AN INVESTIGATION OF THE EFFECTS OF BEHAVIORAL AND PHARMACOLOGICAL INTERVENTIONS ON THE ACADEMIC PERFORMANCE OF STUDENTS WITH ADHD.

by

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Abstract

ADHD is a potentially life-long condition that is first diagnosed in childhood and has no known cure. In addition to having behavior problems such as inattention and hyperactivity, the disorder impacts other areas of the child's functioning, including academic performance. Treatments for ADHD have commonly focused on improving the behavioral manifestations of the disorder with very few studies examining the impact of these treatments on other areas of functioning. Academic performance and homework completion are common concerns cited by the parents of children with ADHD. The present study examined the impact of medication and behavior therapy on the homework performance of children with ADHD. Six children attending 4th or 5th grade participated in this study. Data were collected on the child's homework completion and accuracy and classroom behavior during medication, behavioral therapy, and no-treatment conditions. Both treatments improved homework performance and classroom behavior for all six participants. Behavior management resulted in a more consistent performance on homework compared to the medication condition. Limitations and considerations for future research are discussed.

Introduction

Attention deficit hyperactivity disorder (ADHD) is a diagnostic label given to a heterogeneous group of children who have significant difficulties in attention, impulse control, and overactivity (American Psychiatric Association [APA], 1994). ADHD is one of the most prevalent psychiatric disorders of childhood in the United States for which there is no known cure (American Academy of Pediatrics, 2000; American Medical Association [AMA], 1998; Rivas-Vasquez, 2003; Spencer, Biederman, & Wilens, 2000a). The American Academy of Pediatrics (2000) reports that 6% of school-aged children are affected by ADHD with boys being diagnosed more often than girls with ratio estimates as high as 6:1 (Brown, 2000). A population-based study by Neuman, Sitdhiraksa, Reich, Ji, Joyner, Sun et al. (2005) found a prevalence rate of about 7% and a male to female sex discrepancy of 2:1. Children with ADHD have marked difficulty concentrating and maintaining appropriate activity levels; they are easily distracted, fidgety, and interrupt normal classroom and social interactions. Behavior in these children is usually disorganized, haphazard, and not goal-directed (Schwiebert, Sealander, & Tollerud, 1994). ADHD can lead to academic difficulties as well as behavioral, emotional, and social problems, problems with self-esteem, and negative interactions with teachers, parents, and peers (Brown 2000; DuPaul, Guevremont, & Barkley, 1992; Klaussen, Miller, Rayna, Lee, & Olson, 1999; Spencer et al., 2000a).

ADHD appears to be pervasive, resulting in a number of undesirable outcomes. ADHD in children and adolescents often is associated with: (1) distress in families

(Barkley, McMurray, Edelbrock, & Robbins, 1989); (2) marked functional impairment (Rucklidge & Kaplan, 1997); (3) poor academic achievement (DuPaul & Weyandt, 2006); (4) an increase in the likelihood of substance use and abuse (Molina, Smith & Pelham, 1997); and (5) relational problems in families, educational, and occupational settings (Eakin, Minde, Hechtman, Ochs, Krane, Bouffard et al., 2004). Thus, ADHD can have potentially serious consequences for affected individuals and their families. ADHD and its associated problems, which predominately are expressed as and result from inattention, continue into adulthood for as many as 70% of affected children and teens (Adler & Chua, 2002; AMA, 1998; Faraone, Biederman, & Mick, 2006; Kordon, Kahl, & Wahl, 2006; Rivas-Vasquez, 2003; Weyandt & DuPaul, 2006).

History of ADHD

ADHD, as it is currently defined and diagnosed, is a relatively new classification in terms of its conceptualization as a deficit in the ability to regulate attention and cognitive function (Barkely, 1997, 2006). Among researchers who study ADHD, there appears to be a consensus that the disorder was first recognized, described, and brought to clinical attention by Dr. George Still, a British pediatrician (Barkley, 1998; Connors, 2000; Rafalovich, 2001; Rowland, Lesene, & Abramowitz, 2002; Still, 1902; Stubbe, 2000). In his 1902 Goulstonian lectures, Still described a group of 20 children he recently had studied who were hyperactive and had great difficulty concentrating. Many of these children had concurrent learning disorders and concomitant behavior problems such as impulsivity, law breaking, dishonesty, and

destructiveness (Connors, 2000; Still, 1902). Still stated that parents and teachers commonly reported that this disorder led to significant behavioral problems for the child (Connors, 2000; Rafalovich, 2001; Still, 1902; Stubbe, 2000). Consistent with today's diagnostic trend, Still (1902) found a sex ratio of 3:1 for this disorder, with boys being more frequently diagnosed than girls.

As researchers, scientists, and physicians have continued to study this disorder, several changes in the understanding of the key components of the disorder have occurred. This, in turn, has resulted in several changes in the nomenclature of the disorder. The first change in terminology came after an epidemic of influenza and encephalitis in 1917-1918. A number of children who had been seriously ill with influenza or encephalitis were institutionalized because they suffered brain damage as a result of these diseases. Hospital and school staff found that some children who had suffered from encephalitis subsequently developed hyperactive and distractible behavior that was very similar to the behavior described by Still (Connors, 2000; Rafalovich, 2001; Rowland et al., 2002; Stubbe, 2000). As a result, researchers began to study the differences in the behavioral difficulties experienced by children with mental retardation and brain damage and those with brain damage alone (Connors, 2000; Stubbe, 2000).

In a series of studies, Strauss and Lehtinen (1947) discovered that children with brain damage, such as those who suffered encephalitis, had hyperactivity and distractibility at the core of their problem behavior. Thus, they concluded that excessive motor behavior and distractibility were key indicators of brain damage and

not a unique behavioral syndrome as previously asserted by Still (Connors, 2000; Stubbe, 2000). Other researchers and physicians had already reported similar findings and had concluded hyperactive, distractible behavior was due to an organic brain disturbance (Kennedy, 1924; Strecker, 1929; Strecker & Ebaugh, 1924). As a result, Still's impulsive-hyperactive-distractible syndrome began to be referred to as Minimal Brain Damage (MBD) Syndrome, a diagnostic term coined by Strauss and Lehtinen (Connors, 2000; Strauss & Lehtinen, 1947; Stubbe, 2000).

Research into the causes and symptoms of MBD Syndrome continued and resulted in a second shift in the understanding of the disorder. Laufer and colleagues (1957) reported that MBD syndrome could and did occur in children who did not have any detectible brain damage. In most cases, no evidence of brain damage was found. These findings led researchers to abandon the hypothesis that hyperactive, impulsive, and inattentive behavior was caused exclusively by brain damage (Laufer & Denhoff, 1957; Laufer, Denhoff & Solomons, 1957). As a result, MBD Syndrome was no longer referred to as minimal brain damage syndrome; it was renamed minimal brain dysfunction. Although this change in terminology seems minor, the new term reflected the results of research that indicated that children without any brain damage could display a hyperactive, impulsive, and inattentive behavior pattern. Hence, researchers determined that this behavior could stem from compromised brain function or brain damage, injury, or insult (Rafalovich, 2001; Stubbe, 2000).

Minimal brain dysfunction was a popular topic of research during the 1960s and 70s with over 200 published studies of this hyperactive behavior pattern in children appearing in the literature during those 2 decades (Barkely, 2006; Conners, 2000). This body of research yielded two important outcomes. First, a standard approach to assessment was identified, which, at that time, consisted of: (1) observation or history of hyperactivity, impulsivity, and/or distractibility; (2) measurement of learning abilities; (3) interviews with teachers and parents; and (4) identification of neurological indicators as measured by an EEG (Clements & Peters, 1962; Connors, 2000). Second, researchers identified the inability to control motor functions, impulse, and attention as the key components of Minimal Brain Dysfunction. Perceptual, learning, and other deficits were considered to be variable attributes of the disorder and were not necessary for diagnosis (Clements, 1966; Stubbe, 2000). These findings resulted in a formal change from the term "minimal brain dysfunction" to "hyperkinetic syndrome," a change that was reflected in both the International Statistical Classification of Diseases, 8th edition (ICD-8) (World Health Organization [WHO], 1968), and the Diagnostic and Statistical Manual, 2nd Edition (DSM-II) (APA, 1968).

The term “attention deficit disorder” is unique to the United States and first appeared in the DSM-III (APA, 1980). The selection of this diagnostic label resulted from the findings of over 200 studies of minimal brain dysfunction and/or hyperkinetic syndrome that pointed to the inability to regulate attention as the most salient characteristic of the disorder (Barkley, 2006; Connors, 2000; Rowland et al.,

2001; Stubbe, 2000). As a result, subsequent publications of the DSM continued to use the term attention deficit disorder to refer to the cluster of inattentive, impulsive and hyperactive symptoms whereas successive publications of the ICD, including the 10th edition that is currently used in Europe and Asia, retained the name hyperkinetic syndrome.

The DSM-IV-TR (APA, 2000), the current edition of the diagnostic manual, continues to focus on inattention as the key deficit associated with ADHD. For a diagnosis of ADHD to be made, the individual must meet a number of diagnostic criteria. In addition to the manifestation of behavioral symptoms, the symptoms must have been present prior to the age of 7, they must occur in at least 2 settings (e.g., school and home), and the symptoms create a clinically significant, functional impairment in social, academic, and/or occupational performance. The DSM-IV-TR also allows for a diagnosis as to the specific type of ADHD that the child exhibits. If the child experiences 6 or more of the hyperactive-impulsive symptoms, he or she is said to have ADHD, Predominately Hyperactive-Impulsive Type. If the child has 6 or more of the inattentive symptoms, he or she is diagnosed with ADHD, Predominately Inattentive Type. And finally, if a child has 6 or more hyperactive symptoms and 6 or more inattentive symptoms, he or she is diagnosed with ADHD, Combined Type.

In addition to the direct behavioral symptoms of the disorder listed in the DSM-IV-TR, children with ADHD experience a number of additional difficulties. These difficulties include poor parent-child relationships, negative teacher-child interactions, poor social skills, oppositional behavior, aggression, and internalizing

problems such as anxiety or depression. (Connor, Glatt, Lopez, Jackson, & Melloni, 2002; Faraone & Biederman, 2002; Multimodal Treatment Associates [MTA] Cooperative Group, 1999; Tannock, Purvis, & Schachar, 1993; Tutty, Gephard, & Wurzbacher, 2003). One of the more prominent difficulties associated with ADHD is academic underachievement (Barry, Lyman & Klinger, 2002; Ryan, Reid, Epstein, Ellis, & Evans, 2005; Wolraich, Wibbelsman, Brown, Evans, Gotlieb, Knight et al., 2005). Academic performance is an area of concern because academic underachievement in students with ADHD correlates with a number of undesirable outcomes including increased risk for school failure, grade retention, dropping out of high school, and later employment difficulties (Barkley, 1998; Harpin, 2005; Henshaw, 1992; Hoza, Waschbush, Pelham, Molina, & Milich, 2000).

At the present time, three interventions are recognized as efficacious for the treatment of the core symptoms of ADHD. According to the National Institutes of Health (NIH) effective treatments for ADHD include: (1) the use of stimulant medications; (2) the use of behavioral therapy; and, (3) the combination of these two treatments (NIH, 2000). Despite demonstrating efficacy for the core symptoms of ADHD, these treatments have inconsistent impacts on improvement in the academic difficulties experienced by some children with ADHD. Stimulant and behavioral therapy are reviewed in terms of their effectiveness at reducing the core symptoms of ADHD and the associated problem of academic underachievement.

Stimulant Medication

Stimulants have been used in the treatment of ADHD since 1937, when Dr.

Charles Bradley serendipitously discovered the beneficial impact of stimulant medication on the hyperactive and distractible behavior of children (Bradley, 1937; Connors, 2000). When children who had suffered encephalitis underwent medical tests to determine the extent of their brain damage, many of them complained of headaches shortly after medical testing. In an effort to reduce the number of headaches the children experienced, Dr. Bradley began administering stimulant medication immediately after testing. In addition to decreasing the number of headaches reported, the medication had an unexpected effect on the child's behavior. During the first week of stimulant use during medical testing, hospital staff and teachers reported that the behavior of half of the children had improved (Bradley, 1937; Connors, 2000).

Although Bradley published his results immediately, the beneficial impact of stimulants on hyperactivity, impulsivity, and distractibility did not come to the forefront of medicine until the 1950s and 60s. These decades saw the beginning of tightly controlled clinical trials of stimulant medication for the treatment of children with hyperkinetic behavior. In 1957, these results of these studies led to FDA approval of a stimulant medication to treat hyperkinesis in children (Connors, 2000; Stubbe, 2000). Today, stimulants are the first-line intervention for children with ADHD (Connors, 2000; Friemoth, 2005; Greenhill, 1995; Jenson, 2002; Kratochvil, Helligenstein, Dittman, Spencer, Biederman, Wernickie et al., 2002; Miller, 1999).

Stimulants are preferred as the first-line treatment because they have a quick onset of action, global effects on the core behaviors of ADHD (i.e., inattention,

hyperactivity, impulsivity), and low incidence of side effects (Greenhill, 1995; Spencer, Heilignstein, Biederman, Gaires, Kratochvil, Connors et al., 2002). For the past 50 years, the stimulant of choice has been methylphenidate (MHP) and its derivatives that are marketed under the trade names of Ritalin®, Metadate®, Daytrana®, and Concerta® among others (Conners, 2002; Gray & Kagan, 2000; Wigal, Swanson, Regino, Lerner, Soliman, Steinhoff et al., 1999). Other stimulants that are available include amphetamine-dextroamphetamine compounds that are marketed under the trade names of Adderall® and Dexedrine® among others.

