5-1-1998

Attention Deficit Hyperactivity Disorder in adolescents and the use of Ritalin

Joanne Nelson
Rowan University

ATTENTION DEFICIT HYPERACTIVITY DISORDER IN ADOLESCENTS AND THE USE OF RITALIN

by

Joanne Nelson

A Thesis

Submitted in partial fulfillment of the requirements of the
Masters of Arts Degree in the Graduate Division
of Rowan University

May 1998

Approved by

Date Approved 5/1/98

ABSTRACT

Attention Deficit Hyperactivity Disorder in Adolescents and the use of Ritalin

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Advisor: Dr. S. Jay Kuder

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The purpose of this study was to see if a combined stimulant intervention/behavior improvement system facilitated greater gains on achievement tests and on a behavior improvement level system than a behavior improvement system alone with ADHD adolescents. The sample used consisted of 10 subjects classified with ADHD. Subjects were matched for IQ, age, educational classification and placement, socioeconomic status, and family type. Five subjects received stimulants and five received no medication, but all subjects were involved with the behavior improvement system at school. Pretest results were gathered using the KTEA (Kaufman Test of Educational Achievement, brief form) and the student's standing on the behavior improvement system. Post test scores from the same two instruments were then gather for comparison. Although statistical tests were not significant, these results hold practical significance as demonstrated by the larger grade level gains made by the stimulant group in all areas tested (e.g. reading +1.80 grade levels for medicated vs. +0.52 for non-medicated). It is believed that further research needs to be conducted with larger samples who have less variability within each sample to get more accurate results.

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Table of Contents

Chapter One

Approximately 3-5% of all American children, up to 3.5 million children, have an Attention Deficit Disorder (ADD). ADD and ADHD (with hyperactivity) are a primary sources of school failure and under-achievement. ADD and ADHD are frequently accompanied by poor self-esteem and behavioral challenges. These disorders are neurobiologically based (CH.A.D.D., 1995).

Interventions for Attention Deficit Hyperactivity Disorder can involve medication, behavioral therapy, parental training, diet, and/or a change in educational placement, just to name a few. The topic of this thesis involves stimulant drugs, like Ritalin, its uses, effects, history, and changing research on this topic as it applies to ADHD in adolescents.

In the past, it has been common for doctors to discontinue stimulant drugs when a child reaches puberty. Some of the side effects of drugs like Ritalin usually involve loss of appetite, which may effect growth. The purpose of discontinuing drug use was to allow the adolescent to go through this natural growth spurt and reach their full potential size. Another fear of many parents was the continuing use of a controlled dangerous substance, or C.D.S., like Ritalin may lead to drug addiction problems later. Some parents state that by the time an ADHD child reaches adolescence, the child should become more responsible for their own behavior and exhibit better control.

On the other hand, stimulant medications have helped children achieve better in school by allowing the student to focus their attention and control their impulses. These abilities can help children academically in the classroom, socially and/or behaviorally on the playground, as well as to improve their self esteem through personal achievements at school and at home.

As a teacher of emotionally disturbed junior high school students, and as a parent of an ADHD 13 year old, I have a personal and professional interest in this debate over

whether to use stimulant drugs during adolescence. I have seen the benefits academically in the classroom as demonstrated by an ADHD child's ability to focus and learn from a lesson presented. I have seen a child smile simply because he has completed an assignment on time and earned a reward for it. And I have seen children become less involved in aggressive responses, and choosing solutions with more thought during social situations with their peers.

The pros and cons of whether or not to place these children on drug therapy can haunt parents and teachers alike. Academic and social growth are goals they both are striving for. Therefore, parents and teachers must ask themselves what are the effects of stimulants on academic performance? Do ADHD children not on stimulants make the same academic achievements as ADHD children on stimulants? On the other hand, will ADHD students on stimulants achieve more academic growth than ADHD students not on stimulants? Also, questions relating to the effects of the social achievement of ADHD children on stimulants as compared to ADHD children not on stimulants should be addressed.

Statement of Problem

This raises an important question: Do ADHD adolescent junior high school students, who are taking Ritalin, demonstrate larger increases in achievement in school, as shown by the Fall and Spring achievement tests and behavioral measures, than ADHD adolescent junior high school students who are not taking Ritalin?

Hypotheses

I hypothesize that ADHD adolescent students who are taking Ritalin will demonstrate larger increases in mean standard score on the Kaufman Test of Educational Achievement (KTEA) when comparing Fall and Spring standard scores than ADHD adolescent students who are not using Ritalin intervention. I also hypothesize that ADHD adolescent students who are taking Ritalin will achieve a higher status on a behavior improvement system than ADHD adolescent students who are not using Ritalin intervention.

Definitions

Attention Deficit Disorders were previously known as Minimal Brain Dysfunction

in Children, Hyperkinetic Child Syndrome, Minimal Brain Damage, Minimal Cerebral Dysfunction and Minor Cerebral Dysfunction. ADHD is now called Attention Deficit Hyperactivity Disorder and is defined according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, American Psychiatric Association, 1994) as:

A. Either (1) or (2)

(1). **Inattention**. At least six or more of the following symptoms of inattention which has persisted for at least six months to a degree that is maladaptive and inconsistent with the developmental level of the child:

(a) often fails to give close attention to detail or makes careless mistakes in schoolwork, work, or other activities.
(b) often has difficulty sustaining attention in tasks or play activities
(c) often does not seem to listen when spoken to directly
(d) often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)
(e) often has difficulty organizing tasks and activities
(f) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
(g) often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)
(h) is often easily distracted by extraneous stimuli
(i) is often forgetful in daily activities

(2). **Impulsivity-Hyperactivity**. At least six (or more) of the following symptoms which has persisted for at least 6 months to a degree that is maladaptive and inconsistent with their developmental level:

Hyperactivity

(a) often fidgets with hands or feet or squirms in seat
(b) often leaves seat in classroom or in other situations in which remaining seated is expected
(c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)
(d) often has difficulty playing or engaging in leisure activities quietly
(e) is often on the "go" or often acts as if "driven by a motor"
(f) often talks excessively

Impulsivity

(g) often blurts out answers before questions have been completed
(h) often has difficulty awaiting turn
(i) often interrupts or intrudes on others (e.g., butts into conversations or games)

B. Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age seven.

C. Some impairment from the symptoms is present in two or more settings (e.g., at school [or work] and at home)

D. There must be clear evidence of clinically significant impairment in social, academics, or occupational functioning

E. The symptoms do not occur exclusively during the course of a pervasive Developmental Disorder and are not better accounted for by another mental disorder (e.g., Mood Disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder)

Ritalin or methylphenidate hydrochloride USP is described in the Physician's Desk Reference (P.D.R.) as a mild central nervous system stimulant (44th Edition, 1990). The P.D.R. continues to state that the mode and action in man is not completely understood, but Ritalin presumably activates the brain stem arousal system and cortex to produce its stimulant effect.

A behavior improvement system is a system of positive reinforcements, negative reinforcements, and punishments designed to extinguish unwanted behaviors by replacing them with desired behaviors. Behavior improvement systems typically consist primarily of positive reinforcement of desired behavior that may include: non-verbal reinforcement (e.g., a smile), verbal praise, a positive phone call home, a touch (e.g., pat on shoulder), a tangible reward (e.g., token, food), and privileges (e.g., extra P.E.). Secondary to a behavior improvement system are a list of negative reinforcers and punishments which may include: delay of a desired activity until completion of an assignment (e.g.recess after math is completed), a phone or letter home informing parents of negative behavior, removal from situation (e.g., time out, in-school suspension), or punishment (e.g., detention, suspension, fine from token economy).

Behavioral improvement systems usually consist of a type of level system where students who have met certain behavioral requirements move up to the next level. These levels usually involve progressively more privileges and more trust on the part of the child. The child's goal is to obtain the highest level by increasing desired behaviors (e.g., being on-task) and decreasing unwanted behaviors (e.g., acts of aggression).

Purpose

The purpose of this research study is to determine if students with ADHD who are taking stimulant medication achieve at higher levels and have more positive social behavior than similar students not on medication. If stimulant usage proves effective in adolescence, then these older children can benefit from its use. This is important because in the past,

stimulants where used only during childhood years (e.g., 6-12). More recently, doctors are prescribing stimulants to adolescents and adults with ADHD so that continued benefits from this medication can help them through high school and into adulthood. The families involved with these adolescents, as well as their teachers, will find the results of this study important because of the possibility for both academic and behavioral growth. The students themselves can experience success and therefore improve their self image. I hope to find a positive relationship between the use of stimulant medication and success in school for these older ADHD children.

