the next condition, LQ, LE problems were presented alone with an increase in on task behavior to a 97% M (range, 95% to 100%). A reversal to baseline showed a decline in on task behavior to a mean of 50% (range, 45% to 60%). On task behavior increased to a mean of 99% (range, 95% to 100%) when HQ, HE problems were presented alone. A reversal to baseline then showed a decrease to a mean of 55% (range, 50% to 60%). During the final condition, both dimensions were presented concurrently. Although Mallory had the opportunity to work on either set of problems, she chose to solely work on the HQ, HE problems for the remaining four sessions, during which the percentage of intervals of on task behavior was 100%.
**Percentage of Problems Completed Accurately (Milton)**

Figure 6.21 shows the percentage of problems completed accurately across experimental conditions for Milton. During baseline, Milton’s mean percentage of problems correct was 81% for low effort, low rate problems (range, 75% to 90%) and 57% for high effort, high rate problems (range, 55% to 62%). When conditions were alternated every other session, the mean increased to 97% (range 96% to 98%) for low effort, low rate problems, and to 69% (range, 60% to 72%), for high effort, high rate problems. When only high effort, high rate problems were presented, the mean increased to 79% (range, 71% to 85%). When low effort, low rate problems were presented alone, the mean decreased slightly to 94% accuracy (range, 90% to 97%). During the final condition, with both conditions presented concurrently, Milton chose to work only on the low effort, low rate problems. The mean percentage of problems correct slightly increased to 96% (range, 92% to 100%).

**Percentage of Problems Completed Accurately (Mallory)**

Figure 6.22 shows the percentage of problems completed accurately across experimental conditions for Mallory. Mallory’s mean baseline was 94% of low effort problems completed accurately (range, 91% to 97). When both dimensions were alternated every other session, high quality, high effort produced a mean of 92% accuracy (range, 88% to 96%), while LQ, LE resulted in mean of 95% (range, 90% to 97%). When HQ, HE problems were presented alone, accuracy increased to a mean of 96% (range, 91% to 98%). When LQ, LE problems were presented alone, performance was similar M=96%; (range, 92% to 99%). At this point, the level of difficulty was increased from single digit divisor to double and triple digit divisor.
problems for the HQ, HE dimension and accuracy decreased to a mean of 86% (range, 77% to 96%). In the final condition, both dimensions were presented concurrently, but Mallory chose to work only on the HQ, HE problems for the four remaining sessions. The percentage of problems correct increased to a mean of 92% (range, 90% to 96%).

*Number of Problems Completed per Minute (Milton)*

Figure 6.31 shows the number of problems completed per minute across experimental conditions for Milton. His mean baseline rate was 4.2 problems per minute (range, 3.8 to 4.8) for low effort, low rate problems and 2.2 (range, 1.6 to 3.4) for high effort, high rate problems. When both dimensions were presented alternately, Milton’s mean rate increased to 6.3 problems per minute for LE, LR (range, 5.8 to 6.5) and to 3.7 for HE, HR (range 3.2 to 4.2). When only high effort, high rate problems were presented, his mean rate increased again to 5.2 (range, 3.5 to 6.6). When only low effort, low rate problems were presented, he completed a mean of 5.8 problems per minute (range, 4.4 to 6.6). In the final condition when both conditions were presented concurrently, Milton chose to work only on the low effort, low rate dimension, with a mean of 5.7 problems per minute (range, 4.9 to 6.2).
Figure 6.11  Percentage of intervals on task for Milton.

Figure 6.12  Percentage of intervals on task for Mallory.
Figure 6.21 Percentage of problems completed accurately for Milton.

Figure 6.22 Percentage of problems completed accurately for Mallory.
Figure 6.31 Number of problems completed per minute for Milton.

Figure 6.32 Number of problems completed per minute for Mallory.
**Number of Problems Completed per Minute (Mallory)**

Figure 6.32 shows the number of problems completed per minute across experimental conditions for Mallory. Mallory’s mean baseline was 5.2 low effort problems per minute (range, 4 to 6.3). When both LQ, LE and HQ, HE problems were alternately presented (every other session), the mean for LQ, LE increased to 6 problems per minute (range, 4.2 to 6.3). High quality, high effort produced a mean of 4.7 problems per minute (range, 4.4 to 5.1). When HQ, HE problems were presented alone in the next condition, the mean increased to 5.8 problems per minute (range, 5.3 to 6.8). When LQ, LE problems were presented alone in the following condition, the mean increased to 7 problems per minute (range, 6.8 to 7.1). The level of difficulty for the high effort, high quality problems was then increased (from single digit division to double and triple digit divisor problems). With the increase in difficulty, the mean for the next HQ, HE condition was 3.4 problems per minute (range, 2.4 to 4.5). During the final condition, both dimensions were presented concurrently, but Mallory chose to work only on the HQ, HE problems all four sessions, resulting in a mean of 4.8 problems per minute (range, 2.9 to 5.5).