MHP readily crosses the blood-brain barrier and behavioral effects of the medication can be seen 30 to 60 minutes after administration. These improvements in behavior last about 4 to 5 hours on average; thus, multiple doses of traditional stimulant medications are necessary to provide a full day's reprieve from symptoms (Friemoth, 2005; Pliszka, 2003; Spencer et al., 2000; Wolraich & Doffing, 2004). Extended-release and long-acting stimulant preparations in pill or patch form often result in about 8 to 12 hours of improved behavior; however, this may not fully eliminate the need for a second dose of medication after school or in the early evening hours (Kratochvil et al., 2002; Wolraich & Doffing, 2004).

The most readily apparent benefit from the administration of stimulant medication is the reduction in hyperactivity, impulsivity, and inattention, which comprise the core symptoms of ADHD (e.g., Connors, 2002; Jenson, 2002; Spencer et al., 2000; Wolraich & Doffing, 2004). Children taking stimulant medication are generally more attentive and less hyperactive and impulsive than untreated peers with ADHD.

Behavior rating scales (e.g., Connors' Rating Scale) measuring ADHD symptoms that are completed when the child is taking medication often yield scores that are in the average range indicating that the child's attention and activity levels are typical for a child of that age. The administration of stimulant medication is not without side effects. The most common side effects of stimulant medication are insomnia and decreased appetite. These side effects typically abate during treatment; however, when and if they are problematic, a change in dose is generally sufficient to alleviate them (Wigal et al., 1999; Wolrich & Doffing, 2004).

Stimulant medication is the most widely studied medication for ADHD. The efficacy of stimulants in treating the core symptoms of ADHD is well documented in the empirical literature. In a broad search of the databases available via PsychInfo and MEDLINE (PubMed), a search for ADHD and stimulant medication revealed over 224 empirical studies published in peer-reviewed journals since the most recent revision to the diagnostic criteria in 1994. Over 70 of these studies were tightly controlled examinations of the efficacy of stimulant medication, MHP specifically, in pediatric populations. In excess of 2800 children have participated in studies of MHP. No consistent, significant difference in efficacy for decreasing the core symptoms of ADHD (i.e., inattention, hyperactivity, impulsivity) has been reported between the various stimulants, including MHP (Ritalin), d- and l-amphetamine compounds (Adderall), and pemoline (Cylert) (Faraone, Beiderman, & Roe, 2002; Jenson, 2002; Wolraich & Doffing, 2004).

When the researcher examined the results of these 73 controlled studies of MHP, statistically significant improvements in ratings of behavior are evident for the core symptoms of ADHD with lesser effects noted on the associated problems of ADHD (e.g., academic problems, aggression, defiance, poor social skills, poor parent-child relationships, etc). Using Cohen's (1988) method, effect sizes were calculated by dividing the mean difference between the treatment and control group by the pooled standard deviation. An effect size can range from a score of "0" for no effect, meaning the 2 groups do not differ, to a score of "2.00" that indicates the treatment accounts for over 97% of the change in the dependent variable for the treated group. Per Cohen's recommendations, effect sizes are usually classified as large when $d \approx 0.80$, moderate when $d \approx 0.50$, and small when $d \approx 0.20$. Little or no treatment effect is indicated when $d \leq 0.19$ (Cohen, 1988).

Across the 73 controlled efficacy studies, the average effect size for the impact of MHP (methylphenidate/Ritalin®) on measures of inattention ($d = 0.75$), hyperactivity ($d = 0.84$), and impulsivity ($d = 0.78$) is fairly large. The impact of this medication on classroom behavior was moderate ($d = 0.63$). The variable that improved the least with the use of medication was academic performance ($d = 0.19$) showing little to no impact across studies. Thus, MHP (Ritalin) has a large, beneficial impact on the core symptoms of ADHD with little, if any, effect on the difficulties in academic performance experienced by these children. It is important to note that when examined individually, the results of studies investigating the impact of stimulant

medication on academic performance are mixed. The inconsistent results across studies might at least partially account for the minimal effect size.

There are a number of issues concerning the literature that examines the effect of various types of ADHD treatment on academic performance. First, there are very few studies (i.e., 42) in the published literature that include an outcome measure related to academic performance (Ryan et al., 2005). This is a small number of studies considering the fact the first examination of the impact of stimulant treatment on academic achievement in students with ADHD appeared in the early 1970s (Conrad, Dworkin, Shai & Toblessen, 1971; Finnerty, Soltys, & Cole, 1971); and, academic performance continues to be recognized as a common concern for children with ADHD (Barkley, 2002a; Barry et al., 2002; LeFever, Villers, Morrow, & Vaughn, 2002). Only recently have studies of ADHD treatments begun to regularly include outcome measures related to academic achievement (Hetchman, Abikoff, Kein, Weiss, Respitz, Kouri et al., 2004; MTA Cooperative Group, 1999, 2004; Northup, Gulley, Edwards, & Fountain, 2001; Pelham, Carlson, Sams, Vallano, Dixon, & Hoza, 1993; Pelham, Wheeler, & Chronis, 1998; Purdie, Hattie, & Carroll, 2002).

Second, the results of this body of research might be inconsistent across studies due to the nature of the measures used. In these 42 studies, performance on academic tasks was measured by either a standardized measure of academic performance (e.g., Iowa Test of Basic Skills) or a curriculum-based measure (e.g., scores on worksheets). Results from studies using standardized measures of academic performance, including scores on the Iowa Test of Basic Skills, showed little or no

effect (d = -0.04 to d = 0.20) for stimulant medication in the majority of studies included in the review (Ryan et al., 2005). Only one study (Connors & Taylor, 1980) found a moderate-to-large effect (d = 0.25 for reading to d = 1.32 for math) of medication on academic performance measured by scores on standardized tests of achievement.

Using standardized measures of achievement as indicators of change in academic performance is problematic for a number of reasons. First and foremost, these tests are not very sensitive to change over a short period of time (e.g., an 8-week study). Second, scores on these measures may or may not correlate well with the student's actual performance on academic tasks completed in the classroom (DuPaul & Weyandt, 2006; Espin & Foegen, 1996; Linn, 1990; Malecki & Elliott, 2002; Witt, Dunbar, & Hoover, 1994; Willingham, Pollack, & Lewis, 2002). Third, discrepancies in performance on standardized tests of achievement have been found to reflect various demographic variables (i.e., gender, race, socioeconomic status, size of school), the amount of homework a student is assigned, the amount of television a student watches, with the same degree of consistency as the differences in the students' grade point averages (Borzekowski & Robinson, 2005; Duckworth & Seligman, 2006; Furgeson, 2003; Pope, Wentzel, Braden, & Anderson, 2006; Ryan & Ryan, 2005; Stoneberg, 2004; Zavodny, 2006). Therefore, using scores obtained from standardized assessment tests as the sole measure of change in academic performance may be ill advised because these scores might not capture changes in academic

performance that are reflected in the child's actual performance on class work and or homework.

To help resolve this issue, thirty-one studies identified in the review of the literature conducted by Ryan et al. (2005) used curriculum-based measures to assess changes in academic performance during treatment with stimulant medication. Again, results were mixed with some studies reporting little or no effect ($d = 0.01$) for treatment with medication (e.g., Chase & Clement, 1985), whereas other studies reported very large effects ($d = 1.09$) (e.g., Ardoin & Martens, 2000). Although it would appear that a curriculum-based measure (e.g., an exercise with grade-level math problems) would provide a more externally valid and sensitive measure of change in academic performance, these studies did not use the child's actual schoolwork as a dependent measure. Rather the child completed tasks that simulated academic work that he or she might be asked to do in the classroom setting. Further, in most studies using curriculum-based outcome measures, the child's progress in only one academic area, such as reading, spelling, or math, was monitored. Therefore, a clear picture of the child's performance on academic material across subjects is unknown. In addition, no published studies included measures of academic performance for school work that the child would be expected to complete on his or her own time in an unstructured environment, such as homework.

In an unpublished study, Lieberman (1999) investigated the impact of a third dose of traditional, short-acting MHP on homework productivity in students with ADHD who were already taking a dose of medication at 8 a.m. and noon to manage behavior

and attention during the school day. The dependent variables Lieberman (1999) examined were on-task behavior, homework accuracy, and homework completion while the participants were doing math problems at home. Some participants improved on the dependent variables of homework completion and homework accuracy while taking MHP whereas others did not. Because the participants had not been screened for math abilities prior to the study, the lack of improvement in math homework completion and accuracy exhibited by some participants might be attributed to the child's math skills rather than medication failure. Thus, MHP might not have improved homework completion and homework accuracy because the child lacked math skills, a deficit that could not be addressed by MHP alone.

Finally, only 7 of the 42 studies identified by Ryan et al. (2005) took place in a general education classroom. The remaining studies took place in more restrictive environments including psychiatric hospitals, university or residential schools, or other clinical settings, none of which are representative of the educational environment of most students with ADHD (Ryan et al., 2005). Thus, very little is known about the impact of stimulant medication on the child's performance when he or she receives instruction in a non-restrictive setting, such as a regular, general education classroom.

Although Ryan et al. (2005) identified 42 studies that examined the impact of medication on the academic performance of students with ADHD, almost no studies have investigated the impact of common behavioral interventions on the academic performance of students with ADHD. Studies examining the performance of children

with ADHD who do not take medication have examined various skill-building programs (e.g., instruction on how to organize tasks, how to take notes, how to study, etc.), academic and/or peer tutoring, teacher feedback on the child's performance, and self-monitoring strategies (e.g., Barry & Messer, 2003; Currie, Lee, & Scheeler, 2005; DuPaul, Ervin, Hook, & McGoey, 1998; Evans, Axelrod, & Langberg, 2004; Rief, 2003; Shimabukuro, Prater, Jenkins, & Edelen-Smith, 1999, etc.). Researchers have not examined the impact of common behavioral treatments (e.g., token economies, contingency management, behavioral contracts) on the academic performance of students with ADHD.

Failing to empirically examine the impact of common behavioral treatment strategies on homework and class work performance is problematic given homework problems are common for the student with ADHD (Power, Werba, Watkins, Angelucci, & Eiraldi, 2006; Zentall, Moon, Hall, & Grskovic, 2001). The difficulty with homework and school work may play a role in creating the higher rates of learning problems, grade retention, and school failure and drop out, as well as lower rates of college admission and retention that are reported for students with ADHD (Barkley, Fischer, Smallish, & Fletcher, 2006; LeFever et al., 2002). Despite empirically demonstrating that children with ADHD have marked difficulty with homework and class work completion, only a few studies have focused on how existing interventions, such as medication and behavioral treatment, can address these issues. This is problematic given the potential negative educational outcomes experienced by at least some students with ADHD.

Token Systems

A number of behavioral interventions are available to treat ADHD. These include procedures designed to increase acceptable behavior and decrease inappropriate behavior. Token reinforcement and contingency contracting are two behavioral techniques that focus on rewarding novel or low frequency behaviors that are desirable alternatives to the child's ADHD related behavior (e.g., interrupting, getting out of seat, failing to complete class work or homework) (Abramowitz & O'Leary, 1991; Barkley, 1998; Braswell & Bloomquist, 1991; Carlson, Mann, & Alexander, 2000; DuPaul & Stoner, 1994; Pfiffner & Barkley, 1990; Pelham et al., 1998; Root & Resnick, 2003; Teeter, 1998). Penalties for symptomatic behavior are provided by response cost (i.e., token or point loss) interventions (Carlson et al., 2000; Chronis, Fabiano, Gnagy, Onvando, Pelham, Lopez-Williams et al., 2004; Neef, Marckel, Ferreri, Bicard, Endo, Aman et al., 2005; Rapport, Tucker, DuPaul, Merlo, & Stoner, 1986).

By and large, the most common behavioral intervention used to manage the classroom behavior of students with ADHD is some form of token economy with both reinforcement and response cost aspects (Barkley & Murphy, 1998; DuPaul & Eckert, 1997). Token reinforcement consists of providing the child a specific, pre-set number of tokens contingent on appropriate behavior; thus, a number of appropriate behaviors are reinforced. (Barkley, 2002b; Carlson et al., 2000; DuPaul et al., 1992; Pfiffner & O'Leary, 1987). Tokens are accumulated throughout the day and exchanged for rewards and privileges selected by the child. Penalties for symptomatic

behavior displayed by the child with ADHD are provided by the response cost (i.e., token/point loss) aspect of the token-economy intervention such that engaging in inattentive, off-task, or other problem behavior results in a point or token loss for the child (Carlson et al., 2000; Rapport, Murphy, & Bailey, 1982, 1980; Root & Resnick, 2003).

A number of decisions need to be made when designing a token economy. First, the target behaviors should be selected. All behaviors should be defined in a concrete, descriptive manner. When possible, behaviors should be phrased in a positive (do) rather than negative (do not) manner. Second, a schedule for earning tokens needs to be created. That is to say, the number of tokens that will be earned for each behavior should be specified.

Once the behaviors are selected and assigned token values, back-up reinforcers should be chosen. The items a child earns as part of the token economy need to be reinforcing for him or her; therefore, reinforcers should be selected with input from the child. In addition, guidelines need to be made as to when tokens can be exchanged for reinforcers. Tokens can be exchanged several times per day, such as after breakfast, after lunch, and/or after school, or on a schedule that works for the parent and child such as after school and before going to bed.