There are certain implications of the possible findings in this research study. First, if stimulant medications are found to increase academic and social achievements, than should they be used with all ADHD adolescent students? Second, what if the increase in academic and social achievements is not significant or what if there is no difference at all? Also, what if significant achievements in school are not related to whether the student is on medication, but are found to be related to the amount of the dose (e.g., mg./kg)? What if the side effects out-weigh the educational benefits of the medication? What if the parent, teacher, and/or doctor disagree about whether the educational benefits are not significant enough to warrant continuing drug therapy?

In the chapters that follow there will be more detailed information about ADHD and this research study. In chapter II, an extensive review of the literature will be conducted involving literature supporting both sides of the stimulant issue. In chapter III, the design of the actual research study will be laid out in detail. In chapter IV, the results of the research will be presented using charts, graphs, tables and script. Finally, in chapter V, a discussion will be presented detailing what was found, possible reasons for such findings, interpretation of the data, and predictions for future research pertaining to the topic.

Chapter Two

Background on ADHD

Attention Deficit Hyperactivity Disorder has been one of the most researched topics in the education of children with special needs today (Dulcan, 1997). ADHD is also the most common psychiatric disorder of childhood (Swanson, Cantwell, Lerner, McBurnett, & Hanna, 1991). The history of this disorder (called many other names in its development) dates back to the early 1900's when it was considered some type of brain damage, a traumatic brain injury, or "morbid defects in moral control" (Still, 1902: as cited in Greenhill & Osman, 1991). In the 1950's the causes were thought to center around a brain dysfunction, not damage. Today, ADHD is a low visibility but highly prevalent disorder that can effect every part of a child's life, from school, to home, to playground and later to work or to job sites. ADHD, as it is defined today in the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV), is manifested by inattentiveness, hyperactivity, and/or impulsiveness, displayed through a variety of behaviors (eg. distractible, unable to stay seated, calling out in class, difficulty waiting turns, etc.) for a period of time (longer than six months) and in different environments (in the classroom, at home, on the playground, etc.) which is not caused by another mental disorder. It is also the most common neurobehavioral disorder of childhood (DSM-IV, American Psychiatric Association, 1994). Shaywitz & Shaywitz, in 1988, estimated that ADHD now affects as many as 10-20% of the school-aged population (cited in Greenhill & Osman, Eds. 1991).

Researchers have looked for neurologically based evidence of brain differences in children and adolescents with ADHD using MRI and PET imaging technology. Some have found differences in both the caudate and corpus callosum sections of the brain in shape and size (Castellanos et. al., Hynd, Hern, et al., Giedd et. al., Sermud-Clikeman, Filipek

et al., as cited in Seidman, Biederman, Farone, Weber and Oullette, 1997). Other findings by Zametkin were related to actual brain structure or function that included a difference in cerebral metabolism (as cited in Seidman et al., 1997). Furthermore, reductions of the frontal area of the brain were found in ADHD children by Hynd, Semrud-Clikeman, Lorys, Novey & Eliopulos (as cited in Seidman et al., 1997).

Assessment and treatment practice parameters for children, adolescents, and adults have been reviewed and updated over the years (Dulcan, 1997). Currently, assessment of ADHD in children and adolescents includes a review of school-related data such as reports of behavior, learning, and attendance. Rating scales filled out by the teachers and the parents also provide valuable information. The student should be observed using structured observation techniques (e.g. standardized checklist) in the classroom and in less structured settings like the playground and lunchroom. A medical evaluation, which includes a complete medical history (including pregnancy history), vision and hearing exams, blood tests for lead, and a thyroid dysfunction check, should be conducted.

After looking at the results of the various diagnostic tests used to determine if a child has an attention deficit disorder, the student's individual problems should be addressed. Some students may have the bulk of their problems in the category of hyperactivity, while others may be impulsive or inattentive. A majority exhibit problems in two or all three of these areas.

The neuropsychology of ADHD is the study of brain behavior relationships (e.g. intellectual functioning, attention/concentration functioning, memory functioning, language functioning, spatial functioning and executive functioning, [J. Zielinski, personal communication, October 25, 1997]) and was the topic of a research study out of Massachusetts General Hospital (Seidamn, Biederman, Farone, Weber and Oullette, 1997). The performances on tests of neuropsychological functions of both ADHD children and adolescents were compared. The neuropsychological performances of the ADHD children were significantly impaired when compared to the control group. The brain functioning findings of Seidman, as well as the brain structural differences, brain size and metabolism findings of the researchers mentioned previously, are conclusive that ADHD has roots in neurological and brain composition abnormalities (Castellanos et. al., Hynd, Hern, et al.,

Giedd et. al., Sermud-Clikeman, Filipek et al., Zametkin et al., as cited in Seidman, Biederman, Farone, Weber and Oullette, 1997).

Treatment of ADHD and the Use of Stimulants

Treatment of ADHD may include psychosocial interventions, environmental modifications, principles of behavior modification, medication (usually a central nervous system stimulants like methylphenidate), parent training, family counseling, education through support groups, and educational adjustments. For 60 years the primary treatment for ADHD (the name has changed frequently through the years) has been the use of pharmacological intervention with one of the central nervous system stimulant drugs like d-amphetamine (Dexedrine) and pemoline (Cylert) (Swanson, Cantwell, Lerner, McBurnett & Hanna, 1991). Amphetamine sulfate (Benzedrine) and its use in behavior disordered children was first reported by Bradley in 1937 when he reported this stimulant to have a positive effect on the academic achievement (cited in Gadow, 1983). Methylphenidate was first introduced in 1955 as a hopefully nonhabituating alternative to Dexedrine and other amphetamines for the treatment of hyperactivity in children (Wiener, 1991). The use of stimulant medication, like Ritalin, with children has received the most controversy.

Stimulant use as part of the treatment of ADHD in children can have a positive effect on their cognitive, learning and academic performances. Results from the use of methylphenidate in ADHD children can be seen as increased output, accuracy, efficiency, improved learning acquisitions, increased effect, and increased self-correcting behaviors (Douglas, Barr, O'Neil, & Britton, 1986).

Usually for more severe cases, stimulant medication is used in combination with other modifications, education, support groups, additional medications, and/or counseling. A study conducted in 1993 (Pelham, Carlson, Sams, Vallano, Dixon, & Hoza) measured the effects of stimulant intervention alone, behavior modification alone, and stimulant and behavior modification used together. Results showed that using the behavior modification alone tended to increase on-task behavior significantly more than stimulants. However, stimulants alone produced significant improvement in all measures except seat work

accuracy (e.g. disruptive behavior, physical aggression, verbal abuse, destruction of property, cheating, verbal intrusion, social validity {e.g. like a normal child or pleasant}, and following rules). Combined intervention (stimulants and behavior improvement) produced significant improvements for all measures. Children were also more likely to be rated as very pleasant on the social validity scale when involved in either stimulants alone or in combination with behavior improvements as opposed to behavior improvement intervention alone. All treatments in this study were shown not to generalize into non-intervention periods (Pelham et al., 1993). Several other authors, who have conducted similar studies, found that medications may improve some behaviors while behavior modification improved other symptoms in the same subject (Pelham & Murphy, 1986, as cited in Pelham, Carlson, Sams, Vallano, Dixon, & Hoza, 1993). This further supports the benefits of a combined treatment of stimulants and behavior modification.

The use of methylphenidate can improve the symptoms of ADHD children in the classroom. But improvements in other situations (e.g. home) and times (e.g. morning and afternoon) may not be as significant (Schachar, Tannock, Cunningham, & Corkum, 1997). Often side effects become a problem for some children. Some of these side effects may include: insomnia, dizziness, anorexia, headache, daytime drowsiness, irritability, sadness, crying, tics or over focusing. In a study conducted in Canada (Schachar et al., 1997), subjects were given either a placebo or methylphenidate twice a day (morning and lunch time) for four months. Baseline information on behavior at home and school, at different times of the day, different lengths into the study, as well as height and weight measures were obtained. The results showed that more children were withdrawn from the stimulant group in this study due to side effects of the medication than were withdrawn from the placebo group. Weight increase in the methylphenidate group was -.4 kg. as compared to +1.2 kg. with the placebo group, yet both groups demonstrated approximately +2 cm. in height in the four month study. Benefits of the stimulant group's behavior were only seen in the school setting. This may be due to loss of drug effectiveness by the time the child got home or from rebound effects which could have been alleviated by a third late afternoon dose. Some side effects noted may have been due to actual symptoms of ADHD and not due to medication. Finally, teachers noticed more behavior improvements and less side

effects, and parents noticed less behavior improvements and more side effects. These findings could be due to the time the doses were administered, and the different behavioral expectations of the teacher and the parent. Usually treatment with stimulants lasts over several years and although short term benefits and risks have been studied, extended use of stimulants is not as well understood. We do not know whether the side effects evident in short term studies diminish or increase over time, or if other side effects appear at a later date.