**Social Validity**

In general, both teachers rated this intervention highly. Milton’s teacher gave highly favorable marks to the questions, answering strongly agree to questions 1, 3, 7, 8, and 9; slightly agree to questions 2 and 5 (see Appendix I). She strongly disagreed that the study interfered with the structure of her classroom environment in question 6. She remained undecided for question 4 and marked ‘unsure at this time’ in the comments section. For the open ended question, she wrote that she really
would not use the reinforcers in an intervention that she used, because she felt that fifth graders should not work primarily just to gain a reward, but simply for their own personal self-satisfaction and gain. Mallory’s teacher strongly agreed to questions 1, 3, and 9; slightly agreed to questions 4, 5, 6, 7, and 8, and marked neutral to question 2. She strongly agreed that Mallory improved her on-task performance during intervention but marked neutral for her improving her on-task performance in general. She wrote below in the comments that she saw no noticeable improvement in Mallory’s behavior during the rest of the school day. She slightly agreed that the study interfered with the structure of her classroom environment. For comments below that question, she wrote that she felt that other students were more distracted when the intervention was in session and sometimes, although she never expressed this to any of the observers, felt that we interrupted the flow of her morning routine just by our presence. For the question, “what would you change about this intervention,” she wrote that she would not use the reinforcers because she felt it made it too easy for them. For most sessions during Study 1, Mallory earned an average of two prizes and for Study 2, earned an average of one reinforcer.

Summary

In summary, the results of Milton’s intervention (Study 2) continue to support his (Study 1) choice of low effort problems over high effort problems, regardless of the lower rate of reinforcement in effect. The time allocation for Mallory indicate that she continued to be most influenced by the quality of the reinforcers offered over the effort level of the problems presented, which replicated the results of Study 1.
CHAPTER 7

DISCUSSION

This chapter presents the discussion of this study and the summary in relation to the 4 experimental questions, implications for practice, limitations, and suggestions for future research.

Research Questions

(1) Research Question #1: How do the dimensions of reinforcer rate, immediacy, quality, and response effort interact to affect the students’ choices between concurrently presented academic tasks?

Choice responding was defined as the way in which a person allocates his/her time or responding when response options are presented. The results of recent research where choice responding was used was more precise than other assessment measures, in determining an appropriate intervention because the participant’s specific choice allocations were identified (Neef & Lutz, 2001a; Neef, Shade, & Miller, 1994; Northup et al., 1996). Fisher & Mazur (1997) explained that through concurrent schedules, an experimenter could evaluate the student’s choice of one
response over another and how that response might affect the overall consequences. Concurrent arrangements were used in Study 1 which aided the examiner to more precisely evaluate the student’s choice of one reinforcer over another because it forced the student to choose between the concurrently presented options. The problems competed on various reinforcer dimensions, which included rate, effort, quality, and delay. During each session, the problems were equal on two dimensions but competed on two other dimensions. For example, one set presented higher effort and high quality of reinforcement than the other, but both were equal in rate of reinforcement and delay to reinforcer exchange. The dependent variable was the percentage of time allotted to each problem set. The assessment produced specific measurable responses that indicated the reinforcer dimensions which were influential for each participant. Six different experimental conditions (RvQ, RvE, RvI, QvE, QvI, and IvE) were assessed to determine what the most and least influential dimension was for each participant.

During the Study 1 assessment, Mallory chose to spend 78% of her time on the high quality dimension, 71% to immediacy, 70% to rate and the least of her time (40%) on low effort problems. Milton allocated 98% of his time to the low effort set, 94% to quality, 79% to immediacy and the least amount of his time (12%) on the reinforcer high rate dimension. A direct measure of each participant’s specific preferences was obtained through the Study 1 concurrent choice assessment. Thus, an intervention was developed and implemented based directly on the results of the assessment. In the final phase of the Study 2 intervention when both conditions were presented concurrently, both Milton and Mallory allocated 100% of their time to
one condition over another. Milton chose to work only on the LE, LR set for the five remaining sessions. Mallory chose to work only on the HQ, HE set for the four remaining sessions. For both students, on-task behavior was 100% for all sessions of the final phase. Thus, Study 2 replicated the results of Study 1 in that the dimensions of response effort and reinforcer quality remained most influential for Milton and Mallory, respectively.

(2) Research Question #2: To what extent are the choices of students with ADHD influenced by immediacy of reinforcement and response effort relative to other dimensions, reflecting impulsivity?

Milton allocated 79% of his time to immediacy, ranking it as his 3rd most influential dimension. However, low effort was his most influential dimension, which suggests impulsivity as well. Because low effort problems were easier for him to complete, he obtained immediate feedback (the answer) quicker than he did working a more difficult problem that took him longer to complete. Access to his answer was more delayed because of the longer duration of time needed to figure and write the answer to the problem. In the delay versus immediacy (DvI) condition, he allocated 94% of his time to immediacy; 100% in immediacy versus rate (IvR); and 0% in both quality versus immediacy (QvI) and in effort versus immediacy (EvI). In the DvI and the IvR condition, obtaining immediate reinforcement was strongly influential over delay and rate of reinforcement. Rate was not effective in influencing any of Milton’s responses, scoring only 3% in RvQ, 10% in RvE and 0% in IvR. Quality of reinforcement overrode immediacy in QvI which indicated that he was willing to delay reinforcement if he deemed the
reinforcers provided worthwhile. Response effort (low effort) overrode immediacy in EvI which suggests impulsivity as described above.