To maximize effectiveness, the token system should be designed so the child comes into contact with positive reinforcers early in the program and frequently for the duration of the program (Schroeder & Gordon, 2002). In empirical examinations of reinforcement preferences for children with ADHD, the immediacy of the

reinforcer had the greatest impact on behavior, regardless of the difficulty of the task and/or the quality and quantity of the delayed reinforcers (Neef et al., 2005; Rapport et al., 1986). Chronis et al. (2004a) found that, in order for a token economy to be maximally effective, children with ADHD needed to come into contact with reinforcers at least daily at the beginning of the program and be provided the opportunity to earn weekly bonuses. After the behavior has improved, the reinforcement schedule can be thinned. Over time, it is recommended that token system be completely faded when behavioral change is maintained on a very thin schedule of reinforcement (Barkley & Murphy, 1998). Finally, the child needs to be educated about the plan to make certain he or she understands how to earn and exchange tokens so he or she can comply with the program (DuPaul & Stoner, 1994).

Providing the response cost aspect of the token system is important for its overall success. For example, DuPaul, Barkley, and McMurray (1991) reported the combination of token reinforcement and response cost was more effective in increasing levels of on-task behavior for students with ADHD when compared to either intervention used alone. In addition, Pfiffner and O'Leary (1987) used an alternating treatment design to compare the effect of an all-positive token economy and a token economy with response cost on rates of on-task behavior and accuracy in academic tasks in eight children with attention difficulties. The data from this study indicated that the token economy with a response cost was most effective at increasing the target behavior. Participants were on-task for more than 80% of observed intervals and completed course work with at least 70% accuracy at the

conclusion of treatment compared to being on-task 60% of the time and completing about 25% of the coursework at the initiation of treatment.

Overall, research on token systems indicates that they are effective in addressing a number of the problem behaviors exhibited by the child with ADHD. In the limited number of studies examining the effectiveness of a token economy to address the behavior of children with ADHD, a token system has been shown to: (1) decrease rates of impulsive and disruptive behavior (Carlson et al., 2000; Johnson, Handen, Lubetsky, & Sacco, 1994; Neef et al., 2005; Sullivan & O'Leary, 1990); (2) increase adherence to rules and on-task behavior (Carlson et al., 2000; Johnson et al.,, 1994; Neef et al., 2005; Sullivan & O'Leary, 1990); and, (3) increase rates of task completion and accuracy for academic tasks (Carlson et al., 2000; Pfiffner & O'Leary, 1987) in the classroom setting. Outside of the classroom environment, researchers have used the token economy to: (1) increase the display of sportsmanlike conduct (e.g., giving high fives and verbal praise to teammates, helping a player up from the floor, giving a nonaggressive pat) during in sporting events (Hupp & Reitman, 1999; Hupp, Reitman, Northup, O'Callaghan, & LeBlanc, 2002); (2) reduce rates of inattentive and disruptive behavior in recreational settings (Reitman, Hupp, O'Callaghan, Gulley, & Northup, 2001); and, (3) improve performance in physical activities, such as a structured exercise program (Trokiables, French, & O'Connor, 2001).

Using a token economy, researchers have been able to decrease the amount of problem behavior displayed by children with ADHD. In a handful of studies, the

token economy was used to increase completion and accuracy of academic class work (Carlson et al., 2000; Pfiffner & O'Leary, 1987). The token economy has occasionally been employed as a way to improve academic performance but rarely has been used to address aspects of homework performance for the student with ADHD. Two interventions that are based on the token economy and warrant investigation as treatments for improving the classroom behavior and academic performance of children with ADHD are the daily behavior report card (Dougherty & Dougherty, 1977; Pelham, 1993) and a goal-setting procedure (Kahle & Kelley, 1994; Kelley & Kahle, 1995; Miller & Kelley, 1994).

Daily Behavior Report Card

Daily behavior report cards are a treatment technique used to address behavior in one setting by providing consequences in a different setting (Bailey, Wolf, & Phillips, 1970). These techniques have several different names in the treatment literature including home-school notes, home-based reinforcement, and daily report cards (Chafouleas, Riley-Tillman, & McDougal, 2002). Generally speaking, daily behavior report cards are used to modify the classroom behavior of a student by applying consequences in the home setting, although behavior in other environments can be targeted. A token economy serves as the foundation for the daily behavior report card whereby children earn privileges at home contingent on the display of acceptable behavior in the classroom setting (Chafouleas et al., 2002).

The daily behavior report card has two primary functions. The first is communication. The daily behavior report card provides a formal mechanism for

teachers to provide feedback to students about their classroom behavior. Teachers are able to easily communicate both appropriate and inappropriate student behavior to the child's parents on a daily basis. The student's parents can then provide consequences and feedback to their child in a timely and predictable manner, which helps to facilitate behavior change (Brehuner & May, 2003; Kelley & McCain, 1995). The second function of the daily behavior report card is to motivate the child to make improvements in his or her classroom behavior through the use of a token economy system (Chafouleas et al., 2002). By applying contingencies and consequences for the child's classroom behavior, the parent can reinforce and encourage the display of a number of appropriate behaviors (Carlson et al., 2000).

Daily behavior report cards have a number of features that make them a desirable intervention for classroom behavior. First, the behaviors included on the daily report card can be individualized to meet the specific goals of the student. Second, the report cards are efficient and are estimated to take less than 5 minutes of teacher time per day (Chafouleas et al., 2002). Third, information is easily exchanged between parents and teachers which helps parents and teachers collaborate to achieve behavior change in the child (Chafouleas et al., 2002; Fairchild, 1976; Lahey, Gendrich, Gendrich, Schnell, Gant & McNess, 1977). Finally, individualized consequences can be delivered in the home setting which allows the student the opportunity to earn a wide variety of possible reinforcers contingent on appropriate classroom behavior (Karriker, 1972). Parents can provide a wide array of social, verbal, activity-based, tangible, and other positive reinforcers, whereas, teachers have more limited options

when reinforcement must be delivered in the classroom setting (Broughton, Barton, & Owen, 1981; Fairchild, 1976; Karriker, 1972). In addition, when the individual can tolerate a slight delay in reinforcement and the reinforcement is provided in an alternate setting (i.e., the home rather than the classroom), treatment gains have been shown to generalize to other settings (Budd, Leibowitz, Riner, Mindell, & Goldfarb, 1981).

Daily behavior report cards first appeared in the treatment literature in the 1970s. Bailey et al. (1970) implemented a daily behavior report card as a technique to manage the classroom behavior of several pre-delinquent boys. These boys were attending a special summer school session and were living in a community-based group home. Each of the youth had difficulty adhering to classroom rules and often failed to engage in appropriate behavior (e.g., working on class work, attending to the teacher, etc.) during the school day. The research conducted by Bailey et al. (1970) demonstrated that the boys' classroom behavior was amenable to change when teaching parents administered contingent reinforcement in the group-home setting for appropriate classroom behavior. In addition, the daily behavior report card had a small but positive impact on seatwork completion rates, although no aspect of the intervention directly targeted this behavior. Finally, when reinforcement was faded to an intermittent schedule, gains in behavior were maintained (Bailey et al., 1970).

Since the publication of the study by Bailey and colleagues (1970), daily behavior report cards have demonstrated success at reducing a number of behaviors in typically developing students including rule-breaking and disruptive behavior in junior-high

school students (Bailey et al., 1970; Harris, Finfrock, Giles, Hart, & Tsosie, 1975; Schumaker, Hovell, & Sherman, 1977); mild disruptive classroom behavior in preschool and elementary-age students (Allyon, Garber, & Pisor, 1975; Coleman, 1973; Davies & McLaughlin, 1989; Dougherty & Dougherty, 1977; Karriker, 1972; Lahey et al., 1977; McCain & Kelley, 1993; Taylor, Cornwell, & Riley, 1984); poor homework and class work completion rates (Blechman, Schrader, & Taylor, 1981; Dougherty & Dougherty, 1977); poor rates of accuracy on school work (Strukoff, McLaughlin, & Bialozor, 1987); and, ADHD-related behavior (Pelham, 1993; Stein, 1999). In addition to having positive effects on behavior and academic performance, daily behavior report cards have a high rate of treatment acceptability by teachers and parents (Chafouleas et al., 2002; Dolliver, Lewis, & McLaughlin, 1985; Kelley & McCain, 1995).

Currently, more than 450 students have participated in over 40 studies investigating the daily behavior report card system. In these studies, researchers utilized the daily behavior report card to target various behaviors including disruptive (e.g., talking out of turn), appropriate (e.g., raising hand before talking), and/or academic (e.g., turning in homework assignments) behavior. In most cases, the data collected were the teacher ratings of the target behaviors as recorded on the daily behavior report card. Due to the research design used, the number of participants in each study, and the individualized (i.e., not standardized) nature of the data collected, an effect size using Cohen's method (1988) was not calculated. The assumptions underlying the use of statistical procedures, including effect size, generally are not

met by single-subject designs that rely on small sample sizes and collect individualized rather than standardized data (Kirk, 1995). Even so, the impact of the daily behavior report card on problem behavior can be quantified by estimating the percent of change in the rate of behavior between the baseline and the intervention conditions.

Aggregate results from these studies indicated marked improvement in behavior during treatment with a daily behavior report card. Rates of problem behavior displayed in the classroom fell to less than 20% during treatment with a daily behavior report card. Many studies reported a decrease in problem behaviors to a near zero rate during intervention for the majority of targeted students (e.g., Ayllon et al., 1975; Bailey et al., 1970; Coleman, 1973; Davies & McLaughlin, 1989; Dougherty & Dougherty, 1977; Karriker, 1972; Lahey, et. al., 1977; McCain & Kelley, 1993; Schumaker et al., 1977). In addition, the completeness and accuracy of seatwork were specifically targeted in several studies. Data from these studies indicate that the completeness and accuracy of schoolwork increased to 80% or greater for the majority of the students when a daily behavior report card was used (e.g., Blechman, et al., 1981; Dougherty & Dougherty, 1977; Harris et al., 1975; Karriker, 1972; Kelley & McCain, 1995; Strukoff et al., 1987). Therefore, the daily behavior report card that includes a target behavior related to academic performance appears to show promise as an intervention for children with ADHD. Nevertheless, the daily behavior report card has not been utilized in this manner.

Goal Setting

The goal setting procedure is a strategy for homework completion outlined by a number of researchers working with students with learning disabilities (Kahle & Kelley, 1994; Miller & Kelley, 1994). Generally speaking, the goal-setting procedure is used to teach students to set small, attainable goals when completing homework. To accomplish this, students break each homework assignment into small portions, such as groups of 5 questions. The student then attempts to complete the group of questions (the goal) in a specified period of time, for example, 5 minutes. After 5 minutes has elapsed, the student checks his or her work to see if he or she met the goal. If the child did meet the goal, he or she earns a token. At the end of the homework session, the child trades his or her tokens for a reinforcer.

By having the child set goals and work for short, sustained periods of time, his or her homework completion and accuracy improves and off-task and inattentive behavior decreases (Kahle & Kelley, 1994). The addition of a token system serves to motivate the student to complete tasks in a timely manner and learn the goal-setting procedure (Kahle & Kelley, 1994; Miller & Kelley, 1994). Because the student learns this procedure and is able to implement it without adult supervision, the child's ability to complete homework independently often improves (Miller & Kelley, 1994).

A goal-setting procedure also has been validated as a method to increase academic and homework performance for other populations including non-learning disabled children who have homework difficulties (Toney, Kelley, & Lanclos, 2003) and children with emotional disturbances (Cancio, West, & Young, 2004). It has also

been used as a way for teachers to foster homework competence and study skills in young, typically developing students (Beidel, Turner, & Taylor-Ferreira, 2005; Rock, 2004; Ross, Singer-Dudek, & Greer, 2005). Despite the effectiveness of this procedure for students with learning disabilities, inattention, and/or homework difficulties, the procedure has not been empirically examined for use with students with ADHD. Including a goal-setting procedure similar to the one described by Miller and Kelley (1991) as an element of a behavioral parent-training program for students with ADHD has been recommended (Chronis, Chacko, Fabiano, Wymbs, & Pelham, 2004); however, it has not been empirically validated for this use.

Academic Interventions

As stated previously, academic difficulties are an underlying difficulty associated with ADHD in children. Learning problems have been associated with the disorder for most of its history (Connors, 2000; Stube, 2000). At one time, learning problems were part of the diagnostic criteria for ADHD (Clements, 1966). Currently, however, learning problems are not necessary for a diagnosis of ADHD. Yet, children with ADHD often have academic difficulties and do not perform as well as their peers on class work and homework (Barkley, 2002a; Barry et al., 2002; Mayes, Calhoun, & Crowell, 2000; Resta & Eliot, 1994; Tannock, 1998). Despite the fact that medication, especially MHP, affects the underlying neurobiological aspects of ADHD and improves the child's ability to "pay attention," academic performance often fails to show the same degree of improvement as the child's behavioral and attentional symptoms (Elia, Ambrosini, & Rapoport, 1999; Miranda, Presentacion, & Soriano,

2002; MTA Cooperative Group, 1999, 2004; Pelham et al., 1998; Swanson, McBurnett, Christina, & Wigal, 1995).

Most interventions for ADHD, including medication and psychosocial interventions, attempt to remediate the attentional and behavioral problems displayed by the child with ADHD, with the unfounded assumption that improvements in academic, social, and classroom performance will follow. Pelham and Gnagy (1999) clearly state the most critical limitation of most, if not all interventions for ADHD, including medication and contingency management, is that they do not teach the child the necessary skills to improve and regulate performance in areas beyond behavior. To date, most interventions for ADHD do not have a component to directly address academic performance. Instead, these interventions focus on the more salient features of the disorder, the problematic, disruptive, and/or impulsive behavior. As such, interventions to directly address the academic performance deficits associated with ADHD warrant inclusion in research examining interventions for ADHD given the serious impact ADHD has on the academic performance of the affected child. This, in turn, has implications for his or her future achievement and accomplishments.