Teachers may demonstrate different attitudes towards ADHD children who are taking methylphenidate than ADHD children who are not taking methylphenidate (Whalen, Henker, & Dotemoto, 1980). It was observed that ADHD children on placebos received more intense and controlling negative verbal interactions than those students on stimulants or the controls. Also, the placebo group were more often referred to by name (referring to the child instead of the behavior) than the other two groups. An implication of the results of this study may be the effect of medication on others in the classroom who are not ADHD. The teacher tends to spend more time correcting non-medicated ADHD children which can impinge on the time available for other students in the classroom.

Many symptoms pertaining to success in the classroom of ADHD children have been controlled by stimulants. Yet another problematic area still exists for many ADHD students: the area of social skills. The peers of ADHD students may be cautious about starting friendships with others who tend to be difficult and disruptive. The social impact of stimulant treatment for hyperactive children has also been reviewed in a report by Whalen & Henker (1991). The ADHD child in this study frequently initiated social contact with peers but in a way perceived as immature, intrusive, or aggressive. Some of these behaviors may in fact be the result of their difficulty in dealing with frustration. ADHD children seem less able to adjust their behaviors in agreement with social cues. The use of stimulants, in addition to enhancing concentration and cognition, also improves interpersonal cooperation.

Relationships between ADHD children and their mothers showed a decrease in maternal criticism and an increase in maternal warmth and mother-child contact following stimulant treatment (Schachar, Taylor, Wieselberg, Thorley, & Rutter, 1987; as cited in

Whalen & Henker, 1991). Situations in the home may also benefit by the child being more focused and compliant with parents and less controlling and domineering with peers (Barkley, Karsson, Pollard, & Murphy, 1985; Cunningham, Siegel, & Offord, 1985; as cited in Whalen & Henker, 1991).

Situations involving organized sports where ADHD children were often selected last due to skill deficits and misbehavior, also seem to benefit from stimulant intervention. Stimulants did not improve baseball skills, but did have a positive effect on attending and following the action. Teammates tended to overlook skill deficits like poor batting, but were less likely to forgive a teammate who was facing the wrong way or throwing his glove in the air (Whalen & Henker, 1991).

Non-disabled children view the behaviors associated with ADHD as undesirable and negative. This raises the question of peer status with ADHD children. Stimulant medication and the perceptions of the peers of children with ADHD is a concern. Methylphenidate, in a study conducted in 1989, did improve the ADHD child's standing in the peer group. The medicated boys were more likely to be named best friends or chosen as "fun to be with" or cooperative by their peers than those boys receiving a placebo (Whalen, C. K., Henker, B., Burrmester, D., Hinshaw, S. P., Huber, A., & Laski, K. 1989). Apparently, this improvement was dose related with the greatest improvements at the .6mg/kg level as compared to the .3mg/kg level and placebo. Yet these improvements were not sufficient enough to upgrade the ADHD child's status to that of normal peers. The problem here is that ADHD children on stimulants are not continuously medicated. This leads to a decline in appropriate behaviors around lunchtime or before and after school. The child may display desirable social-interchanges during the morning only to have his reputation spoiled by a single unfavorable misbehavior before lunch when his medication has worn off and before his lunchtime dose has taken effect (Whalen & Henker 1991).

The possibility of side effects from the use, or prolonged use, of stimulant medications has swayed many parents to withdraw their child from stimulant treatment. Certain characteristics may lead to a successful withdrawal from medication while other may burden the process. For example, if the child believes that the medication is no longer

useful or necessary then medication termination is less traumatic. But if the child believed that "good" work and behavior are due solely to medication than the withdrawal from medication can be detrimental. In a case study by Rosen, Leary and Conway (1985), the withdrawal of stimulant medication from a 9 year old subject was examined. The subject, Tom, was given 5mg of methylphenidate twice a day. On the sixth day of the study, Tom's dose was reduced to 2.5mg/b.i.d. With the reduction of medication came an increase in behavioral techniques which included immediate material rewards for following classroom rules and completing assigned work, as well as daily positive notes home when Tom met his behavioral and academic goals. Tom's productivity was 93%, completing all assignments except for one day. His average time-on-task was 57% per structured observations. During the third week of school, Tom's prescription had ran out and for 4 days he was without medication. Tom's productivity dropped to 57% and on-task percentage dropped to 15%. When asked about his work and behavior, Tom attributed all his problems to not having his pills. Tom was then placed on a 2.5mg placebo table. His productivity rose to a mean of 87% and his on task rate increased to a mean of 64%. Tom attributed his success to his pills. The placebo was then slowly withdrawn while the teacher began prompting and reinforcing more adaptive and internal attributions to the causes of his behavior (e.g. "I finished and I did it on my own. I don't need the pills."). After complete withdrawal from medication, Tom completed 97% of his assignments and was on task an average of 71% of the time for 5 days of observations.

After completing third grade, Tom started fourth grade with positive results and drug free. However, Tom's behavior went downhill and Tom was placed back on 5mg of Ritalin. When Tom was complemented on his behavior, he stated that it wasn't him it was the Ritalin. Tom also started fifth grade without Ritalin but because the teacher wouldn't institute a behavior modification program, Tom's mother put him back on medication (Rosen, Leary and Conway, 1985). The earlier results of Tom's success did not generalize to other situations.

The problem with the Rosen, Leary and Conway (1985) study was that it only dealt with a single subject but it brings up an important topic. Many believed that just the thought of using a drug to improve school performance would increase the child's

perception of their performance citing the drug as the reason for their success. In another study conducted, 26 subjects were used as opposed to just one. In contrast, ADHD boys who were given the same task with medication and then with a placebo attributed their success significantly more often to their effort than to the medication (Milich, Licht, Murphy, & Pelham, 1989). This study, too, had a methodological flaw. The subject either received their medication or a placebo, yet a third condition could have been added by giving no pill at all. Because the subjects believed they were on medications during both sessions, the results did not address whether there are self-evaluation differences associated with knowing if one is on methylphenidate or not.

The controversy involved in the use of methylphenidate often centers around the possible side effects. One of the reported side effects of stimulant drugs is the threat of growth retardation. A study by Klein and Mannuzza (1988) looked at young adults who were treated with methylphenidate in childhood to determine if their ultimate height was effected. The ADHD children in the study were treated on the average with 45mg. per day for an average of two years when they were between the ages of 6-12. When the subjects' height was evaluated during drug treatment, their growth rate was found to be adversely affected. However, this longitudinal study found that when compared to a control group of same age peers, there was no significant height difference when the children had reached an average age of between 16-23 years of age. In a study by Hechtman, Weiss, and Perlman (1984), similar findings were concluded between ADHD adults who were stimulant-treated as children, ADHD adults who were untreated, and control group adults. The subjects demonstrated equivalent height and weight achievements. The findings in these studies support the theory of growth rebound after the removal of methylphenidate treatment. Also, genetic influence and parental stature must be considered in the ultimate height reached by any child. Other factors that may effect growth is the comorbidity of other disorders with ADHD. For example, conduct, mood, and anxiety disorders might also affect growth (Biederman, Newcorn, & Sprich, 1991, as sited in Spencer, Biederman, Harding, O'Donnell, Parone, & Wilens, 1996).

Growth deficits in both height and weight and their possible link to stimulant use were studied at Massachusetts General Hospital and Harvard Medical School (Spencer,

Biederman, Harding, O'Donnell, Parone, & Wilens, 1996). They found that there was a modest height difference in the ADHD patients as compared with controls. These height deficits were not evident after early adolescence. Furthermore, they found no evidence of delayed puberty development or weight deficits. These results are consistent with the hypothesis that ADHD may be related to a delayed tempo of growth in height, and not to impeded growth due to complications of stimulant treatment (Spencer et al., 1996).