For Mallory, immediacy was the second most influential dimension to which she allocated an overall mean of 71% of her time (only 7% lower than her most influential dimension (quality). In the DvI condition, Mallory allocated 98% of her time to immediacy; 42% in IvR; 48% in QvI; and 93% in EvI. When immediacy competed against delay and effort, the immediacy dimension was strongly favored. When immediacy competed with quality, it was almost equal, with quality having a 2% lead. Immediacy was least influential (42%) when it competed against rate, which indicated that rate of reinforcement for Mallory had a slightly stronger influence than immediacy of reinforcement. Mallory’s choices confirmed impulsivity because it remained a strong contender in all 4 dimensions. Between 42% to 98% of her choice responses were allocated to the immediacy condition, suggesting that impulsivity is a strong characteristic for Mallory. Results show that impulsivity was reflected in the choices of both Milton and Mallory, both of whom have been diagnosed with ADHD.

(3) Research Question #3: To what extent are self-monitoring procedures based on an assessment of influential reinforcer dimensions differentially effective in increasing on task behavior, academic accuracy and productivity?

Based on the assessment of influential reinforcer dimensions in Study 1, an intervention designed to increase on task behavior, academic accuracy and productivity was implemented with the hope that each student would differentially distinguish between the most and least influential dimensions. Milton and Mallory
made improvements in accuracy, fluency and on-task behavior during intervention. While both conditions were equally effective in maintaining high percentages of on-task behavior, the performance of both students showed no difference between the alternating conditions. With Milton, it was predicted that he would spend less time on the low effort, low rate condition and more time on high effort, high rate in an multi-element design, where conditions were singularly presented. With Mallory, it was predicted that she would choose to allocate more of her time to the high quality, high effort condition over the low quality, low effort condition. Although on-task behavior during intervention increased significantly for both participants, the percentage remained approximately the same between conditions. Milton went from a 44% mean (range, 25%-58%) on task during baseline to a 96% mean (range, 96%-100%) for the LE, LR condition and a 98% mean (range, 97%-98%) for the HE, HR condition. Mallory went from a 46% mean (range, 30%-60%) on task performance during baseline to a 96% mean (range, 95%-97%) for the LQ,LE condition and a 96% mean (range, 87.5%-100%) for the HQ,HE condition. Milton’s on task performance had only a 2% variance, while Mallory’s on task performance remained the same for both conditions.

For both students, the graphs depicting the percentage of intervals on-task (Figures 6.11 and 6.12) show experimental control with the low percentages of on-task behavior during returns to baseline. Clearly, the self-monitoring interventions had a strong effect on improving each student’s on-task behavior during both conditions. Returns to baseline where each student completed regular classroom worksheets during independent seatwork showed returns to low
percentages of on-task behavior. Although the self-monitoring procedures were effective in improving on-task behavior significantly during both conditions, they were not differentially effective between the dimensions identified as most and least reinforcing in Study 1. However, I will summarize the accuracy and rate results below. During Study 2, where the self-monitoring worksheet was used, Milton completed an average mean during baseline of 4.2 LE, LR problems per minute with an accuracy percentage of 81%. Mallory completed 5.2 LE,LQ problems per minute with an accuracy percentage of 94%.

During intervention, Milton completed an overall mean of 5.9 LE,LR problems per minute with an accuracy percentage of 96% and 4.5 HE,HR problems per minute with a 75% accuracy. Mallory completed 6.5 LQ,LE problems per minute with an accuracy percentage of 96% and 4.7 HQ,HE problems per minute with a 92% accuracy. Both participants demonstrated an improvement in their fluency and accuracy in basic mathematics facts. Milton raised his LE, LR problem per minute by 29%, working 1.7 more problems per minute at the end of the study. His accuracy rate increased by 16% by LE,LR and by 24% for HE,HR by the end of the study. Mallory raised her LQ,LE problem per minute by 20%, working 1.3 more problems per minute. Her accuracy rate increased by 2% for LQ,LE problems and showed a decrease of 1% for HQ,HE, taking into account the difficulty level of these problems were increased. So, she maintained her accuracy rate within 1% between the easier and more difficult problems later in the study, indicating success of maintaining accuracy with the presentation of harder problems.
Research Question #4: To what extent do the teachers view the procedures and results as socially valid?

The social significance of the target behavior, the appropriateness of the procedures, and the social importance of the results were all addressed (Wolf, 1978). Both teachers rated the study as being socially significant in that it did produce an increase in the measured dimensions of the target behaviors. Both teachers addressed any concerns that they had with the appropriateness of the procedures. Both agreed that they would not use reinforcers for their own personal reasons given. They both agreed that they liked the intervention and would possibly use it in their classrooms, as well as recommend its use to other teachers or professionals. As for the social importance aspect, Milton’s teacher noted a socially valid improvement in his behavior in other areas, as well as improved performance in his mathematics skills. While Mallory’s teacher maintained a neutral stance on Mallory’s overall on-task performance during the school day, she did note that she improved in her mathematics skills. Both expressed that each of the students benefited academically from the study.