Based on the above review of the literature, it appears that both MHP (Ritalin) and behavioral interventions (daily behavior report card and a goal-setting intervention) may prove useful in improving both the classroom behavior and the homework performance of the non-learning disabled student with a diagnosis of ADHD. The purpose of the present study is to examine the relative impact of MHP and a goal setting procedure on the homework completion and accuracy of non-

learning disabled students with ADHD in the upper-elementary school grades. In addition, the effectiveness of MHP and the daily behavior report card on the classroom behavior of students with ADHD will be measured. Finally, this study attempts to examine the issue of the impact of behavioral treatment on the academic performance of children with ADHD. Additionally, by using a crossover alternating treatment design, where each participant receives both a medication and a behavioral intervention, the participant's performance during each treatment type can be directly compared.

Method

Participants

Participants were recruited through pediatric hospitals and medical centers in two cities the Midwest. After the initial intake and assessment were completed, parents of potential participants were given the option to take part in this study. Parents of eligible participants completed an

informed consent form and participants completed assent procedures that the Human Subjects Committee deemed appropriate for their age (see Appendix A and B).

To be included in the study, participants met the following criteria: (1) a primary diagnosis of Attention Deficit Hyperactivity Disorder; (2) attending school in grades first through fifth; and, (3) current classroom grades allowed for academic improvement to be demonstrated. Exclusion criteria included: (1) a documented neurological disorder; (2) mental retardation; (3) psychiatric diagnoses other than ADHD and oppositional defiant disorder; (4) asthma because some treatment for

asthma creates ADHD-like symptoms; (5) a documented learning disability; (6) prior treatment for ADHD including medication; (7) an uncorrected hearing or vision problem; and (8) the presence of any known physical condition that would contraindicate the use of methylphenidate as a treatment.

A total of six children attending fourth or fifth grade participated in this study. Participants attended school in a medium-sized midwestern city. All participants carried a primary diagnosis of ADHD made by a doctoral-level psychologist who entered the diagnosis based on assessments that met the clinical practice guidelines of the American Academy of Pediatrics (2000). In addition to meeting DSM-IV criteria and a clinical interview, psychological testing was conducted that included the completion of the following rating scales by parents and teachers: Behavior Assessment System for Children (2002), The Achenbach Child Behavior Checklist (2001), Connors' Rating Scale-Revised (1998), The Eyberg Child Behavior Inventory (1999), and The ADHD Rating Scale-IV (1998). Participants were also asked to bring in copies of recent school wide achievement testing to help rule out learning problems. If learning problems were suspected, additional testing was conducted and the child was excluded from the pool of eligible participants.

Participants did not significantly differ on demographic variables such as age. No participants had been retained in a grade during their education prior to participation in this study. No participants received special education services under an Individualized Education Plan or a Section 504 plan. All participants were considered

to be of average intelligence based on his or her individual results from recent school-wide achievement testing.

Two girls and four boys participated in the study (see Table 1 for participant characteristics). Jessica was a 10 year-old Caucasian female attending public school in the fourth grade. Jessica resided with her biological parents and brother in an intact family. Katie, an African-American female was 10 years of age and attended public school in the fifth grade at the time of study participation. She lived with her biological mother and siblings in a single-parent household. Mark was a 10 year-old Caucasian male who attended fifth grade at a private Catholic school during this study. Mark lived with his biological parents and 2 brothers. Joe, a Caucasian 10-year-old male attended public school and was in the fourth grade during the study. He lived with his biological parents and older brothers. Adam, a 10 year-old Caucasian male, attended fourth grade at a public elementary school at the time of this study. He lived with his biological parents and older sister during this study. Ben was a 9 year-old Caucasian male who resided with his biological mother and 2 younger siblings during this study. He was attending public school in the fourth grade.

Procedures

Teachers. Teachers completed a daily behavior report card that asked about the participant's behavior in the classroom (see Appendix C). An instruction sheet regarding the daily behavior report card was given to teachers. The teacher was asked to mark "yes" or "no" in response to a series of questions about specific behaviors (e.g., raised hand before speaking) that the participant might have exhibited during

each academic period (e.g., math, English, specials, etc). In addition to the reporting on the student's behavior, the teacher was asked to indicate if the student completed assigned class work and turned in his or her homework. Information about the student's grades also was requested on the daily behavior report card.

In addition, students were asked to make a list of their homework assignments. Teachers were asked to check the homework list, to make corrections if necessary, and to sign the list. In some cases, the participants had a separate daily planner in which to list homework assignments, in other cases, the student listed them on the daily behavior report card at the end of the day. The daily behavior report card and the homework list were exchanged between the teacher and parent daily using a specific folder that the participant carried in his or her book bag.

Parents. Parents of the participants scheduled a time each day for their child to do homework between 3 and 6 p.m. Parents were asked to provide an area for the participant to complete homework that was suitable for such a task. Parents were encouraged to select a quiet area away from distractions and to have the necessary materials (e.g., pencils, paper, etc) available for the child to use when completing assignments. In all cases, participants in this study used the dining room or kitchen table as the homework area. Homework supplies were kept in a near by location (e.g., in a drawer in the kitchen). Participants completed homework in the usual fashion. Parents were not given any instructions regarding what to do during homework time other than to prompt their child that it was time to do homework.

Design

This study used a single-subject, alternating-treatment design (Campbell & Stanly, 1967). Three of the subjects received the behavioral management component first followed by the medication intervention. The other 3 participants were given the same two treatment conditions; they, however, were presented in reverse order. There were no control groups because each participant served as his or her own control.

Treatment Conditions

Participants were randomized to one of two conditions in pairs. The first individual who enrolled in the study was randomly assigned to a condition by flipping a coin. The second participant who enrolled in the study was then assigned to the remaining condition. This procedure was repeated for each pair of participants such that when the third and fifth participants enrolled, their condition was assigned by flipping a coin. The fourth and sixth participants were then assigned to the remaining condition. The two intervention conditions are as follows:

Condition One. (1) Baseline 1. Data were collected for at least 5 school days while the participant was not receiving any intervention; (2) Medication condition. The participant received approximately 10 school days of medication (approximately 14 days total including weekends), which included three doses of methylphenidate (Ritalin), one in the morning, one at noon, and one at about 4 PM. This phase was concluded with a 2-3 day washout period. (3) Baseline 2. This condition was the same as Baseline 1 in that the participants were not receiving any intervention, however, the minimum length of this condition was 3 days; and, (4) Behavior-management

intervention condition. For approximately 10 school days a positive motivational system for homework completion and classroom behavior were in place. Students were taught the goal-setting procedure and used it through out this phase of the study. Due to the nature of single-subject designs, the specific number of days the participant was in each condition varied. The participant remained in a given condition until his/her homework performance in that condition stabilized and was no longer demonstrating a clear ascending or descending trend.

Condition Two. The same conditions are in effect for this condition; however, the interventions were reversed. The order was as follows: (1) Baseline 1; (2) Behavior-management intervention condition; (3) Baseline 2; and, (4) Medication condition.

Behavior-Management Intervention

This intervention had three components. First, it included a motivational system for the daily behavior report card and a separate system for homework completion. Second, the goal-setting procedure was taught to participants. Third, a correction procedure was implemented to address the accuracy of homework.

Motivational System. The scores on the daily behavior report card (see Appendix C) were tied to a motivational system. After school and prior to the scheduled time to complete homework, parents reviewed the daily report card that was filled out by the teacher. If the participant received a sufficient number of teacher responses (at least 70%) that indicated that the participant engaged in appropriate classroom behavior, the participant was allowed to choose a preferred activity or item from a pre-approved list. This researcher, parent, and participant sat down together to discuss and select

reinforcers for this list. This reinforcer list was named the "I had a good day" list. The items on this list were selected individually and were not grouped together in packages. All items on this list were available to the child between the time he got home from school and the beginning of his bedtime routine. Examples of items on this list included riding a bicycle, skateboarding, choosing the after school snack, playing a game of cards with dad, jumping on the trampoline, an extra amount of time for video games/television programs, a dollar to save toward a purchase at a discount store, etc. (see an example list in Appendix D).

Completion of homework also was tied to a motivational system; however, a separate reinforcer list was used. Reinforcers on this list were unique to this list and were not otherwise available to the child. All reinforcers on this list could be accessed only between the time homework was completed and the child's bedtime. An individual item was selected from the list. Examples of items on this list included an extended bedtime, watching a favorite evening television program, picking the movie for family movie night, having a bedtime snack, playing a game with the researcher, one-on-one time with a parent, taking a bubble bath, etc. This list was titled "my homework is done" list (see Appendix D).

Once the participant completed all homework assignments, his or her parent signed the daily homework list and the child selected a reinforcer from the "my homework is done" list. No participants refused to do homework during this study. Nevertheless, a plan was in place such that if a participant refused to do his or her homework, he or she would have been assigned an extra chore as a response cost for

homework refusal. This same penalty was imposed for students who forgot to bring the assigned work home from school during a treatment condition.

Goal Setting. Participants were taught the goal-setting procedure to help facilitate homework completion. This researcher taught this skill to the participant in a one-on-one manner during the child's scheduled homework time. The goal setting procedure used in this study was adapted from the work of Miller and Kelley (1994), and Kahle and Kelley (1994). Generally speaking, the goal-setting procedure teaches students to set small, attainable goals when completing homework. The specifics of the procedure are discussed below. To address issues of task avoidance, homework assignments were completed in order of difficulty, with the most difficult assignment being completed first and the easiest assignment completed last.

On the first day of the behavior-management intervention, the goal-setting procedure was explained to the parents in detail and additional questions were answered. The participants were then taught the goal-setting procedure. The procedure used in this study is as follows:

(1) The participant was asked to check and see if the items necessary to complete all homework assignments were available (e.g., textbooks, paper, workbooks, pencils, etc). On the homework sheet, the participant checked off whether or not he or she had all the necessary items. During the first session the researcher helped the participant identify the items that might be needed to complete homework including items that were missing. During subsequent sessions, the participant was asked to check to make sure all of the items were available.

If the participant had all the necessary items, he or she was given verbal praise (e.g., you did a good job getting all of the stuff you needed for your homework). If an item was missing, the researcher asked the participant to identify what he or she had forgotten. The participant received verbal praise for correctly identifying missing items (e.g., although you forgot X this time, it was good that you noticed it so you can bring it next time) and the participant was encouraged to develop a strategy to help him or her remember the item in the future. In addition, the child was encouraged to problem solve the situation to determine what if anything could be done (e.g., I could call a friend and he or she could read me the list of spelling words) to acquire the missing item or information immediately.

(2) The participant arranged the homework assignments in subject order beginning with the most difficult subject and ending with the easiest. The difficulty and preference of school subjects was determined by the parent and the participant during the initial meeting with the researcher.

(3) During the first session, the process of goal setting was explained to the participant. The researcher talked the participant through the procedure of goal setting, and helped him or her determine how many problems he or she should try to complete in a specific amount of time. The participant was encouraged to select a small rather than a large number of problems (e.g., 5 instead of 15) and a fairly short amount of time (7 rather than 20 minutes). No additional guidelines were provided. The goal setting process was reviewed at the start of subsequent sessions as needed.

(4) The participant was given a goal-setting sheet. The first goal was written down and the timer was set and the participant began working on the first problem. An example of the goal-setting sheet is contained in Appendix E. At the end of the allotted time, the participant determined whether or not the goal was met. The researcher verified this and gave the participant feedback about how to set the next goal during the sessions in which he or she was learning the procedure. Subsequent goals were set based on the number of items the participant completed during the previous goal (i.e., to include more or less items or allow more or less time). Uncompleted items were included in the next goal. The process of setting goals and recording them on the goal sheet was repeated until all homework problems were completed.

(5) Once the participant completed all homework assignments, he or she was allowed to select a reinforcer from the "my homework is done" list. The participant's parents signed the homework sheet at this time.

Participants continued to use the goal setting procedure with researcher supervision and feedback until the he or she had mastered the procedure. The criterion for mastery was that the participant completed the goal-setting sheet correctly (e.g., recorded and adjusted goals such that most goals were met) for 3 consecutive sessions or 3 out of 4 consecutive sessions. This criterion was met by all participants within the first 5 days of the intervention. At this point, researcher presence during homework time was faded as the researcher began to be "late" for homework time and eventually did not arrive until after all homework was completed.

Homework Correction. The third and final aspect of this intervention was homework correction. Each evening when the research arrived to make copies of the student's homework, the participant was asked to review the previous day's homework. The participant was asked to correct any problems that were marked as incorrect by his or her teacher. The researcher gave the participant feedback regarding the accuracy of the new response and had the participant do each problem correctly three times. The participant was required to do this for all incorrect homework responses for the duration of the intervention. This procedure was implemented to help the participant complete tasks with more accuracy and avoid careless mistakes that often accompany inattention.

Medication Intervention

During this phase of the study, the participant received daily stimulant medication as the only intervention. Stimulant medication in the form of methylphenidate (generic Ritalin) was prescribed to each participant by his or her family physician/pediatrician or the physician participating in the research study. In all but one case, the physician participating in the research project prescribed the medication. No participants experienced a change in the amount of medication prescribed by participating physician during the medication condition. Parents administered the medication in the morning and the late afternoon; the school nurse administered the mid-day dose of medication.

As a way to determine if the child was being given his or her medication in the home setting, the researcher conducted pill counts as well as asking for self- and

parent report of mediation compliance. In all cases, it appeared the child and his or her parent complied with the medication regimen based on pill counts. No reliability data were collected on the pill counts because it appeared all families were complying with the medication regimen as prescribed. In addition, collecting reliability data on this measure would have required that a second individual to accompany the researcher to the participant's home which might have inadvertently lead to a loss of confidentiality for the study participants and their families.