Another side effect of psycho stimulant medication is rebound. Rebound effects are defined as the decline in behavior that takes place in the late afternoon and evening following daytime administrations of stimulants (Johnston, Pelham, Hoza, & Sturges, 1988). In a placebo, .3mg/kg dose and a .6mg/kg dose blind study, the results provided limited evidence for behavioral rebound effects in boys taking a morning and noontime dose of stimulants. Also, on the two different measures used, results varied enough to warrant them inconclusive. Rebound effects of the use of methylphenidate not investigated in this study, which may need further study, may be delayed sleep onset, lengthened sleep and changes in REM variables among ADD children.

The use of stimulant medications have been discussed thus far as it relates mainly to the use of methylphenidate or Ritalin. Many other stimulant medications are also available for the treatment of ADHD. The different effects of these stimulants should be compared. In a study by Pelham and others in 1990, sustained-released methylphenidate, sustained-released dextroamphetamine, pemoline, and standard methylphenidate were compared. The dependent variables studied were social behaviors, classroom performance, and performance on continuous performance tasks. What was found in this study was that sustained-released dextroamphetamine and pemoline produced the most consistent results (Pelham, Greenslade, Vodde-Hamilton, Murphy, Greenstein, Gnagy, Guthrie, Hoover, & Dahl, 1990). Also, the effects of the sustained-released stimulants lasted for 9 hours. Since the medications were given on random days, there was a concern about some of the long-acting medications, specifically pemoline, not reaching its fullest potential. The effects of the pemoline was documented on the second and third day and it was found that the effects were equivalent to the other medications. This contradicts the findings earlier that it takes 6-8 weeks to see an effect with pemoline. One of the side effects of the long-acting

stimulants in this study was difficulty falling asleep which subsided by the third day. The concluding recommendation, for 14 of the 15 children receiving a recommendation for medication, was treatment with one of the long-acting stimulants as opposed to standard methylphenidate. Another point to consider is the possibility of a build of the long-acting stimulants over time since the half-life of these medications are longer than standard stimulants.

In another study of comparison, the effects of regular methylphenidate and sustained release methylphenidate were studied to compare their effects on cognitive and social behavior in ADHD children (Pelham, Sturges, Hoza, Schmidt, Bijlsma, Milich & Moorer, 1987). The study was divided up into two separate studies. The first one tracked the effects of the medications on behaviors. The second study tracked the effects across time. Side effects in these studies did not include difficulty in falling asleep as did in the above mentioned study (Pelham, Greenslade, Vodde-Hamilton, Murphy, Greenstein, Gnagy, Guthrie, Hoover, & Dahl, 1990), however appetite suppression was a problem in an equal number of subjects on standard and sustained-released methylphenidate. The results demonstrated in the first study was that both forms of methylphenidate had a positive effect on social and learning dependent variables studied (e.g. rule-following behavior, positive peer behaviors, classroom productivity and accuracy). However, standard methylphenidate had slightly more favorable results in the first study.

In the second study, which looked at how long the effects lasted comparing the standard and long-acting methylphenidate, they found that sustained-released methylphenidate had less variance through the lunch time hour as opposed to the standard methylphenidate. Long-lasting methylphenidate started to slowly decrease its effects after four hours. Effects of the standard methylphenidate were seen faster than sustained-released stimulants.

In addition to different kinds of stimulant intervention, there are also dose-related considerations to examine. Classroom academic and social performances of the child can be effected by dose size in relation to milligrams to kilograms (mg/kg) (Pelham, Bender, Caddell, Booth, Moorer, 1985). This study used a double-blind, cross-over design with order randomized. These children, aged 5-11, received a placebo for two weeks, and three

different doses of methylphenidate (0.15mg/kg, 0.3mg/kg, and 0.6mg/kg) for one week each. The dependent variables measured included the output and accuracy of performance in grade-appropriate reading comprehension workbooks and arithmetic problems, spelling word acquisition, and observation of disruptive and on-task behavior. The results of this study indicated that positive effects on academics were achieved at the 0.3mg/kg dose of methylphenidate yet behavioral improvements maximized at the 0.6mg/kg dose. Also noted was that arithmetic measures increased slightly more than reading measures. They attributed this to the fact that arithmetic improvements tend to come about with drill and repetition, which is a component of the design of this study. Increases in spelling performance was not as significant as both the reading and arithmetic performances but an intervening variable mentioned by the authors might have been that spelling often tended to follow a free play period and students entered into the spelling lesson excited. Overall, this study supports the use of methylphenidate to improve academic and behavior performances in ADHD children (Pelham, et al. 1985).

In a more recent study, academic performance and overt behavior in hyperactive children were compared as it relates to different doses of methylphenidate (Tannock, Schachar, Carr, & Logan, 1989). This study was also a double-blind, placebo-control, within-subject (crossover) design. Participants were between the ages of 6 and 11 and were diagnosed with ADHD according to the DSM-III. The effects in this study were measuring 0.3mg/kg and 1.0mg/kg doses of methylphenidate on academic and behavior performances. An interesting finding in this study was that with a 0.3mg/kg dose in the morning there was no longer any academic or behavioral improvements noted in the afternoon. However, with the 1.0mg/kg dose in the morning, there were still behavioral improvements noted in the afternoon although the academic improvements had diminished. As with the other dose-related studies, academics improved at the 0.3mg/kg dose the same as with the higher dose when compared to placebo, indicating there is no need to increase the dose to get the desired academic effects in the classroom. Behavior did improve at the 0.3mg/kg dose, however, better improvement occurred at the higher dose when compared to placebo.

ADHD in Adolescence

ADHD diagnosed children experience trouble learning due to the symptoms of their disorder (difficulty with sustained attention, listening skills, distractibility, organizational skills, etc.) or due to the comorbidity of other learning/behavioral disorders. It was assumed in earlier years that ADHD did not continue into adolescence or adulthood. However, these ADHD children usually approached adolescence with continued problems. Some of the symptoms special to adolescents with ADHD tend to be more restlessness instead of gross motor hyperactivity. Fidgeting, out of seat behavior, poor impulse control, and inattention are still present in adolescence. The older student may also experience poor organizational skills, difficulty setting and keeping priorities, and weak problem-solving strategies (Dulcan, 1997). All these factors contribute to poor school performance. The ADHD adolescent may have low self-esteem, increased thoughts of suicide, experiment with self-medication attempts (especially if unmedicated by a physician) and substance abuse, and develop poor peer relations. They also tend to make poor judgments with the addition of more independence that comes with adolescence, resulting in decisions that can have dangerous results (e.g. automobile accidents, traffic tickets,etc.) (Dulcan, 1997).

Students who were classified ADHD have been found to have significantly poorer educational outcomes as adolescents when compared to same age peers (Lambert, 1988). In a longitudinal study, conducted by Lambert from the University of California, Berkeley, ADHD adolescents (ages 17-18) were found to more frequently attend special schools, not finish high school, not go on to college, leave school or run away, live away from school in foster care or residential settings, and were more often adjudicated delinquents. However, an interesting finding in this study was that children diagnosed and treated for hyperactivity medically were more likely to smoke cigarettes, yet less likely to abuse illegal substances than their control group (Lambert, 1988).

Medication Use in Adolescence

As the ADHD child grows into adolescence and then into adulthood, the long term effects of stimulant usage must be considered. Conversely, the ADHD adult who did not receive stimulant treatment as a child should be looked at to discover the effects on the ADHD adult who did and did *not* receive stimulant medications as a child. In a study by Hechtman, Weiss, and Perlman (1984), ADHD adults who were treated with stimulants as children, ADHD adults untreated as children and a non-ADHD untreated control group were reviewed. What they found was that the control group did better in all areas tested (e.g. schooling, school-guidance questionnaire, employer questionnaire, work records, debts, personality disorders, some psychological tests, etc.) than both the treated and untreated hyperactive groups. Interestingly, there were a few areas that the stimulant treated group did better than the untreated group. These areas included: fewer car accidents, seeing their childhood more positively, stealing less in elementary school, and generally having better social skills and self-esteem. Stimulant-treated hyperactives were more involved in alcohol and stimulant use when compared with their controls, but untreated hyperactives were involved with more heroin use (Hechtman et al, 1984).