General Discussion

The results of the Study 2 intervention were not consistent with the validity of the Study 1 assessment findings. However, during the final phase, when concurrent presentations of the conditions were offered, Milton selected low effort over high effort problems and Mallory chose high quality over low quality problems which was consistent with the most influential dimension in Study 1. For the most part, both students distinguished the difference between the two conditions during the alternating phase of the design. Although Milton expressed on numerous
occasions that he was “working fast” to get as many points as possible so that he could get more prizes, he did not distinguish the fact that the rate of reinforcement was higher for the high effort problems than the low effort. Mallory recognized the distinction mainly because of the effort level of the problems presented and the quality of reinforcers associated with each condition. Mallory continued to select problems yielding high quality reinforcers during concurrent presentations of both dimensions, as she did during the Study 1 assessment phase. The effort level of the problems was not significant to her, as she would work on which ever side offered the better reinforcers. For Milton and Mallory, the effectiveness of the intervention for decreasing classroom disruptions and increasing on task behavior was related to the self-monitoring procedures used in the interventions.

Implications for Practice

The results of Study 1 extended the research by Neef and Lutz (2001) by not only comparing different levels of influential dimensions (e.g. HRvLR) but in that preferences in terms of the most preferred and the least preferred were identified. Because both participants allocated a high percentage of their time to immediacy and/or low effort problems, impulsivity was confirmed to be a strong characteristic for both. This finding is consistent with one of the diagnostic characteristics of ADHD. Milton demonstrated impulsivity in that he chose easier over more challenging work, regardless of the better benefit (higher rate of reinforcement) of doing the harder problems. “Choices governed by easy problems might reflect a form of impulsivity, in that the latency to both positive (point delivery) and negative reinforcement (termination of the problem stimulus) is longer for difficult problems.
because they take more time to complete than easy problems” (Neef, 2002, p. 12).

Milton also was inattentive in that he did not discriminate rate of reinforcement between the conditions during Study 1 and this remained consistent in Study 2. However, the intervention did aid in strengthening his inattentiveness by the noted percentages above of his on-task behavior. Also, although he did still choose the easier over the harder problems when given a choice, he made significant gains in his accuracy and fluency in both conditions. During the initial assessment, Mallory allocated more of her time to easier problems as well. Mallory’s intervention was designed to encourage her to challenge herself with more difficult problems, with the incentive of more quality reinforcers. The intervention was successful in this intention. Reinforcer quality was a highly influential dimension and in Mallory’s case, successfully competed with low response effort to effect self-control. She also made gains in her academic fluency, accuracy, and on-task behavior.

Results also suggest that interventions where self-monitoring procedures are implemented and practiced are more effective for ADHD students in a general education environment than standard teaching practices that do not incorporate self-monitoring skills into their repertoire. It also implies that using self-monitoring methods to raise accuracy and fluency automatically produces high percentages of on-task behavior which occurred with both participants. Each student was able to control their learning environment more effectively by making choices, pacing themselves accordingly, checking their answers, recording their own scores, and assessing their overall performance. With self-monitoring, strong immediate consequences are provided, which combats the inattentive characteristic of ADHD.
By managing their own environment, these students learn how to use and apply functional skills that may transfer or generalize to other environments. As mentioned in Chapter 2, low motivation is a common trait of students with ADHD. Through this active learning method and the control of their academic outcomes, their level of motivation is raised and increased confidence is gained.

Results also suggested that while the use of self-monitoring procedures were highly effective in improving on-task behavior, with smaller gains in academic accuracy and rate, the self-monitoring procedures may have been so reinforcing that the participants did not discriminate between the alternating conditions in Study 2. Both students were in classrooms that did not use reinforcers and used traditional worksheets during independent seatwork. During Study 2, each student successfully monitored their own learning and came in direct contact with reinforcement. Milton would check his previous day’s score and work to beat that score in the next session. Three reasons why the procedures may have been so reinforcing are: (1) Each student felt a sense of accomplishment and met with success at every session. (2) Each student obtained reinforcement at the close of each session, as opposed to none at all in their regular education classrooms. (3) The self-monitoring procedures were completed using a game-like format with the invisible ink, which both students told me they liked. It may be possible that any or all of these three reasons could have been reinforcing to each participant to the point that although they may actually have discriminated between the two conditions, they still chose to work to
their full potential to gain success, reinforcement, and/or just for the fact that it was fun (presented in a game-like format), unlike worksheets completed in their own classrooms.

Another implication is that both students were on medication to help regulate this disorder, yet impulsivity still strongly affected their choices. This is cause to ponder if the dosage of the medication was accurate for regulating their behavior or is the medication even effective at all in controlling impulsive behavior.