Dependent Measures

Homework Completion. For the duration of the study, the researcher made copies of the participants completed homework assignments daily. The assignments were scored as to the percent of problems complete and the percent of problems that were accurate. A problem was considered complete if the participant provided an answer. The problem was counted as accurate if the participant provided the correct answer. The percent complete was calculated by dividing the number of problems the student completed by the total number of problems assigned and multiplying by 100 (e.g., completed 18 of 20 assigned problems equals 90% complete). The percent accurate was calculated by dividing the number of items the student completed correctly by the total number of problems assigned and multiplying by 100 (e.g., 16 of the 20 assigned problems were correct so the accuracy rate was 80%) (see Table 3).

Daily Behavior Report Card. For the duration of the study, a copy of this teacher-completed form was made and retained by the researcher. Information on this form was used to monitor the child's appropriate and inappropriate behavior in the

classroom. Data from this form were quantified as the percentage of appropriate behavior. This percentage was calculated by totaling all of the "yes" responses entered by the teacher and dividing that number by the total number of teacher responses and multiplying by 100 (e.g., 40 yes responses divided by 50 total teacher responses times 100 equals 80%) (see Table 3).

Medication Side Effects. Parents of all participants completed a Barkley Side Effects Questionnaire that was adapted from Barkley, McMurray, Edelbrock, and Robbins (1990) (see Appendix F) prior to starting the medication phase and at the conclusion of the medication condition. This data were collected to help the child's physician determine if any notable side effects of the medication were present. No participant reported experiencing adverse side effects during treatment with medication although transient effects might not have been captured by this measure since it was administered before and at the conclusion of medication phase.

Inter-rater Reliability. Reliability was calculated for approximately 30% of the data collected regarding the percent of the child's homework that was complete, the percent that was accurate, and the score on the daily behavior report card. A second individual, other than the researcher, calculated the participants' scores on the daily behavior report card and the percent complete and percent accurate for each homework assignment. Due to the fact that the data were not overly complex and a high degree of inter-rater agreement was expected, simple inter-rater reliability was computed. Reliability was calculated by taking the number of agreements divided by

the total number of data points multiplied by 100. Reliability was greater than 90% for data points included in the reliability analysis.

Results

Data were collected from six participants, 2 girls and 4 boys who were attending the fourth or fifth grade in one of two medium-sized midwestern cities. Improvement was noted on homework completion, homework accuracy, and classroom behavior in both the behavior-management and medication intervention (see Figures 1 - 6). Rates of completion and accuracy on homework approached 100% for all participants during both interventions. Improvement in behavior based on teacher report on the daily behavior report card was evident with most participants scoring 90% or greater on the daily behavior report card during both intervention conditions. Data regarding classroom grades also are included; however, teachers did not report these data on a daily basis for all participants. Therefore, these data might not accurately reflect the students overall school grades and should be interpreted with caution.

The behavior intervention resulted in more days with 100% homework completion for all six participants (see Table 2). The behavior intervention also resulted in a higher average rate of completion and accuracy compared to the medication intervention for five of the six participants. Four of the six participants had higher scores on the daily behavior report card during the behavioral condition as well (see Table 3). In addition, improvement in homework completion and accuracy took fewer days to manifest during the behavioral condition compared to the medication condition.

Variability in homework performance was calculated by figuring the simple range of scores for each variable in each condition. These data also are reported in Table 3. Homework performance (i.e., rates of completion and accuracy) and behavior scores were less variable and more stable during the behavior intervention for three of the participants, Adam, Ben, and Katie. For Joe, the variability was the smallest for all dependent variables during the medication condition. Mark had the least amount of variability on the completion and accuracy of homework during the behavior intervention; however, his behavior scores had a smaller range in the medication condition. Finally, Jessica had less variability in her rate of homework completion during the behavior condition whereas her accuracy and behavior scores were more stable in the medication condition.

Carry-over effects. Some carry over effects are noted because no participant experienced a return to a rate of homework completion and accuracy or behavior that resembled his or her performance during the first baseline condition. It was anticipated that students who had the behavior-management intervention before the medication intervention might use the goal-setting skill during the medication condition resulting in a clear carry-over effect. On the contrary, only one student, Jessica, used the goal-setting procedure during the medication condition and did so only after asking the researcher for permission. These data are notated in figure 4 with the label of "combined" for the treatment condition.

Discussion

Results of this study indicate that homework completion and accuracy improved

during treatment with both interventions (behavior-management and medication). For three of the participants, homework performance was more consistent in the behavior treatment condition as compared to the medication condition, which showed slightly more variability. Five of the six participants had the highest average score on homework completion and accuracy during the behavior management intervention. Four of the six participants also had their highest average score on the daily behavior report card during the behavior intervention. Only one participant had higher average scores on homework completion, accuracy and behavior in the medication condition. Only one participant had average scores that were divided between conditions such that the highest scores on homework completion and accuracy occurred in the behavior management intervention and the highest average score on the daily behavior report card was during the medication condition.

The second baseline condition does indicate that some type of carry over effect was present because no participant returned to his or her baseline rates of homework completion and accuracy or behavior. There are two possible reasons for this. First, the second baseline condition was short and was not intended to be a full treatment reversal; rather, it was a wash out period between treatment conditions. Therefore, it is possible that participants would have returned to rates similar to the initial baseline condition if the second baseline was of a longer duration. Second, it is possible that the participants were receiving some other treatment, academic, behavioral, or medical, and did not report this information to the researcher although this seems unlikely.

With regard to specific carry-over effects from the behavioral intervention to the second baseline and medication intervention, only one student used the skills taught in the behavior intervention during the medication intervention. Jessica reinstated the goal-setting procedure during the last 7 days of medication condition. She did not do so independently however, she asked permission from the researcher. No other participants used the goal-setting procedure during the medication condition although the worksheets and the timer were available to them.

Behavior Intervention

Generally speaking, the behavior intervention resulted in consistent improvement in three dependent variables (i.e., homework completion, homework accuracy, classroom behavior) measured for all participants. Once the participant's performance reached 100% for homework completion, rates remained at or near 100% for the duration of the behavior condition. Rates of accuracy also were fairly stable during this intervention.

This finding permits a number of possible conclusions including that motivation through positive reinforcement and/or teaching the child a specific, homework related skill (i.e., goal setting), or even that the correction of errors is an important key in improving homework performance in children with ADHD. Because a component analysis was not conducted, the relative impact of each aspect of the behavioral intervention package (i.e., goal setting, positive motivational system, and error correction) cannot be measured. Thus, no firm conclusions can be made as to which element was the most influential in improving homework performance for study

participants. One can only conclude that the combination of treatment components was successful. There are a number of possible reasons this treatment package was beneficial.

One possible reason performance improved during the behavior-management intervention is that children with ADHD are thought to respond well to a highly structured environment. As mentioned previously, the participants had a set time and location to complete homework that provided a minimal amount of structure for the participant in all conditions. The behavior intervention, however, also provided structure for the process of homework completion by having the child use the goal-setting strategy. The fact that this additional structure was provided during the behavior intervention could account for the fact that participants had a consistent performance and had fairly stable rates of homework completion and accuracy during this intervention.

In addition, students with ADHD often need frequent feedback about their performance (Pfiffner, Barkley, & DuPaul, 2006). The goal-setting procedure provides students immediate and frequent feedback about their progress on homework assignments because it is implemented while they are completing the work. When the timer sounds at the conclusion of the time allotted for the goal, the student stops to assess his or her progress. If the child was able to meet the goal by completing the selected number of problems, he or she marked "yes" in the "goal met" column on the goal setting sheet. If the goal was not met, the child marked "no" and adjusted subsequent goals so that he or she could meet the goal.

For the first few days of the procedure, the researcher helped provide feedback and taught the student how to use the procedure to monitor homework performance. After the child mastered the procedure, he or she was able to get feedback on his or her performance and monitor his or her own progress using the goal sheet without assistance from the researcher. Using this type of feedback may have helped the participant obtain a more consistent performance on homework assignments, and may account for the consistency of performance during this intervention. This conclusion is partially supported by the fact that when Jessica returned to using the goal-setting strategy during the final 7 days of the medication condition, her performance increased and became more stable than it had been during the first half of the medication condition.

Nevertheless, two aspects of the study procedures can be ruled out as potential contributors to the improvement of the child's homework performance during the behavior-management condition. The first is scheduling a time and place to do homework, as this variable was held constant across conditions, including baseline. The second possibility would be researcher presence. The researcher had daily contact with the participant across all conditions for the duration of the study. Homework time was observed during the baseline and medication conditions. Thus, the amount of time the researcher spent with the child while he or she was working on homework was similar in all conditions.

Medication Condition

All six participants showed improvement in the medication condition relative to

baseline on all measured variables. The participants' average number of homework problems that were completed and accurate did improve during treatment with medication compared to the baseline rate. Improvements in classroom behavior as measured by teacher ratings on the daily behavior report card were evident during treatment with medication as well (see Figures 1 through 6). Only one student experienced consistently better homework performance (i.e., completion and accuracy) and classroom behavior during the medication condition as expressed by his average score and range of scores for each variable and that was Joe.

The homework performance for the other 5 participants was variable indicating that some of them responded better to medication than others. For example, Adam completed his homework in its entirety for only 1 day during treatment with medication; whereas, Ben had 7 such days during the medication phase. Although all participants received medication that was determined to be with the therapeutic range by the prescribing physician, variation in the individual responses to medication were evident for homework completion and accuracy. The exact reason for this differential response across participants is unknown. It does, however, appear to be consistent with the findings of previous research that, when reviewed in aggregate, indicated an inconsistent impact of medication on standardized tests and curriculum-based measures of academic achievement (see Ryan et al., 2005, for a full review).

The impact of medication on classroom behavior also was variable across participants during that condition with some participants showing consistent, steady improvement on this measure whereas other participants had more erratic and

unpredictable change on this variable. For example, Katie's lowest scores on the daily behavior report card occurred at the beginning of treatment with medication and her best scores were at the end of the treatment with medication. This trend appears to indicate a steady improvement in behavior during the medication condition. Adam, however, received low scores on his daily behavior report card at the both the beginning and the ending of this treatment phase with the most improvement noted in the middle of the medication condition. Several plausible reasons for the variability in scores on the daily behavior report card are discussed below.

Daily Behavior Report Card

Consistent with previous research (Bailey et al., 1970; Davies & McLaughlin, 1989; Dougherty & Dougherty, 1977; Lahey, et. al., 1977; McCain & Kelley, 1993) the daily behavior report card resulted in improvements in the participant's behavior. When contingent reinforcement was available during the behavior-management intervention, scores on the daily behavior report card improved. Additionally, some improvement was noted in scores on the daily behavior report card during conditions that did not involve the delivery of contingent reinforcement such as the second baseline and the medication condition. There are a number of possible explanations for scores on the daily behavior report card improving in both treatment conditions. First, the use of the daily behavior report card in and of itself has been found to improve behavior to some degree even in the absence of contingent reinforcement (Chafouleas et al., 2002). Second, the daily behavior report card has also been used to

measure the therapeutic effects of an intervention, which, in this study was medication.

The daily behavior report card may result in improvements in the absence of reinforcement for several reasons. First, improvements in scores might reflect a simple placebo effect (i.e., a change in teacher ratings because he or she anticipates the student is getting some sort of treatment). It is also possible that the scores improve due to reactivity on the part of the participant (i.e., the child is aware that his or her behavior is being monitored and therefore, he or she changes it). Finally, it is possible that the student uses the daily behavior report card as a self-monitoring strategy even if reinforcement is not available.

Mark appeared to use the daily behavior report card as a self-monitoring strategy during the second baseline and medication conditions. Even though contingent reinforcement was not provided for his performance during those conditions, Mark requested his percentage of "yes" responses from his parents on a daily basis. In addition, he asked to see his daily behavior report card to read any extra notes (e.g., a really good day) his teacher might have written. Thus, Mark received feedback about his behavior during the second baseline and the medication condition. It is interesting to note, however, that he was not interested in his scores on the daily behavior report card during the first baseline condition. His interest in his score developed after he began receiving contingent reinforcement during the behavior intervention condition. Thus, for Mark, it appears that the daily behavior report card provided a way for him to monitor his classroom behavior and he was able to change his behavior in the

absence of external, contingent reinforcement. This appears to support the idea proposed by Chafouleas et al. (2002) that students might change their behavior when they know it is being monitored.

With regard to improved scores on the daily behavior report card during the medication condition for the other five participants, Chafouleas et al. (2002), Pelham (1999), and others (Barkley, 2006) report that the daily behavior report card is a useful way to measure improvement in classroom behavior that results from any intervention, including medication. During the medication condition, the daily behavior report card most likely served this purpose for all participants but Mark. Therefore, scores on the daily behavior report card reflected, but did not contribute to, improvements in behavior during the medication condition for the other five participants.

Finally, there is a third reason behavior change could have been noted on the daily behavior report card during any phase of this study and that would be teacher feedback. It is possible that the teacher provided the participant verbal feedback about his or her behavior when filling out the daily behavior report card during the school day. Data regarding teacher feedback to the participants about their classroom behavior were not collected. Despite the possibility the teacher provided some verbal feedback, it is unlikely that this feedback would provide reinforcement of similar magnitude and value as the reinforcement provided by the student's parent. As previously mentioned, Broughton et al. (1981), Chafouleas et al. (2002), Fairchild (1976) and others have reported that the lack of available powerful reinforcers in the

classroom, including teacher attention, is one of the main reasons the daily behavior report card with parent-moderated contingencies is successful. Further, providing only verbal praise and feedback from the teacher without having the parents provide at least some additional reinforcement has been insufficient to create and sustain behavior change in students (Chafouleas et al., 2002).