Most parents, teachers, physicians, and others concerned with the ADHD child, are focused mainly with improving the academic achievement of the child. The frustration level of the ADHD child becomes apparent typically when the child is challenged academically. Therefore increasing the child's academic levels without increasing their frustration is an accomplishment all are striving for. The cognitive effects of methylphenidate on the ADHD child, which may include information-processing, were the focus of a study in 1994 (Klorman, Burmaghim, Fitzpatrick, Borgstedt & Strauss). Subjects received methylphenidate or placebo for 21 consecutive days in random order and under blind conditions. The average dose received by each subject .76mg/kg. The results were a generality of improvements in the subjects who received stimulants. Also noted in this study was that maturation had similar effects on performance as did methylphenidate. This is an indication that as the ADHD child grows into adolescence and adulthood, there may be less of a need for stimulants or a need for a smaller dose (mg/kg).

One of the hardest school situations for an ADHD child to succeed in is the lecture format classroom. This is often the case in ADHD adolescents where lectured lessons are used more frequently. Not only does the child have to focus on the lecture, take notes, write and listen at the same time, but he also has to ignore others who may be off task and keep their own behavior in check, especially when they feel frustrated at the speed of the lecture. Junior high school students who are not ADHD can feel overwhelmed by the changes and added responsibilities of junior high school life. The use of stimulants in adolescents in junior high has been studied because of the possible positive effects on ADHD students in these difficult lecture type classrooms. Performances on tests and quizzes, observations of attention and behavior during lectures, teacher ratings, and accuracy of assignments completed during study hall were studied in the research of Evans & Pelham (1991). A double-blind placebo-controlled design using 9 male subjects ranging in age from 11-15 years old with a diagnoses of ADHD according to DSM-IIIR were given either methylphenidate (8 on methylphenidate and 1 on pemoline due to previous non response to methylphenidate) or a placebo. The study took place at a Summer Day Treatment Program. For 90 minutes a day, during their 9 hour day, students participated in a 60 minute American history class followed by a 30 minute study hall. Students were also to be taught note taking skills in this class. Monday through Thursday, the students listened to the lecture and took notes. Every Tuesday through Thursday, the students took a quiz on the previous day's notes with a cumulative test on Fridays. During the study hall period, the students were given an assignment to complete with the remaining time to be used to study their notes for the next day's quiz. No written material or text were provided during study hall. Their notebooks were collected at the end of study hall and given back to them at the beginning of the following class to insure all studying was done from notes taken in class and took place in study hall.

Dependent measures in this study were academic performances on daily quizzes, lecture question and answer assignments, and cumulative tests. Behavioral performances included observations of aggression, verbal abuse, destruction of property/inappropriate use of materials, cheating, interrupting, and talking to self. Teacher ratings on a Conners Scale for inattentive/overactivity and oppositional/ defiant were performed at the end of each

class.

The results of this study were the first to demonstrate that stimulants improved the performances in young adolescents on measures that they would encounter in a regular junior high school class. Improvements in these subjects were both academic and behavioral in nature. Improvements were the same with both the higher and lower doses of medication which was the same found with younger subjects in previous studies. Grade improvements averaged from a D- on placebo to a B- on medication which indicates that school failure could be reduced in ADHD adolescents who benefit from stimulant medication. It is important to note that the setting of this study was closely related to a junior high school class so external validity could be insured. Also, the use of a study hall more closely resembles a junior high school situation where assignments are completed independently outside the regular classroom in a study hall or at home. It might be beneficial to provide a third dose of medication in the late afternoon to enhance the study skills needed for homework at the junior high school level. It is important to mention that 3 of the 9 adolescents were not recommended for medication at the end of the study. One due to adverse rebound at night which manifested itself as verbal confrontations with his parents. The other two subjects did not have side effects but the parents chose not to continue because these two students were on medication as children and they did not want to continue stimulants. This study documented the benefits of stimulants to help ADHD adolescents who potentially would have poor academic results function better in the classroom. Careful monitoring is needed to adjust the child's dose and reduce side effects (Evans & Pelham, 1991).

The results of studies involving stimulant treatment often show a positive effect on the child's learning. But when reviewing these studies one must take into account methodological considerations. There are many different kinds of stimulant drugs which may have different effects on a variety of academic tasks. Also, there is the controversy over dosages. While a small dose may be beneficial to academic areas, a larger dose may be needed for behavioral improvements. This higher dose, however, may actually impair the academic gains of the drug (Sprague & Sleater, 1977; as sited in Gadow, 1983). The schedule of when a child gets his medication and when it will wear off is also a

consideration in the use of stimulants. Short-acting stimulants given in the morning would not be helpful by the afternoon. Furthermore, the duration of treatment is important especially when looking at standardized achievement test scores. Studies often look at the short-term (e.g. weeks) effects of stimulants, but long-term effects (e.g. months or a school year) are what is looked at when comparing standardized test scores from year to year produced by the same ADHD child. Finally, the setting and the inclusion of other therapies has a significant effect on how well a medication will work. Many studies support the fact that medications work best with some type of behavior modification implemented as well (Pelham, Carlson, Sams, Vallano, Dixon & Hoza, 1991). However, there are also studies that conclude that while stimulants increase academic productivity, the effect on standardized achievement tests are not especially strong, and some behavioral interventions are clearly superior (Gadow, 1983).

The effect of stimulant medication on younger children as demonstrated by performance in school has been studied extensively. What needs to be looked at now is the effects of stimulant medication on the performances of older children, particularly adolescents in school. Specifically, how does the use of stimulant medication effect the academic performance on standardized achievement tests as compared to the fall and spring test results of ADHD adolescents (both on and off stimulants) as well as the behavioral/social standings of this population as compared to their status on a behavioral improvement system? The purpose of the proposed study is to see if a combined stimulant intervention/behavior improvement system facilitates greater gains on achievement tests and a behavior improvement level system than the behavior improvement system alone on ADHD junior high school adolescents.

Chapter Three

Description of subjects

Ten subjects will be obtained for this study; 5 taking stimulants and 5 not taking stimulants. The criteria for inclusion will be an IQ 80-120 according to a review of the students' records. Also in these records must be a DSM-IV diagnosis of ADHD by a psychologist or psychiatrist. The students must attended the same out of district school for the emotionally disturbed, be between the ages of age 12-14, and be grade 7-8. The criteria for exclusion will be that the student have no other psychiatric diagnosis (eg. schizophrenia). Also the subjects must not be more than 4 years below grade level on the KTEA (Kaufman Test of Educational Achievement) composite score. The sample will be gathered by a review of records and an interview with nurse. Since the students' names will not be used, medication will not be altered, IEP will be followed, and educational delivery will not be changed than informed consent will only be obtained from the building principal.

Design

The design of this research will be a causal comparison ex-post facto study. The comparison will be between two populations of ADHD junior high school students, one who is taking stimulants and one who is not, to see if stimulants cause a difference in academic and behavioral achievement. This study will also be quasi-experimental in that the groups are already placed (not random) and can not be changed by the researcher. Subjects in both the experimental and control group will be matched as close as possible in regards to IQ, academic levels, socioeconomic level (e.g. free lunch), classroom assignment, classification, and home situation (e.g. foster care, single parent, etc.).

Independent variables in the study will be a level of methylphenidate dose between .6mg/kg and 1.0mg/kg for the medicated students and no stimulant intervention for the control group. Dependent variables to be gathered for comparison will be the fall (Sept.) KTEA and spring (March) KTEA test scores. Furthermore, the achievement level on the school wide behavior improvement system will be compared from the same two time frames (Sept./March).

Description of site

The study will be conducted at an out of district, county wide, special education school. Important features of this setting are that it is an out of district placement for the multiply handicapped population that is struggling with success in their hometown school. The students in this particular study all will have an emotionally disturbed component in their classification and will attend the junior/senior high school at the county school. The school building houses approximately 150 junior/senior high school students. There are 6 junior high school self contained classrooms, and 12 high school homerooms. The junior high school students spend their mornings in the same classroom with the same teacher. Three periods a week, they leave to take physical education classes in the gymnasium. These students are place in their classrooms according to their reading levels. Math class in the junior high school is departmental so they may change classes and attend a class at their math level. One period a week, the school psychologist comes in to run a group counseling session.

Description of Instruments

The measurement tool used to determine the achievement of the subjects will be the Kaufman Test of Educational Achievement brief from. The KTEA is a norm-referenced individually administered achievement test for children grades 1 through 12. The brief form produces standardized scores in reading, mathematics, spelling, and an overall test composite with the mean set at 100 and standard deviations set at 15 (Kaufman & Kaufman, 1985). The test takes about 30-40 minutes to administer to each child. This test is given to the students in the fall or when they enter the district and again in the spring

before IEP's are written.