Limitations and Suggestions for Future Research

An assessment of individual sensitivities to these reinforcement dimensions proved ineffective in determining an effective treatment program for both participants. Suggestions for future research would be to use a larger number of participants to gain a broader assessment of the potential benefits of choice responding. This would help in determining if interventions informed by assessment measures using choice responding procedures to identify least and most influential dimensions are effective with other children with ADHD. It could be that the 2 participants used in this study just didn’t respond as expected, and using a larger participant audience may establish entirely different results.

There was no control group used in this particular study, in which to compare the responses of children with ADHD to those who are not ADHD. In a study by Kollins (1997), a concurrent schedules arrangement was used to examine the reactions of ADHD and non-ADHD children to changes in reinforcement schedules. Results suggested that ADHD children were less sensitive to these changes than the control group. It is interesting to note that both of the ADHD
participants used in this study did not distinguish when changes in the reinforcement schedules were made. On task performance during both conditions was virtually the same (Milton showed a 1% difference in on task performance between conditions; Mallory's remained the same, 96%, for both conditions.) It would have been advantageous to include 2 non-ADHD students in this study to examine their responses and sensitivity to changes and then compare them to those of the 2 ADHD participants.

Another limitation is that due to time constraints, the opportunity to determine the extent, if any, that the students generalized the self-monitoring procedures to other academic areas and environments remains undetermined. In ideal future research, an extended study, which followed the students into the following school year would be paramount to determining the effects of generalization.

A fourth limitation of the study is that we used 2 ADHD students who were both on Ritalin, so the effects of the study could have been altered somewhat based on the knowledge that stimulants are mood altering drugs that help to regulate the levels of certain chemicals in the brain. By regulating these levels, a person is able to block out distractions in the background and pay attention to what they need to focus on. In future research, it would be interesting to compare a group of non-medicated students with ADHD versus medicated students with ADHD in their response allocations and the effects of self-monitoring procedures on their academic productivity, accuracy, and on-task behavior.
Summary

With respect to baseline, on-task performance improved in a socially significant way for both students. In terms of social validity, the experiment was successful in meeting the teachers' expectations for improved performance. The students also gained exposure to self-monitoring practices and procedures, which were effective in improving on-task behavior, academic accuracy, and rate and hopefully will generalize to other environments. I still conclude that choice responding assessments are useful in guiding and implementing treatment efforts more precisely than assessments which employ a rating format. By evaluating this study, we can modify and adjust the intervention to meet the needs of future participants diagnosed with ADHD in need of improving upon a specific behavior. In conclusion, this study was successful in identifying reinforcer and response dimensions most and least likely to influence a person's choices. Determining the effectiveness of treatments informed by this type of assessment remains for future research to explore.
REFERENCES


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APPENDIX A

LETTER TO PARENTS AND CONSENT FORM
December 14, 2001

Dear Parents,

I am a professor of Special Education at The Ohio State University. My graduate students and I are conducting a study on factors that affect the choices made by children with and without a diagnosis of ADHD. To look at this, we will be using a computer-based assessment in which children can earn points exchangeable for rewards (e.g., small toys, stickers, or snack items which they choose) for selecting and completing math problems within their capabilities. For example, in some cases children can choose between math problems that offer greater rewards available at a later time or fewer rewards that are available right away. The assessment sessions take about 15-20 minutes to complete and would be conducted 2 to 5 days per week over a 2 to 4 week period. All of the sessions will occur during the school day.

The computer-based assessment poses no risk to your child. The benefits to your child include practice working on math problems. Your child’s identity will remain anonymous should we use the information in any reports, presentations, or publications.

Participation in this study is voluntary; you or your child will be free to withdraw his or her participation at any time without prejudice or penalty. In order to be eligible for participation, we must have your written permission on the consent form on the next page.

If you have any questions at any time please feel free to contact me by phone at (614) 688-8107 or by email at neef.2@osu.edu.

Sincerely,

Nancy A. Neef, Ph.D.
Project Director
CONSENT FOR PARTICIPATION IN RESEARCH

I consent to the participation of my child, ________________________, in the research project on factors affecting impulsivity versus self control in the choices of children with ADHD.

Dr. Nancy Neef, Principal Investigator, or her authorized representative, Nancy M. Armstrong, has explained the purpose of the study, the procedures to be followed, and the expected duration of my child’s participation.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Furthermore, I understand that I am free to withdraw my consent at any time and to discontinue participation in the study without prejudice to my child or me.

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date:__________________  Signed:______________________
(Principal investigator or authorized representative)

Signed:__________________  Signed:______________________
(student)

Signed:__________________  Signed:______________________
(parent)
APPENDIX B

STUDENT DEMOGRAPHIC INFORMATION
ADHD PROJECT
STUDENT DEMOGRAPHIC INFORMATION
CONFIDENTIAL

Name:

DOB: Age: Free Lunch? Y N Sex: M F Race:

Parent(s) Name: Phone #:

School: Teacher: Room #

Medication
Type: Dosage: Times Administered:

Achievement tests and scores (math):

IQ test and score:

Diagnostic information for meeting DSM-4 criteria for ADHD:

Diagnosis made by: School Psychologist Physician Other

Instruments used Score Date

Subtype (if known)

Other disabilities diagnosed? (list, if any)

Classroom performance or management goals/concerns (if applicable):

List any preferred stimuli for rewards:

Other relevant information:
APPENDIX C

SESSION SUMMARY SHEET
ADHD PROJECT SESSION SUMMARY

Student Name ___________________________ Date ___/___/___ Time _______ Condition _______

GRA Initials _______ Primary ____ Secondary (IOA) ____

Preference Assessment

List items selected in order from most to least preferred, and the point price assigned. At end of
session, circle the item(s) purchased by the S.