Comparison of treatment conditions

As stated previously, the participant's performance on homework and his or her classroom behavior improved during both conditions. Nevertheless, across participants, the behavior intervention resulted in a steady improvement in homework performance that was sustained over time. All participants had more days with 100% homework completion during the behavior intervention (see Table 2) compared to the medication condition. The behavior intervention also resulted in a higher average rate of completion and accuracy compared to the medication intervention for five of the six participants. Four of the six participants had higher scores on the daily behavior report card during the behavioral condition as well (see Table 3). In addition, improvement in homework completion and accuracy took fewer days to manifest during the behavioral condition compared to the medication condition (see figures 1-6). Medication did result a higher average scores on homework accuracy and behavior for Joe, and a higher average score on the daily behavior report card for Mark.

Carry-over Effects

By using an alternating treatment design, it was possible to begin to examine the

impact of behavior therapy on later homework performance in the medication conditions. As a general rule, no specific carryover effects were noted as only one student, Jessica, used the goal setting procedure during the medication phase. Jessica asked the researcher for permission to use the timer during homework for the last 4 days of the medication intervention. Although no goal setting worksheets were completed, it is anticipated that Jessica used the goal-setting procedure correctly since she had reached mastery criteria during the behavior intervention. The use of the timer in Jessica's case resulted in additional improvement in homework performance (i.e., completion and accuracy rates) above and beyond that which was manifested by treatment with MHP during the first 6 days of the medication intervention.

Despite the fact only one participant, Jessica, was noted to use the timer and asked permission to do so, does not rule out the possibility that other students could have used a similar strategy. It is possible that the 2 remaining participants (Mark & John) who received the medication intervention after the behavior intervention, attempted to use a similar, albeit less formal strategy, such as pacing oneself, when doing homework. This is an interesting consideration given that when the researcher discussed the results of the study with Mark's and John's parents at the conclusion of the study, they reported that total amount of time their child spent completing homework assignments decreased throughout the course of the study. The reasons for this are not clear but it might reflect some type of carryover effect.

It also is not known if the participants knew that they were allowed to use the goal setting strategy during the medication condition. At the beginning of the medication

condition, all participants were told that they no longer had to complete the goal setting sheets during homework completion. They were told that the researcher wanted to see how medication impacted their ability to do homework. Therefore, students might not have considered using the goal-setting procedure during the medication condition. The fact that Jessica asked to use the timer raises the issue as to whether or not participants knew they could do so without explicit permission from the researcher. Because the students knew they were participating in a study, they might have felt that they should follow the instructions given by the researcher.

In general some carry over effect was present however. The nature of the specific mechanism responsible for this effect is not known. As discussed previously, the second baseline condition did not show a true return to baseline in that participant's homework performance and classroom behavior did not resemble the rates of these same variables during the initial baseline period. One possible reason this could have occurred is that the second baseline condition was too short to capture a return to previous baseline rates of the behaviors as it was only 3 to 4 days in length.

A second possibility is that parents secured other treatment for their child including medication, behavior therapy, tutoring, or other skill-building programs. Although the parents did not report this information, this does not rule out the possibility that it occurred for at least some of the participants. All but one participant secured the medication through the study physician; therefore, any of the children could have been seen by their regular pediatrician and obtained stimulant medication rather than waiting until the study was complete.

Finally it is possible that the students took part in a school based intervention that was not reported to the researcher. Teachers could have implemented class-wide contingencies to manage the behavior of all students or implemented a system to target the behavior of a participant. In addition, they could have set-up a peer-tutoring system to help children complete seatwork. And finally, teachers could have been exploring any number of classroom accommodations for the participants in this study to help address their behavioral issues. Teachers often do this in preparation for a multi-disciplinary team meeting to discuss additional assessment to determine if an Individualized Education Plan or section 504 Plan would be appropriate to manage his or her classroom behavior.

Potential Mediating Variables

For at least one participant, it appears that environmental variables may have mediated his performance on homework during the medication condition. Mark's performance on homework during the medication condition was directly impacted by the presence of his father. Mark's completion and accuracy rates declined when his dad was supervising homework time. His dad gave him frequent, stern prompts while he was working on homework and was often critical of Mark's performance. When Mark's mother was present, his performance improved (see Figure 7). As a result of this difference, Mark's father was encouraged to provide only supervision during homework time and refrain from intervening when he felt Mark was not working hard enough on his homework. This resulted in some improvement in Mark's performance when his father was present during homework time toward the end of the medication

phase. Thus, although medication was effective for Mark, environmental variables (i.e., the presence of his mother verses his father) appeared to mediate the effectiveness of the medication on homework performance.

Mark's situation is important to consider when medication does not appear to be working for a child with ADHD. Rather than concluding that the problem must be related to the dose or type of medication, it may be necessary to explore variables in the child's environment first. In some cases, the effect of medication might not appear to be a successful intervention due to familial or other environmental variables. In such cases, a combination of pharmacological and behavioral interventions, including parent training, might be necessary. This conclusion is supported by the results of other studies, such as the MTA Cooperative Group (1999) which found a nearly equal improvements in functioning for children with ADHD who were receiving combined (medication plus behavioral) therapy compared to children who received medication alone.

Limitations

The present study investigated the respective impact of a behavioral intervention and a medication condition on the homework performance and classroom behavior of 6 students with ADHD using a single subject, treatment-crossover design. Results indicate that all participants improved with the use of either strategy, with more consistent gains in homework performance (i.e., rates of completion and accuracy) during the behavior intervention. It also appeared that students were able to learn the goal-setting strategy with a minimal time investment (less than 4 homework

sessions); thus is may be a useful skill to teach students with ADHD. Despite the findings of this study, a number of limitations are evident.

First, the study is limited by the length of treatment conditions. Although performance was consistent at the conclusion of the behavior intervention, performance on homework was often still variable at the conclusion of treatment with medication. The reasons for this are unclear. It is possible that a change in the type of medication (e.g., from Ritalin to Adderall or Strattera) or the dose might have resulted in a more consistent performance. Ways to make the medication treatment more effective for the student (e.g., dose-dependent effects) were not explored in this short study. Future studies could examine the relationship of the dose and type of medication to performance on actual homework tasks. Initial studies have begun to explore the relationship of dose to academic performance (e.g., Evans, Pelham, Smith, Bukstein, Gnagy, Greiner et al., 2001) but, by and large, such studies continue to employ simulated rather than actual academic tasks (Fisher & Newby, 1998) and/or use restrictive, laboratory-based environments (Quinn, Wigal, Swanson, Hirsch, Ottolini, Dariani et al., 2004; Wigal & Wigal, 2006).

Second, no follow up data were collected for either condition. This is especially pertinent for the behavior condition. The durability of the improvements in behavior and academic performance were not measured. Participants who received the behavior intervention first were not encouraged to use this strategy during subsequent baseline and/or treatment conditions. After the conclusion of treatment, it is not known if parents and participants continued to use medication or behavior-

management strategies to address continued homework and academic difficulties. Therefore, the long-term impact of either intervention is not known, although parents were provided with a report of their child's performance in each condition at the conclusion of the study. It was hoped that this information would help guide future treatment conditions; nevertheless it is not known if or how this data were used.

Third, formal data were not collected regarding students' performance on in-class assignments. Although the daily behavior report card requested that teachers indicate whether or not the child completed his or her seatwork and the resulting grade, information on grades was reported sporadically. Thus, a potentially important aspect of academic performance was not adequately measured in this study. Since homework is only part of the equation of academic performance, other aspects of this variable such as completion and accuracy for in-class academic work and or test performance should be examined in future studies.

Fourth, future studies could examine medication compliance with a higher level of objectivity. This is a particularly daunting task as stimulants are not blood-level medications so the amount of medication that is in a child's system cannot be obtained via a traditional blood serum test. Therefore, aside from administering the medication, observing the child taking the medication, and checking the child's mouth to determine if he or she actually swallowed the pill, it is difficult to objectively determine compliance with a stimulant medication regimen. Therefore, as mentioned previously, it is very difficult to objectively determine if children are taking medication as prescribed or acquired medication during a non-medication treatment

condition; therefore, most researchers rely on parent- or self-report. This issue is not unique to this study as a large percentage of parents of children assigned to the control group in the original MTA (1999) study reported that treatment with medication or behavioral therapy had been initiated for their child at some point during the 14-month study. Had these parents not reported this, researchers for the MTA (1999) would not have been aware of the treatment.

Finally, future studies should examine issues related to social validity of the intervention. This could address several lingering questions such as, which intervention did parents feel would be the easiest to implement? Which intervention did they feel had the most benefit? How did the students feel about the interventions? Were they satisfied with the results? Would parents prefer a combined (medication and behavior management) intervention? Some indications of these preferences are found in existing literature, such as the MTA (1999) study which reported that parents rated behavioral interventions as more preferred than medication alone. Yet, participants in the MTA study did not experience more than one treatment condition (medication or behavior but not both). Therefore, actual preference for a specific intervention would be difficult to establish given the child experienced only one type of treatment. And finally, long-term data regarding whether or not parents followed though with behavior therapy would be helpful. Allen and Warzak (2000) report that parents often abandon behavior therapy even if it is preferred and effective due to the effort of implementation and social pressure to adopt other treatment methods.

Conclusion

The present study measured the impact of behavioral intervention and pharmacological intervention on the homework performance (i.e., rates of completion and accuracy) and classroom behavior for six elementary school aged students with ADHD. The behavior intervention consisted of home-based contingencies for acceptable classroom behavior and teaching the participant a goal-setting strategy to facilitate homework productivity. Simple correction of incorrect responses was used to address issues of homework accuracy during the behavior intervention. The medication intervention consisted of MHP administered in 3 divided doses each day.

All six participants received both the behavior and medication interventions in a single-subject, treatment-crossover design. Results indicated that homework performance and classroom behavior improved during both interventions with slightly superior results for the behavior intervention as evidenced by a more consistent performance on homework. Specific carry-over effects were not found when behavior treatment preceded intervention with medication nor when medication preceded the behavioral intervention. The daily behavior report card indicated behavior improved when home-based contingencies were provided as well as when medication was used as the intervention.

Future research should collect information on a number of additional factors. First, follow-up data on the child's long-term performance on homework and school work as well as information treatment selection by parents should be collected. In addition, other measures of academic performance including rates of completion and

actual grades on in-class work should be collected to determine the full impact of each intervention on the student's overall academic performance. Finally, dose-response relationships for the impact of medication on homework performance should be investigated using the child's actual homework assignments.

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Appendix A

Informed consent form for parents

INTRODUCTION
The Department of Human Development and Family Life at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to have your child participate in the present study. You may refuse to sign this form and not have your child participate in this study. You should be aware that even if you agree that your child will participate, you are free to withdraw your child at any time. If you do withdraw your child from this study, it will not affect you relationship with this unit, the services it may provide to you, or the University of Kansas.

PURPOSE OF THE STUDY
This study, which is being conducted by Shelby Evans, a graduate student in the Department of Human Development and Family Life at the University of Kansas, is designed to investigate the effects of various interventions on the academic performance of children with Attention Deficit Hyperactivity Disorder (ADHD).

PROCEDURES
While participating in this study, your child will take part in two treatment conditions. In one of these, the researcher will work with your child one-on-one to teach him/her academic skills. You may be asked to participate in various aspects of your child's academic skills training. In the second treatment condition, your child will be following the recommendations of a physician regarding the use of medication to treat his/her ADHD. Information regarding your child's academic performance including grades, homework, classroom performance and behavior, and adherence to his/her medicine regimen will be collected by the researcher. All information will be kept confidential.

RISKS
The risk to your child is minimal and no discomfort is anticipated with his/her participation in this study

BENEFITS
By participating in this study, your child's grades and or classroom performance may improve. The results of this study will be used to help researchers, teachers and practitioners better understand how the academic performance of children with ADHD is effected by different treatments.

INFORMATION TO BE COLLECTED
To perform this study, the researcher will collect information about your child. This information will include copies of your child's homework, your child's grades,

classroom behavior as observed by the researcher and a brief daily checklist of your child's academic performance which will be completed by your child's teacher. The researcher will also ask you for information about whether or not you child has been taking his/her medication. You will also be asked about your child's study habits. Your child's name will not be associated in any way with the information collected about him/her or with the research findings. The researcher will use a number to identify your child instead of his/her name.

The information collected about your child will be used by the researcher, Shelby Evans, her faculty advisors, Dr. Jan Sheldon and Dr. Jim Sherman, and members of the research team. Again, your child's name will not be associated with the information shared with these individuals. Some persons or groups that receive your child's information may not be required to comply with the Health Insurance Portability and Accountability Act's privacy regulations and your child's information may loose this federal protection if those persons or groups disclose it. The researcher will not share information about your child with anyone not specified above unless required by law or unless you give written permission.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you or your child are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, your child cannot participate in this study.

In addition, your child's teacher will be asked to participate in this study as he/she will be providing the researcher with information about your child's academic performance. If your child's teacher refuses to participate, your child will not be eligible to continue to participate in this study.

CANCELLING THIS CONSENT AND AUTHORIZATION

You may withdraw your consent for your child to participate in this study at any time. You also have the right to cancel your permission to use and disclose information collected about your child in writing, at any time, by sending your written request to: Shelby Evans, Human Development and Family Life, The University of Kansas, 1000 Sunnyside Ave, Room 4001, Lawrence, KS 66045. If you cancel permission to use your child's information, the researcher will stop collecting additional information about your child. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above.

PARTICIPANT CERTIFICATION

I have read the Consent and Authorization Form. I have had the opportunity to ask and I have received answers to, any questions I had regarding the study and the use and disclosure of information about my child for the study. I understand that if I have

any additional questions about my child's rights as a research participant, I may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Rd, Lawrence, KS 66045-7563, email dhann@ku.edu.