Another measurement tool to be used in this study will be the school's own unique behavior improvement system. The behavior modification system developed by the school district involves a career advancement level system and a token economy that includes wages per hour (class period) at the different levels (job titles).

examples:

unemployment	$3.00 per/hour	$150 per/week
clerk	$6.00 per/hour	$300 per/week
manager	$10.00 per/hour	$500 per/week
executive	$15.00 per/hour	$750 per/week

Each career step lasts for a 4 week period at which time the students are due for a promotion. Promotions are given if you are able to pay your weekly bills on a consistent basis. Each career step has its own special bills to pay. The first level is Unemployment which includes such bills as public transportation, health insurance, security deposit, rent, public utilities, and a savings account. The second level, Clerk, includes an added expense of entertainment, larger rent, etc. Following Clerk is Manager which involves an actual interview with the assistant principal with a properly completed job application, vehicle registration, drivers permit (used as a hall pass), etc. Next, Executive candidates must type a resume, dress for the interview as best they can, pay drivers license fees, and a mortgage.

Each career step has a built in savings amount to be put aside each week. After a promotion the students get their savings along with their weekly paycheck. This money is needed to make the larger bills associated with each new career step. If a child is unable to pay a certain weeks' bills, they are left on that week until the following week when they are required to pay the rest of their outstanding bills and the next weeks bills. If they are unable to pay their bills at this time, then they drop back a full career step (eg. clerk week 3 goes back to unemployment week 3). Students are assigned fines for infractions like fighting, cursing, unfinished work (off-task), personal target behaviors not being followed, etc. Some of the more serious offenses, like fighting, may require removal from the classroom which results in an automatic loss of the hourly wage earned in that time period, and if they have to see the disciplinary officer than they are charged a court cost (1/2 a days

pay). Suspensions result in the loss of a day's pay. Each student is given one paid sick day per month (if they have a note), and all other absences are unpaid. The system allows for properly behaving students to advance. A student's misbehavior will affect their career, pay, and their ability to pay bills, just like in the real world. This token economy is tangible and reality based which involves both immediate and delayed gratification.

Independent Variables

The use of stimulant medication with ADHD junior high school students will be the independent variable in this study. The ADHD students who are prescribed methylphenidate by their private physician, and ADHD students who are not on methylphenidate will be tracked. Pretest scores will be gathered in September and compared to the post test scores obtained in March between the medicated and unmedicated students. Possible confounds of this study may be: forgotten doses at home, prescriptions that are allowed to run out, different teachers for some of the subjects, possible substance abuse, teacher bias towards medicated and unmedicated subjects, student behavior in the presence of a substitute (deterioration), possible additions of new medications, withdrawal from methylphenidate, or if one of the student leaves district. To address these possible confounds more than the projected 10 subjects (5 in each group) will be used at the start to allow for eliminated subjects due to any of the above mentioned confounds. To try and eliminate teacher bias as it pertains to different subjects being taught by different teachers, both a medicated and unmedicated ADHD subject should be chosen from the same room if a subject is to be chosen at all from that room. The number of different rooms should be kept to a minimum.

Examiners

Myself (head examiner) and other teachers in the district will administer the K-TEA to all students for the spring assessment. Fall testing has already been completed by the appropriate teachers. All teachers, and support staff will implement the behavior improvement plan as outlined by the district guide. All staff have attended several in-services on the behavior improvement system implementation as well as a spring in-service

as a refresher to the administration and scoring of the K-TEA. The involved teachers will be told that their particular student will be involved in a study but they won't be told the research questions or topics. After testing is completed, the head examiner will collect data from the involved teachers. (ex-post facto in design here).

Measures of Dependent Variables

The standardized scores from the K-TEA will be entered into the computer to be averaged and a standard deviation will be obtained. Behavior improvement levels will be entered into the computer under an assigned number:

unemployment week 1	1
unemployment week 2	2
unemployment week 3	3
unemployment week 4	4
clerk week 1	5
clerk week 2	6
clerk week 3	7
clerk week 4	8
manager week 1	9
manager week 2	10
manager week 3	11
manager week 4	12
executive week 1	13
executive week 2	14
executive week 3	15
executive week 4	16
retirement from system	17

These achievement scores from the reading, mathematics, spelling and overall composite sections of the KTEA will be entered into the computer, graphed and averaged with standard deviations calculated. The two sets of data from the medicated and unmedicated groups will then be compared for possible differences in achievement.

Procedure

Instructions to subjects will be no different from any other time when they are administered these tests. Teachers will administer the tests as usual. Data for the behavior improvement level gained by the subjects will be gathered on February 25, 1998, which falls on a Wednesday. This is the chosen time due to the higher frequency of absenteeism on Mondays and Fridays, it does not fall immediately before or after a holiday, it is before the students are under any stress associated with spring testing, and hopefully, it will not be affected by winter weather. The mentioned conditions tend to affect the behavior of many students in our population.

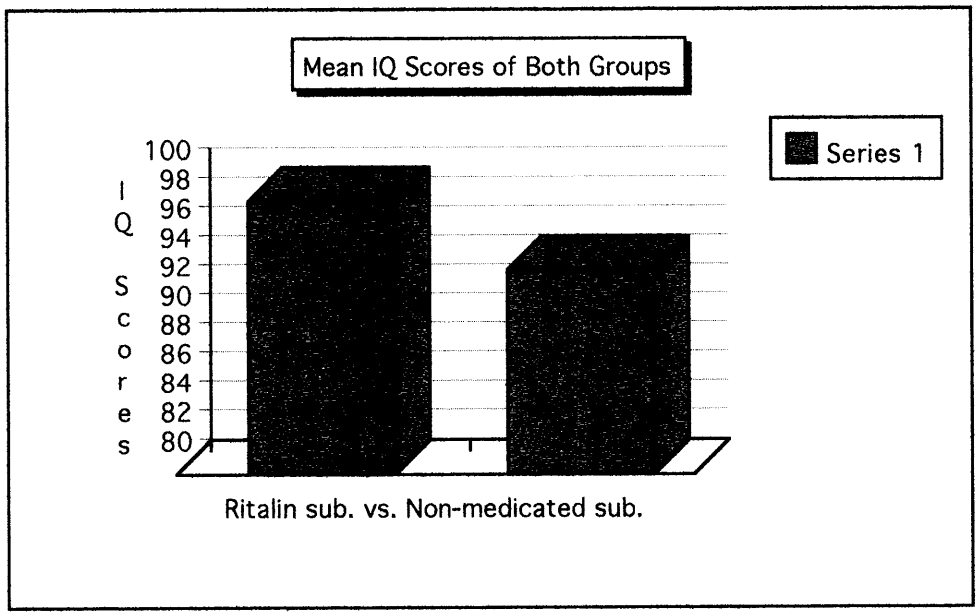
The staff who normally have contact with the subjects will continue to have contact with the subjects and nothing will change. The students will follow the normal procedures of the district. The staff involved will be asked to test the subjects in this study first to gather the data needed for analysis as early as possible.

Chapter 4

Results

The methodology of this research study was quasi-experimental in design since the groups were predetermined according to the population available. Therefore, measures were taken to equalize the two groups being compared. These measures included race, gender, I.Q., age, economic status (e.g. free lunch status), and family type (e.g. nuclear) Each group contained 5 members. The stimulant medicated group had a mean full scale intelligence quotient (FSIQ) of 98.8 and the non-medicated group had a mean FSIQ of 94. Both of these scores fell within the normal range and differed by less than 5 points (see Figure 1).

Figure 1



Each group consisted of all males; four of each group were Caucasian and one in each group was African American (see Tables 1 & 2). The mean ages of both groups were between 13 and 14 and had a mean difference of less than 2 months (the non-medicated group being slightly older).