STORE A Price STORE B Price

1. 6.
2. 7.
3. 8.
4. 9.
5. 10.

Duration of practice session ___ min. Inactivity Time _____ sec.

Math Task Parameters

SET 1 PROBLEMS SET 2 PROBLEMS

VI Schedule ___________ VI Schedule ___________

Type of probs & difficulty level ______________ / ______________ Type of probs & difficulty level ______________ / ______________

Store/Reward ___________ Store/Reward ___________

When item provided ___________ When item provided ___________

Session Data Summary

SET 1 PROBLEMS SET 2 PROBLEMS TOTAL

# Correct ___________ ___________ ___________

# Incorrect ___________ ___________ ___________

Total Attempted ___________ ___________ ___________

Amount of time Spent (duration) ___ min ___ sec ___ min ___ sec ___________

# points earned ___________ ___________ ___________
APPENDIX D

SAMPLE MATH SHEETS, STUDY 2
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| 18    | 11    | 18        | 19        | 19  |                   |
| +8    | +15   | +7        | +4        | +11 |                   |

| 10    | 18    | 15        | 18        | 15  |                   |
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| +9    | +5    | +8        | +6        | +9  |                   |

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APPENDIX E

STUDY 2 TALLY SHEET
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**Tally Sheet**
APPENDIX F

EXPERIMENTAL PROTOCOLS, STUDY 2, MILTON
Protocols for Milton’s Off Task Intervention:

*Using a multi-element design

Session A: Low Effort, Low rate of Reinforcement

1. On the average, 1 point will be given after every 10th problem.
2. Each answer will be written in invisible ink in a box under the student’s answer box for each problem.
3. Student will complete each problem across the page, row by row.
4. At the completion of the worksheet, the student will check his own answer by revealing the correct answer under each box.
5. If the answer box has an asterisk by the answer, and the student answered the problem correctly, the student gets 1 point.
6. After the student self-checks his own paper, he will record the number of points earned, number of problems correct, incorrect, and total attempted on the tally page and turn it in to the teacher/observer to redeem for prizes.
7. If the student is caught cheating, he will forfeit his prizes for the session.
8. Each prize cost 4 points.
9. The student will receive the prize(s) at completion of the session.
10. Low effort problems will be addition problems sums 0-30.

With Student:

11. Complete preference assessment with 10 items of medium-high quality.
12. Instructions to student before giving worksheet:

“You will independently complete this math worksheet. You need to work the problems from left to right in each row, not skipping any problems. Then go to the next row down and do the same until you finish the worksheet. You are to record your answer in the 1st box under each problem. After you finish each problem, you need to use this marker to check your answer. In each box below your answer, the correct answer has been written in invisible ink. You will rub this marker over each box to reveal each correct answer. If there is
an asterick beside the answer (show student an asterick), and your answer was correct, then you get 1 point. After you have finished the worksheet, total your points, number of problems correct, incorrect, and total attempted and write them on the tally sheet. You will then turn your paper in to the teacher/observer. If you are caught changing your answer afterwards or looking to see what the correct answer is before you have written your own answer, you will lose all your points and your chances to earn a prize today. Each prize cost 4 points. If you have enough points to earn a prize, you will receive your prize at the end of the session.

**Session B: High effort, High rate of reinforcement**

1. On the average, one point will be given after every 3rd problem.
2. Each answer will be written in invisible ink in a box under the student’s answer box for each problem.
3. Student will complete each problem across the page, row by row.
4. At completion of the worksheet, the student will check his own answers by revealing the correct answer under each box.
5. If the answer box has an asterick by the answer, and the student answered the problem correctly, the student gets 1 point.
6. After the student self-checks his own paper, he will record the number of points earned at the top of the page and turn it in to the teacher/observer to redeem for prizes.
7. If the student is caught cheating, he will forfeit his prizes for the session.
8. Each prize cost 4 points.
9. The student will receive the prize(s) at completion of the session.
10. High effort problems will be multiplication 0-9.