I agree that my child will take part in this study as a research participant. I further agree to the uses and disclosures of my child's information as described above. I agree to have my child observed in his/her classroom. By my signature, I affirm that I am at least 18 years of age, that I
am the child's parent or legal guardian, and I have received a copy of this Consent and Authorization Form to keep.

Name of my child's teacher:_____

Name of my child's school:_____

Child's Name:_____

Parent/Guardian's Name:_____

Parent/Guardian Signature:_____ Date:_____

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Appendix B

Child assent form

I am interested in finding out how your treatment for ADHD affects your school work. I will stop by your house each day for a few weeks. When I am at your house, sometimes I will ask you about your study habits and your homework. Once in a while, I will come and visit your classroom at school, but I won't ask you any questions when I come to your school. You can decide not to talk to me when I come to your house or your school and that will be okay. You do not have to talk to me if you don't want to. I will be happy to answer any questions you may have now or when we are talking together. Do you want to take part in this project?

Appendix C

Example of the daily behavior report card

Date:_____

Mark. . .	**Reading**	**Math**	**Social Studies**	**English & Computer**	**Science & Health**
Had his supplies ready	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Followed Instructions	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Stayed on task without being prompted	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Remained Quiet	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Stayed in his seat	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Raised his hand to speak	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Did not disturb others	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Completed Seatwork	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Grade on Seatwork (% correct)					
Turned in homework	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
Homework Grade (% correct)					

Homework Assignments:

_____ _____

Teacher Signature

_____

_____

_____ _____

Parent Signature

Appendix D

Example Reinforcer Lists (Items from Mark's actual lists)

"I had a good day"

20 minutes on the trampoline

20 minutes on the skate board (while wearing helmet, knee, and elbow pads)

20 minutes on the bicycle (while wearing a helmet)

20 minutes of playing a game with mom

20 minutes of cartoons or a video

Selecting my own after school snack (includes sweets)

20 minutes of Nintendo Gameboy ® or a computer game

20 minutes of time alone in my room

"Shooting hoops" for 20 minutes with "Josh" (pseudonym the child next door)

"My homework is done"

Cotton candy for my bedtime snack

Staying up 15 minutes late

Watching my favorite 30 minute television show

Playing a game of cards (Uno) with my older brother

Getting $1 to save toward the purchase of an item at the dollar store.

Calling grandma and talking for 15 minutes

Having mom/dad load the dishwasher instead of me

10 minutes on the Internet (supervised by mom or dad)

Appendix E

Example Goal Setting Worksheet

Subject	Problems	Time	Goal Met	What next?
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	
			YES NO	

Appendix F

Barkley Side-effects Questionnaire

CHECKLIST OF SYMPTOMS SOME CHILDREN EXPERIENCE

NAME:_____ DATE: _____

PERSON FILLING OUT FORM: _____

INSTRUCTIONS: Please rate each behavior from 0 (absent) to 9 (serious). Circle only one number beside each item. A zero means that you have not seen the behavior in the child during the past week, and a 9 means that you have noticed and believe it to be either very serious or to occur very frequently.

Behavior	Absent									Serious
Insomnia/Trouble Sleeping	0	1	2	3	4	5	6	7	8	9
Drowsiness	0	1	2	3	4	5	6	7	8	9
Nightmares	0	1	2	3	4	5	6	7	8	9
Stares a lot/Daydreams	0	1	2	3	4	5	6	7	8	9
Bedwetting	0	1	2	3	4	5	6	7	8	9
Talks less with others	0	1	2	3	4	5	6	7	8	9
Uninterested in others	0	1	2	3	4	5	6	7	8	9
Decreased appetite	0	1	2	3	4	5	6	7	8	9
Irritable	0	1	2	3	4	5	6	7	8	9
Hair loss	0	1	2	3	4	5	6	7	8	9
Stomachaches	0	1	2	3	4	5	6	7	8	9
Headaches	0	1	2	3	4	5	6	7	8	9
Nervous Movements	0	1	2	3	4	5	6	7	8	9
Muscle Cramping	0	1	2	3	4	5	6	7	8	9
Seizures	0	1	2	3	4	5	6	7	8	9
Sad/Unhappy	0	1	2	3	4	5	6	7	8	9
Prone to crying	0	1	2	3	4	5	6	7	8	9
Anxious	0	1	2	3	4	5	6	7	8	9
Bites fingernails	0	1	2	3	4	5	6	7	8	9
Euphoric/Unusually happy	0	1	2	3	4	5	6	7	8	9
Dizziness	0	1	2	3	4	5	6	7	8	9
Tics	0	1	2	3	4	5	6	7	8	9
Diarrhea	0	1	2	3	4	5	6	7	8	9
Constipation	0	1	2	3	4	5	6	7	8	9

Barkley, R., McMurray, M., Edelbrock, C., & Robbins, K. (1990). Side effects of methlyphenidate in children with Attention Deficit Hyperactivity Disorder: A systematic placebo-controlled evaluation. *Pediatrics, 86,* 184-192. © 1990 American Academy of Pediatrics.

Table 1
Participant Characteristics

Identification	Age	Grade	School Type	ADHD Type	Comorbid Conditions	Daily MHP Dose
Adam	10	4th	Public	Inattentive	None	30 mg
Ben	9	4th	Public	Combined	None	15 mg
Katie	10	5th	Public	Combined	None	15 mg
Jessica	10	4th	Public	Inattentive	None	30 mg
Joe	10	4th	Public	Hyperactive/ Impulsive	None	30 mg
Mark	10	5th	Private	Combined	ODD	30 mg

Table 2

Number of Days with 100% homework completion by condition

Treatment Condition [a]	Participant	Baseline	Medication	Baseline 2	Behavior
1	Adam	0 of 9 days	1 of 11 days	0 of 5 days	5 of 10 days
	Ben	0 of 7 days	7 of 12 days	2 of 4 days	10 of 12 days
	Katie	1 of 10 days	5 of 12 days	0 of 4 days	6 of 8 days
2	Jessica	0 of 5 days	2 of 6 days [b]	0 of 3 days	6 of 11 days
	Joe	1 of 7 days	4 of 9 days	0 of 3 days	10 of 12 days
	Mark	0 of 7 days	4 of 12 days	4 of 5 days	10 of 10 days

[a] Condition 1 had medication intervention before the behavioral treatment condition. Condition 2 had the behavioral treatment intervention before the medication intervention.

[b] Days that Jessica took medication and used the goal-setting strategy were not included in this number.

Table 3

Mean and Range of Scores on Dependent Variables by Condition

Participant	Variable	Baseline Mean (range)	Medication Mean (range)	Baseline 2 Mean (range)	Behavior Mean (range)
Adam	Complete [a]	63 (0-95)	68 (0-100)	85 (76-92)	97 (85-100)
	Accuracy [b]	65 (0-90)	62 (0-100)	79 (70-90)	90 (81-95)
	Behavior [c]	73 (54-97)	77 (53-88)	84 (76-88)	88 (82-94)
Ben	Complete	48 (0-90)	96 (88-100)	98 (94-100)	99 (98-100)
	Accuracy	44 (0-85)	90 (80-100)	89 (86-92)	96 (88-100)
	Behavior	83 (71-94)	93 (80-100)	91 (84-98)	96 (84-100)
Katie	Complete	57 (0-100)	94 (78-100)	93 (90-97)	99 (95-100)
	Accuracy	55 (0-100)	89 (75-100)	92 (90-94)	96 (90-100)
	Behavior	82 (71-95)	95 (84-100)	86 (85-90)	97 (85-100)
Jessica	Complete	79 (76-85)	94 (82-100) [d]	97 (96-98)	97 (88-100)
	Accuracy	68 (52-83)	88 (80-96) [d]	95 (94-96)	95 (80-100)
	Behavior	72 (62-86)	86 (80-96) [d]	95 (95)	92 (78-100)
Joe	Complete	83 (66-100)	97 (87-100)	96 (95-98)	97 (71-100)
	Accuracy	69 (64-81)	95 (90-100)	93 (90-95)	93 (64-100)
	Behavior	83 (76-96)	91 (84-91)	90 (89-91)	90 (72-100)
Mark	Complete	38 (30-44)	76 (30-100)	94 (70-100)	100 (100)
	Accuracy	30 (21-39)	76 (30-100)	92 (70-100)	93 (67-100)
	Behavior	72 (60-97)	94 (77-100)	89 (80-94)	91 (65-100)

[a] Complete refers to the percent of homework problems that were answered. It was calculated by dividing the number of problems with an answer by the total number of problems assigned and multiplying by 100.

[b] Accurate refers to the percent of completed homework problems that were correct. It was calculated by dividing the number of problems with the correct answer by the total number of problems assigned and multiplying by 100.

[c] Behavior refers to the percent of "yes" responses on the daily behavior report card. It was calculated by dividing the number of yes responses by the total number of teacher responses and multiplying by 100.

[d] Days when Jessica took medication and used the goal-setting strategy were not included in these numbers.

Figure 1

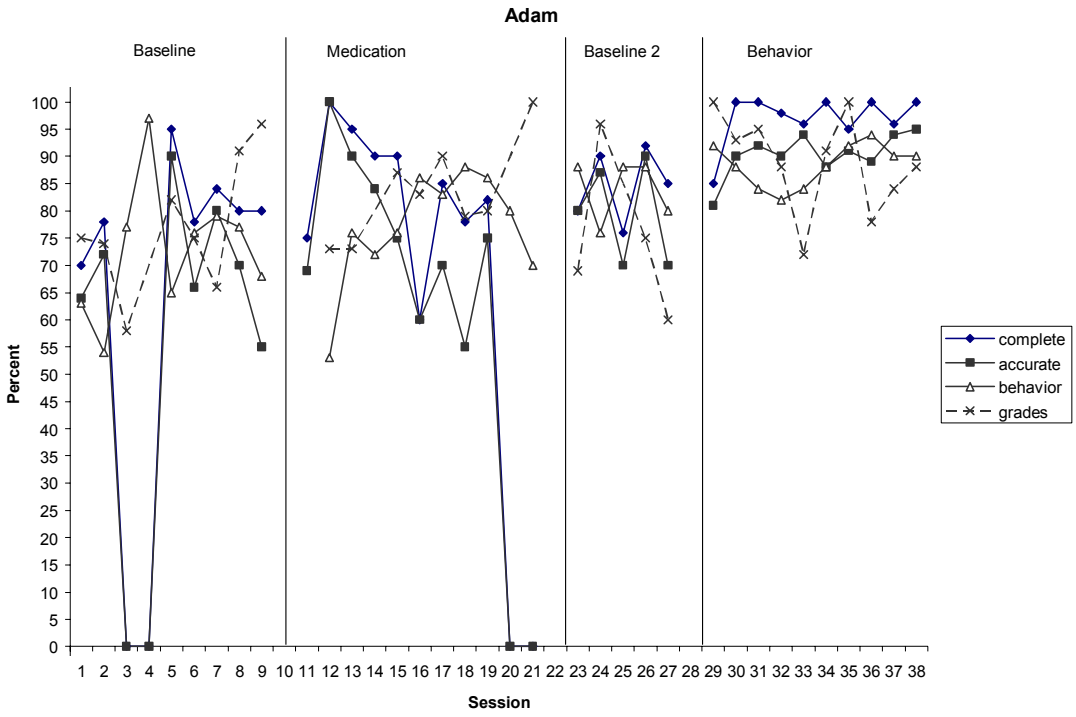

Adam
Baseline
Medication
Baseline 2
Behavior
Percent
Session
complete
accurate
behavior
grades

Figure 2

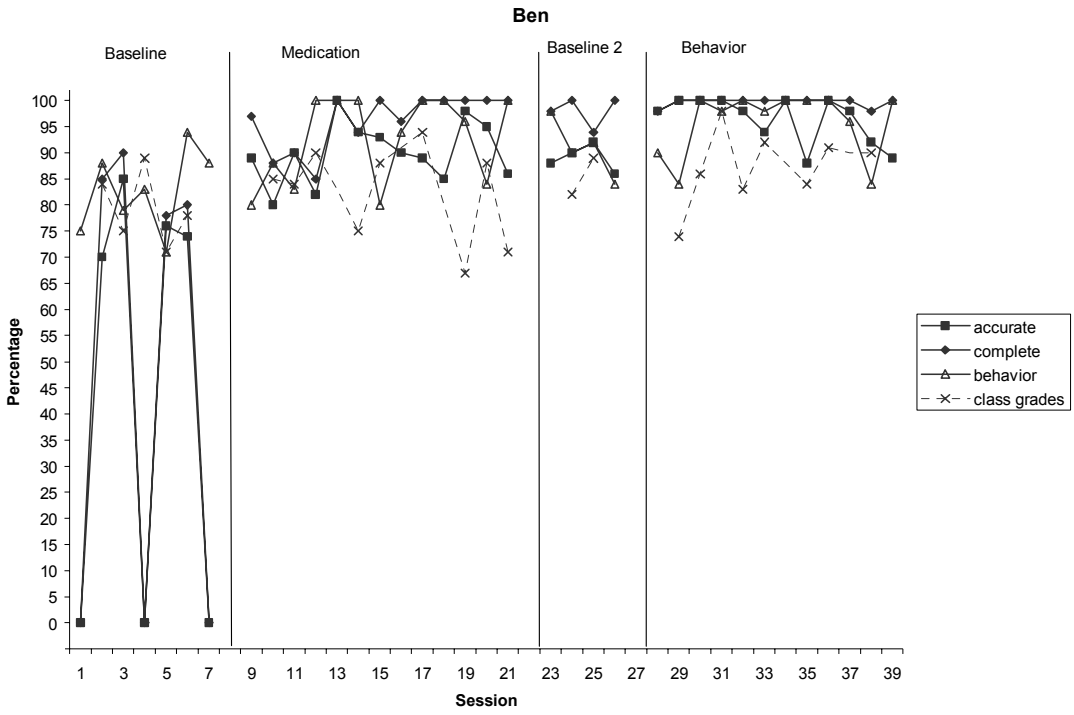

Ben
Baseline
Medication
Baseline 2
Behavior
Percentage
Session
accurate
complete
behavior
class grades