Table 1
Demographic Information of ADHD Junior High Classified Students Using Ritalin

Name	Age as of 3/98 (in months)	Gender	Race	FSIQ
subject 1R	173	male	white	94
subject 2R	162	male	white	103
subject 3R	179	male	white	95
subject 4R	151	male	white	101
subject 5R	153	male	black	101
mean age	163.6 (months)		80% white	
means/percents	13.6 (years)	100% male	20% black	98.8
st. deviation	12.24 (months)			4.02

Table 2
Demographic Information of ADHD Junior High Classified Students Not Using Ritalin

Name	Age as of 3/98 (in months)	Gender	Race	FSIQ
subject 1N	173	male	white	100
subject 2N	160	male	white	87
subject 3N	176	male	white	95
subject 4N	151	male	white	98
subject 5N	165	male	black	90
mean age	165 (months)		80% white	
means/percents	13.75 (years)	100% male	20% black	94
st. deviation	10.07 (months)			5.43

Other considerations in equalizing the groups were classification, family status and economic resources (see Table 3). Of all subjects involved, 100% had an emotional disturbance (ED) in their classification and it was their primary classification. Also, in both of the groups, each contained two subjects who were classified ED alone. The other three members of each group also had a learning disability as a secondary classification (e. g. perceptually impaired, PI, or neurologically impaired, NI).

Family status was determined by a review of the records. Three members in the medicated group and two from the non-medicated group were from single parent homes (see Table 3). The other two members in the medicated group were from either a foster family or an extended family with grandparents, aunts and uncles, and cousins. The two other members of the non-medicated group were from extended families and one was from an intact nuclear family.

Table 3

Economic Status, Family Type, and Classification of Subjects

	Lunch Status	Family Type	Classification
Medicated Subjects			
subject 1R	1	4	ED/PI
subject 2R	2	2	ED/PI
subject 3R	3	2	ED
subject 4R	1	2	ED
subject 5R	1	3	ED/NI
Non-Medicated			
subject 1N	1	4	ED/PI
subject 2N	3	4	ED/PI
subject 3N	2	1	ED
subject 4N	1	2	ED
subject 5N	1	2	ED/NI

60% low income	50% single parent	60% multiple handicapped
20% low/middle	30% extended family	40% E. D. only
20% middle income	10% nuclear family	
	10% foster care	

KEY:

1= free	1= intact nuclear
2= reduced	2= single parent
3= full price	3= foster
	4=extended

Economic status was determined by the school's lunch program. According to forms filled out at the beginning of the year in regards to family income, each student is categorized into one of three groups: free lunch, reduced lunch, or full price status. Three subjects in each group were deemed eligible for free lunch (low economic status). One student from each group was eligible for a reduced cost lunch (low/middle income status). Finally, one student in each group has to pay full price for lunch (middle income status)

In the experimental group data was collected in the form of the weight of each subject and milligrams of methylphenidate per day. According to past research, this data may prove important as it was found that levels around .7 mg/kg per day were found to be optimal for both behavior and cognitive performances (Schachar, Tannock, Cunningham, & Corkum, 1997).

Table 4

Medicated Groups Dose per Day per Weight

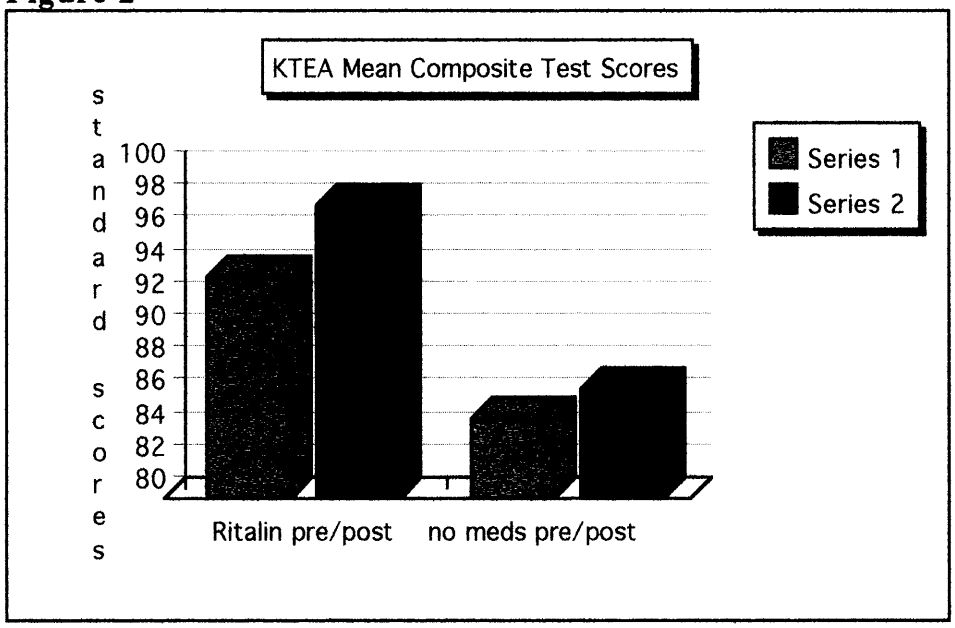
	Weight in lbs.	Weight in kg.	Daily Dose	mg/kg
Subject 1R	118	54	40	0.74
Subject 2R	120	55	40	0.73
Subject 3R	116	53	40	0.75
Subject 4R	81	37	30	0.81
Subject 5R	92	41	40	0.98
Mean	105.4	48	38	0.802
Standard Deviation	17.74	8.37	4.47	0.10

Other data collected was in the form of pre and post test scores from the Kaufman Test of Educational Achievement, brief form (KTEA). These test are administered in the beginning of the school year for new students to the district. For students returning to the district, the pretest scores were derived from the previous year's end of year testing (last year's post test scores). Then, in April, before IEP's are developed, a post test is administered to all students in the district. The results of these two tests are then compared to identify areas of growth, how much growth, and areas that need additional remediation. This information is useful in IEP meetings to establish new goals and objectives.

The ten students in this research study were administered the KTEA in March to obtain post test scores. These scores were then compared to the pretest scores from either September or April of 1997. The pretest results showed that the medicated group had a mean standard score of 93.6 on the composite (overall) test section. The unmedicated group's mean standard score on the pretest composite section was 85. This was a

difference of more than 8 points. The post test standard scores on the composite were 98 for the medicated group and 86.8 for the non-medicated group, a difference of 11.2. Each group demonstrated some overall growth (see Figure 2). The medicated group gained a mean total of 4.4 points while the non-medicated group gained a mean total of 1.8 points.

Figure 2



In closer analysis, in the medicated group subject number two's post test score went down by 3 points (see Table 5, next page). This student refused to do a large portion of the test. For example, when this student was presented with the word "Salute" on a card, he was expected to demonstrate his comprehension of the word by saluting. The test administrator's cue was to say, "Do what this says". He would not salute the test giver. This behavior was demonstrated throughout the test. As a result, the mean standard composite score for the medicated group was lowered. Without his score, the mean difference between the pre and post test scores would have been 6.25.

Conversely, subject number five in the non-medicated group post test score went down by five points. It was noted by the teacher who gave the test that this student was meticulous in his attempts at accuracy and demonstrated a desire to do well. He repeatedly asked during the test how he was doing.

Table 5

KTEA Composite Test Standard Scores

Medication	pretest	post test	+/-	No Medication	pretest	post test	+/-
subject 1R	83	86	+3	subject 1N	74	79	+5
subject 2R	72	69	-3	subject 2N	88	92	+4
subject 3R	118	122	+4	subject 3N	88	83	-5
subject 4R	122	128	+6	subject 4N	96	99	+3
subject 5R	73	85	+12	subject 5N	79	81	+2
mean	93.6	98	+4.4	mean	85	86.8	+1.8
st. deviation	24.52	25.64		st. deviation	8.60	9.43	

Other results were obtained from the individual standard scores of reading, mathematics, and spelling achievement between the pre and post test results, as well as age and grade equivalents. In reading, the medicated group demonstrated the largest gains with a mean standard score gain of +7.6 points. This converts to a growth of an average of +1.8 grade levels in reading achievement or +2.1 years. However, the non-medicated group had their smallest gains in the area of reading growth. Their mean standard score gain was only +0.6 points. This score converts to an average grade level growth of +0.52 and only +0.42 years of reading achievement (see Table 6).