With Student:

13. Complete preference assessment with 10 items of medium-high quality.
14. Instructions to student before giving worksheet:

“You will independently complete this math worksheet. You need to work the problems from left to right in each row, not skipping any problems. Then go to the next row down and do the same until you
finish the worksheet. You are to record your answer in the 1st box under each problem. After you finish each problem, you need to use this marker to check your answers. In each box below your answer, the correct answer has been written in invisible ink. You will rub this marker over each box to reveal each correct answer. If there is an asterick beside the answer (show student an asterick), and your answer was correct, then you get 1 point. After you have finished the work-sheet, total your points, problems correct, incorrect, and total attempted and write them on the tally sheet. You will then turn your paper in to the teacher/observer. If you are caught changing your answer after you are done or looking to see what the right answer is before you have written your answer, you will lose all your points and your chances to earn a prize today. Each prize cost 4 points. If you have enough points to earn a prize, you will receive your prize at the end of the session.
Protocols for Mallory’s Off Task Intervention:

*Using a multi-element design

**Session A: Low Quality, Low Effort**

1. On the average, 1 point will be given after every 11th problem. There will be 100 problems on a worksheet. (Potentially earning a maximum of 9 points and 3 low quality prizes.)
2. Each answer will be written in invisible ink in a box under the student’s answer box for each problem.
3. Student will complete each problem across the page, row by row.
4. After completion of each problem, the student will check her own answer by revealing the correct answer under each box.
5. If the answer box has an asterisk by the answer, and the student answered the problem correctly, the student gets 1 point.
6. After the student self-checks her own paper, she will record the number of points earned, number of problems correct, incorrect, and total attempted on tally sheet and turn it in to the teacher/observer to redeem for prizes.
7. If the student is caught changing her answer after she is done or looking to see what the correct answer is before she has written her answer, she will forfeit her prizes for the session.
8. Each low quality prize cost 3 points.
9. The student will receive the prize(s) at completion of the session.
10. Low effort problems will be addition problems sums 0-30.
11. The student will have 10 minutes to complete the worksheet.

**With Student:**

12. Present to student 10 items (teacher selected) of low quality.
13. Conduct preference assessment of 10 items. Place them on a numbered list (1-10) in order from most preferred to least preferred. Place the last 5 (least preferred) to the side for her to see. Remove the first 5 (most preferred prizes). Show student a pile of 5 cards, numbered 6-10. The least preferred prizes will be listed as 6-10.
*Explain to student: “Today you will be working for these regular prizes. (show student prizes) For every 3 points that you earn doing math problems, you can draw a card (numbered 6-10) showing which prize you get.

14. Instructions to student before giving worksheet:

“You will independently complete this math worksheet. You need to work the problems from left to right in each row, not skipping any problems. Then go to the next row down and do the same until you finish the worksheet. You are to record your answer in the 1st box under each problem. After you finish each problem, you need to use this marker to check your answer. In each box below your answer, the correct answer has been written in invisible ink. You will rub this marker over each box to reveal each correct answer. If there is an asterick beside the answer (show student an asterick), and your answer was correct, then you get 1 point. After you have finished the worksheet, total your points, problems correct, incorrect, and total attempted on this tally sheet. You will then turn your paper in to the teacher/observer. If you are caught changing your answer afterwards or looking to see what the correct answer is before you have written your own answer, you will lose all your points and your chances to earn a prize today. Each prize cost 3 points. If you have enough points to earn a prize, you will receive your prize at the end of the session.

Session B: High quality, High effort

1. On the average, one point will be given after every 11th problem. There will be 100 problems on a worksheet. (Potentially earning a maximum of 9 points and 3 high quality prizes.)
2. Each answer will be written in invisible ink in a box under the student’s answer box for each problem.
3. Student will complete each problem across the page, row by row.
4. At completion of the worksheet, the student will check her own answers by revealing the correct answer under each box.
5. If the answer box has an asterick by the answer, and the student answered the problem correctly, the student gets 1 point.
6. After the student self-checks her own paper, she will record the number of points earned, number problems correct, incorrect, and total attempted on the tally sheet and turn it in to the teacher/observer to redeem for prizes.

7. If the student is caught changing her answer after she is done or looking to see what the correct answer is before she has written her answer, she will forfeit her prizes for the session.

8. Each prize cost 3 points.

9. The student will receive the prize(s) at completion of the session.

10. High effort problems will be single digit division.

11. The student will have 10 minutes to complete the worksheet.

With Student:

12. Complete preference assessment with 10 items of high quality that the student has selected out of the available prizes.

13. Place items in order of preference in the student’s view. Student will be given prizes in order of most preferred down to least preferred.

   a. Instructions to student after doing preference assessment:

   “You will be working for these special prizes today. (show student prizes) For every 3 points that you earn doing math problems, you can draw a card (numbered 1-5) showing which prize you get. (demonstrate) If you earn points for more than one card and the same number is drawn again, there won’t be a prize because you already got that one. Here’s the way to earn points.”

14. Instructions to student before giving worksheet:

   “You will independently complete this math worksheet. You need to work the problems from left to right in each row, not skipping any problems. Then go to the next row down and do the same until you finish the worksheet. You are to record your answer in the 1st box under each problem. After you finish each problem, you need to use this marker to check your answers. In each box below your answer, the correct answer has been written in invisible ink. You will rub this marker over each box to reveal each correct answer. If there is an asterisk beside the answer (show student an asterisk), and your
answer was correct, then you get 1 point. After you have finished the worksheet, total your points, number problems correct, incorrect, and total attempted and write them on the tally sheet. You will then turn your paper in to the teacher/observer. If you are caught changing your answer after you are done or looking to see what the right answer is before you have written your answer, you will lose all your points and your chances to earn a prize today. Each prize cost 3 points. If you have enough points to earn a prize, you will receive your prize at the end of the session.
APPENDIX H

PROCEDURAL INTEGRITY FORMS
Procedural Integrity Checklist:
High Effort, High Rate for On Task Intervention

Child: Million  Date: 5/7/02  Session: 33  Observer: RC

1. Experimenter completes preference assessment with 10 items of medium-high quality.

2. Experimenter reads student the rules for the condition in effect.

3. Experimenter gives a stapled packet of high effort problems and a marker and once student is seated, nods for student to begin.