Figure 3

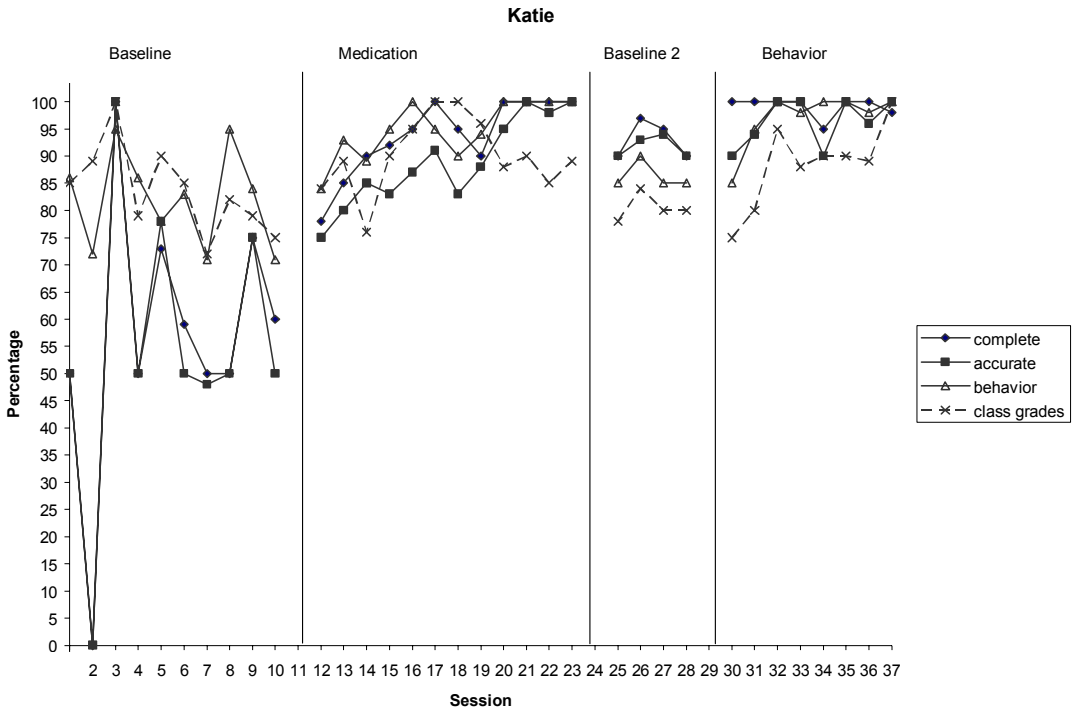

Katie
Baseline
Medication
Baseline 2
Behavior
Percentage
Session
complete
accurate
behavior
class grades

Figure 4

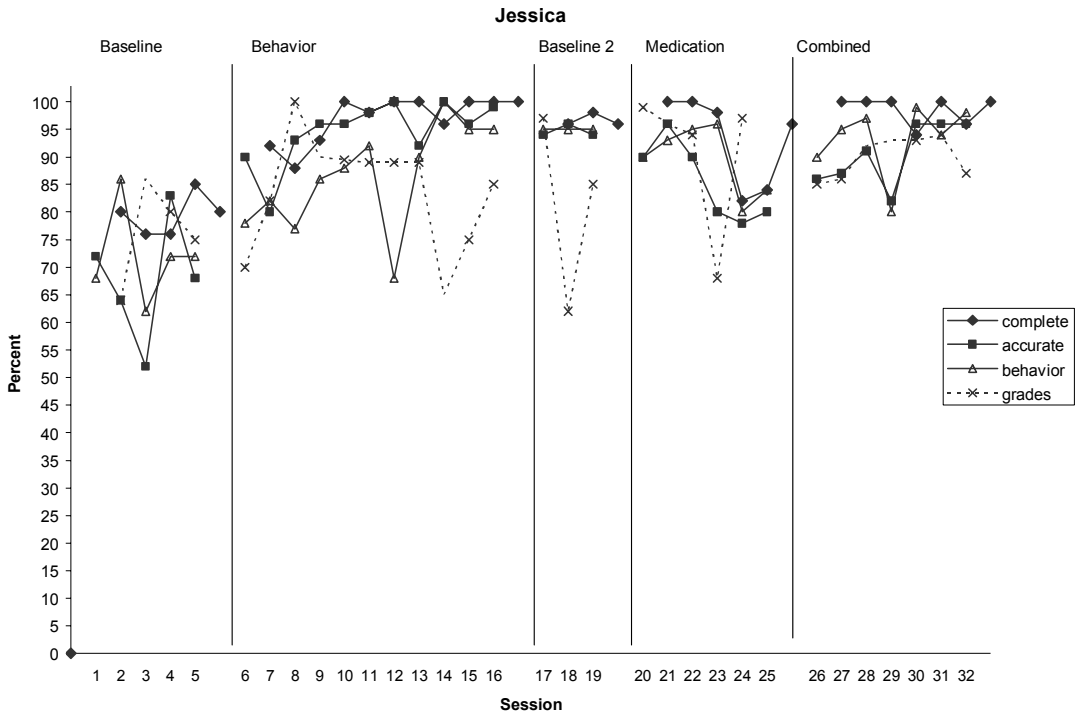

Jessica
Baseline
Behavior
Baseline 2
Medication
Combined
Percent
Session
complete
accurate
behavior
grades

Figure 5

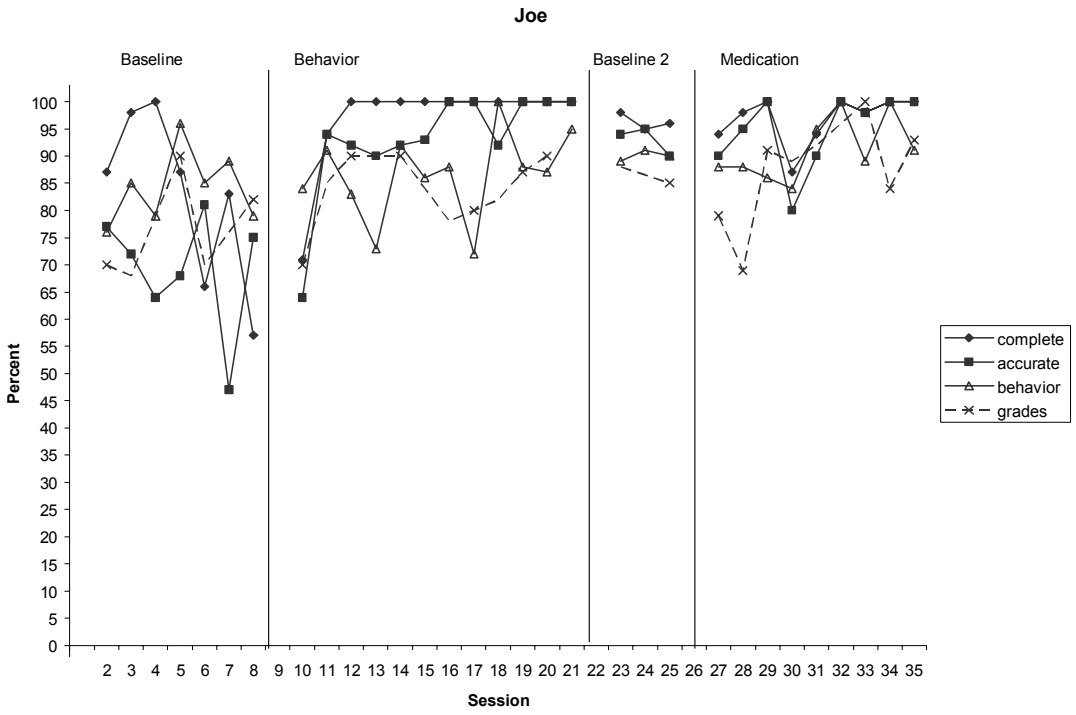

Joe
Baseline
Behavior
Baseline 2
Medication
Percent
Session
complete
accurate
behavior
grades

Figure 6

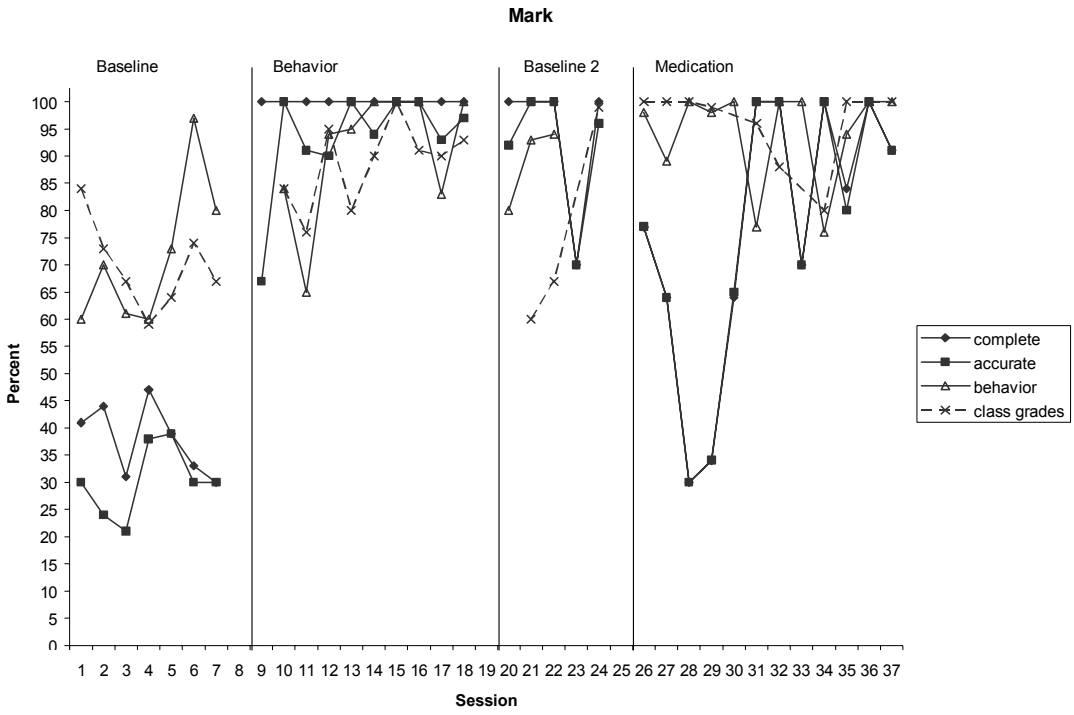
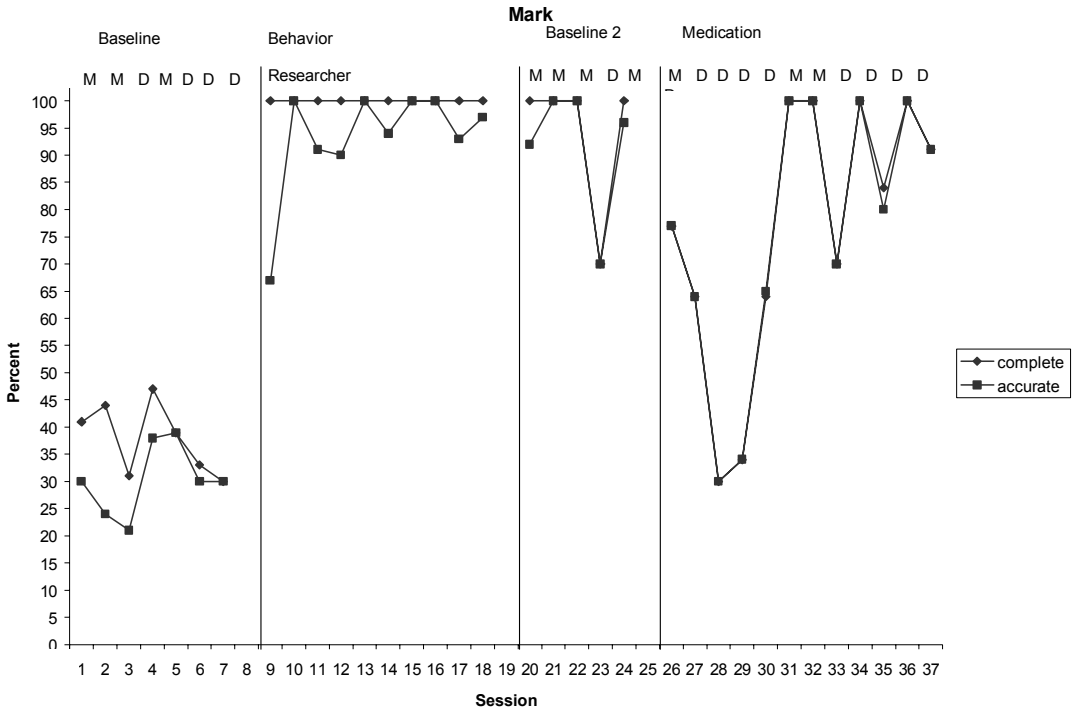

Mark
Baseline
Behavior
Baseline 2
Medication
Percent
Session
complete
accurate
behavior
class grades

Figure 7



M=Mother
D=Dad

Figure Captions