4. Experimenter will stop student once 10 minutes is up. Student will tally up his points and give the packet to the experimenter.

5. Experimenter will check student’s total points earned.

6. Experimenter has student choose a prize for every 4 points earned at the end of the session.

7. Experimenter or teacher gives the prize(s) at the end of the session.

+ Observed
- Not observed
NA Not applicable
Procedural Integrity Checklist:
Low Effort, Low Rate for On Task Intervention

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1. Experimenter completes preference assessment with 10 items of medium-high quality.

2. Experimenter reads student the rules for the condition in effect.

3. Experimenter gives a stapled packet of low effort problems and a marker and once student is seated, nods for student to begin.

4. Experimenter will stop student once 10 minutes is up. Student will tally up his points and give the packet to the experimenter.

5. Experimenter will check student’s total points earned.

6. Experimenter has student choose a prize for every 4 points earned at the end of the session.

7. Experimenter or teacher gives the prize(s) at the end of the session.

+ Observed
- Not observed
NA Not applicable
Procedural Integrity Checklist:
High Quality, High Effort for On Task Intervention

Child: Date: Session: Observer:

1. Experimenter completes preference assessment with 10 items of high quality. _______

2. Experimenter pulls first (most preferred) 5 items (items 1-5) and tells student that she will be working for these special prizes today. _______

3. Experimenter reads student the rules for the condition in effect. _______

4. Experimenter gives a stapled packet of high effort problems and a marker and once student is seated, nods for student to begin. _______

5. Experimenter will stop student once 10 minutes is up. Student will tally up her points and give the packet to the experimenter. _______

6. Experimenter will check student’s total points earned. _______

7. For every 3 points earned, experimenter has student choose from cards 1-5 for a prize. If more than 1 prize is earned, the student will select a card and get the prize that corresponds to that number. Experimenter will place that card back into the deck, resuffle and allow student to choose again. Experimenter will repeat this procedure until all points have been redeemed. (If student draws the same number card again, student will not get a prize.) _______

+ Observed
- Not observed
NA Not applicable
Procedural Integrity Checklist:  
Low Quality, Low Effort for On Task Intervention

Child: Date: Session: Observer:

1. Experimenter completes preference assessment with 10 items of low quality.  

2. Experimenter pulls last (least preferred) 5 items (items 6-10) and tells student that she will be working for these regular prizes. 

3. Experimenter reads student the rules for the condition in effect. 

4. Experimenter gives a stapled packet of low effort problems and a marker and tells student that she will be working for these regular prizes. 

5. Experimenter will stop student once 10 minutes is up. Student will tally up her points and give the packet to the experimenter. 

6. Experimenter will check student's total points earned. 

7. For every 3 points earned, experimenter has student choose from cards 6-10 for a prize. If more than 1 prize is earned, the student will select a card and get the prize that corresponds to that number. Experimenter will place that card back into the deck, reshuffle and allow student to choose again. Experimenter will repeat this procedure until all points have been redeemed. (If student draws the same number card again, student will not get a prize.) 

+ Observed  
- Not observed  
NA Not applicable
APPENDIX I

SOCIAL VALIDITY QUESTIONNAIRE
SOCIAL VALIDITY QUESTIONNAIRE

Instructions: Please answer each question according to the following rating scale.

1=strongly agree       3=neutral/undecided       5=strongly disagree
2=slightly agree       4=slightly disagree

1. Did you see an improvement in the student’s on-task performance during intervention?

   1  2  3  4  5

   Comments:

2. Did you see an improvement in the student’s on-task performance, in general, during the school day?

   1  2  3  4  5

   Comments:

3. Did you see an improvement in the student’s mathematics skills in the areas of accuracy and rate?

   1  2  3  4  5

   Comments:

4. Regarding the self-monitoring procedures used, do you feel that the procedures helped the student improve in skills of self-management in other academic areas?

   1  2  3  4  5

   Comments:
5. Do you feel that the schedules of reinforcement in place were appropriate and effective?

1 2 3 4 5

Comments:

5. Did you feel that any aspect of the study interfered with the structure of your classroom environment?

1 2 3 4 5

Comments:

6. Would you feel comfortable implementing or using this intervention in your classroom with other students with similar problems?

1 2 3 4 5

Comments:

7. Did you like the intervention?

1 2 3 4 5

Comments:

8. Would you recommend this intervention to other teachers or professionals?

1 2 3 4 5

Comments:

10. What would you change about this intervention?