Table 6

KTEA Reading Pretest Results

Medicated Subjects

	standard	grade	age
subject 1R	102	8.5	14.0
subject 2R	73	3.5	9.0
subject 3R	114	10.0	15.6
subject 4R	111	10.2	14.0
subject 5R	69	2.4	7.9
mean	93.8	6.9	12.1
st. deviation	21.3	3.7	3.4
achievement gained (mean)	+7.6	+1.8	+2.1

Non-medicated Subjects

subject 1N	86	5.2	10.9
subject 2N	92	6.2	11.6
subject 3N	92	6.7	12.3
subject 4N	91	5.2	10.9
subject 5N	88	5.7	11
mean	89.8	5.8	11.34
st. deviation	2.68	0.65	0.61
achievement gained (mean)	+0.6	+0.52	+0.42

KTEA Reading Post-Test Results

	standard	grade	age
subject 1R	106	10.0	15.6
subject 2R	68	2.8	8.3
subject 3R	109	11.6	17.0
subject 4R	126	12.5	18.0
subject 5R	98	6.7	12.3
mean	101.4	8.7	14.24
st. deviation	21.3	3.9	3.9

subject 1N	86	6.2	11.6
subject 2N	88	5.7	11
subject 3N	94	7.3	12.9
subject 4N	98	6.7	12.3
subject 5N	86	5.7	11
mean	90.4	6.32	11.76
st. deviation	5.74	0.48	0.62

In the area of mathematics, results demonstrated some growth in both groups. In the medicated group mean standard scores increase an average of +5 points, +1.8 grade levels and +2.1 years in mathematics achievement. The non-medicated group's growth was less impressive with the mean standard score increasing by only +0.6 points, grade level increased by +0.74, and age levels also grew by only +0.78 years in mathematics achievement (see Table 7).

Table 7

KTEA Math Pretest Results

Medicated Subjects	standard	grade	age
subject 1R	76	4.8	10.3
subject 2R	80	5.0	10.6
subject 3R	117	12.6	18.3
subject 4R	111	10.9	14.9
subject 5R	75	3.8	9.3
mean	91.8	7.42	12.68
st. deviation	20.46	4.02	3.80
achievement gained (mean)	+5.0	+1.8	+2.1
Non-medicated Subjects			
subject 1N	74	4.4	9.9
subject 2N	89	5.8	11.3
subject 3N	98	7.4	12.9
subject 4N	105	7.1	12.6
subject 5N	74	4.4	9.9
mean	88	5.82	11.32
st. deviation	13.98	1.43	1.43
achievement gained (mean)	+0.6	+0.74	+0.78

KTEA Math Post-Test Results

	standard	grade	age
subject 1R	82	6.1	11.6
subject 2R	79	5.0	10.6
subject 3R	118	12.9	18.9
subject 4R	130	12.9	18.9
subject 5R	75	4.0	9.6
	96.8	8.18	13.92
	25.31	4.37	4.60
subject 1N	84	6.4	11.9
subject 2N	96	7.4	12.9
subject 3N	85	6.4	11.9
subject 4N	98	7.1	12.6
subject 5N	80	5.5	11
mean	88.6	6.56	12.1
st. deviation	8.85	0.84	0.84

Spelling results were somewhat different than the other findings. Like the other test scores, the medicated group gained more mean standard score points (+4.2) than the non-medicated group (+0.8). However, the medicated group gained less than a grade level (+0.66) and less than a year of age (+0.86) in scores in spelling. The non-medicated group also achieved less than a grade level (+0.78) and less than a year in age levels (+0.76) in achievement in spelling (see Table 8 next page).

Table 8

KTEA Spelling Pretest Results

Medicated Subjects	standard	grade	age
subject 1R	85	5.2	10.9
subject 2R	73	3.6	9.0
subject 3R	118	12.9	18.9
subject 4R	113	9.2	14.6
subject 5R	92	5.6	11.0
mean	96.2	7.3	12.88
st. deviation	18.97	3.74	3.93
achievement gained (mean)	+4.2	+0.66	+0.86
Non-medicated Subjects			
subject 1N	61	3.3	8.9
subject 2N	90	5.6	11.0
subject 3N	84	4.9	10.3
subject 4N	94	5.6	11.0
subject 5N	86	5.2	10.9
mean	83	4.92	10.42
st. deviation	1.28	0.95	0.90
achievement	+0.8	+0.78	+0.76

KTEA Spelling Post-Test Results

	standard	grade	age
subject 1R	87	5.9	11.6
subject 2R	71	3.0	8.6
subject 3R	126	12.9	18.9
subject 4R	122	11.8	17.6
subject 5R	96	6.2	12.0
	100.4	7.96	13.74
	23.37	4.22	4.35
subject 1N	63	4.9	10.3
subject 2N	94	6.7	12.3
subject 3N	79	4.6	10.0
subject 4N	97	6.7	12.3
subject 5N	86	5.6	11.0
	83.8	5.7	11.18
	1.49	.98	1.08

Results for behavior were calculated using a level system token economy scale. The behavior improvement system used in the school was piloted last year in both a junior and senior high school room. This year the system was implemented school wide. This meant that all students started on the same level or employment step of Unemployment week 1 (1). Post test scores were gather near the end of February. All medicated subjects were off the Unemployment level which takes four straight weeks of acceptable behavior to achieve (see table 9). The lowest level of the medicated group in the post test was on step 5 or Clerk week 1. Next, was a student who made it to Clerk week 4 (step 8) followed by a student who made it to Manager week 1 (step 9). The next two highest levels achieved by the medicated group were Executive week 1 (13) and a student who had reached retirement (17). Retirement is the highest level in the program and the student has to earn enough money at each employment level to pay his weekly bills while avoiding fines and court costs. He must also exhibit good behavior, work on personal target behaviors, fill out job

applications correctly, read and sign a lease, apply for a driver's permit, driver's license, and car registration, pass interviews with the assistant principal, and be interviewed by an administrator from another campus (someone they never met). Out of a population of 183, only 20 students have reached the retirement level.

Table 9
Behavior Levels Achieved by Both Groups

Medicated	PreBMod Level	PostBModLevel	Non-medicated	PreBMod Level	PostBModLevel
subject 1R	1	8	subject 1N	1	11
subject 2R	1	5	subject 2N	1	1
subject 3R	1	17	subject 3N	1	9
subject 4R	1	13	subject 4N	1	1
subject 5R	1	9	subject 5N	1	1
mean	1	10.4	mean	1	4.6
st. deviation		4.67	st. deviation		4.98

The non-medicated group at the time of post testing still had 3 subjects on Unemployment week 1 (1). One student made it to Manager week 1(9) and the highest level achieved was Manager week 3 (11). The mean average for achievement on the level system was 10.4 for the medicated subjects (Manager week 2). For the non-medicated group, the mean average for achievement was 4.6 (Unemployment week 4).

Overall the mean averages collected from these tests support the use of stimulants to improve academic and behavior performances. Medicated students' mean scores on the KTEA were higher than the non-medicated group's scores. Behaviorally, the medicated students achieved higher levels on the level system implemented in the school.

Chapter 5

Discussion

Brief review

The purpose of this research was to determine if the use of stimulants in ADHD adolescents would have a positive impact on their academic and/or behavior performances. Subjects were selected for each group (medicated and non-medicated) on the basis of their diagnosis of ADHD without other psychological problems. Each group was then equalized in regards to similar full scale intelligence quotients, ethnic background, economic status, educational classification, age, and gender. The medicated group was analyzed for daily dosage amounts of stimulants to insure closely matched milligrams of stimulant per kilograms of body weight. Standardized pretest scores on the KTEA were collected in the Fall and post test scores were obtained in the Spring for comparison. Behavior levels according to the school-wide behavior improvement system were gathered in the Fall and Spring as well.

Summary of Results

The results, despite showing a greater academic achievement in the given school year by the medicated students, are not statistically significant at the .05 level, a level generally acceptable in the field of education. On the composite test scores from the KTEA the medicated group gained a mean of 4.4 points, where as the non-medicated group gained a mean of 1.8 points. The reading section of this test demonstrated that the medicated group gained a mean of 7.6 points and the non-medicated group gained only a mean of 0.6 points. In math, the medicated group's mean average growth was 5.0 points and the non-medicated group's mean point gain was 0.6 points. Spelling scores for the medicated

group had a mean gain of 4.2 points and the non-medicated group gained a mean of 0.8 points. The behavioral improvements were the strongest results produced, yet they also fell short of being statistically significant at the .05 level. The behavioral results show the medicated group obtaining a level of 10.4 from a starting point of 1 while the non-medicated group reached a level of 4.6 from a starting point of 1.

The results obtained from this study do possess practical significance which suggests that ADHD adolescents can benefit from the use of stimulant medication. Despite the fact that statistical significance was not obtained, looking at the results in a practical or functional respect allows us to see the growth made by the medicated group vs. the non-medicated group. The stimulant group grew 1.8 grade levels in both reading and math while the non-medicated group advanced only .52 grade levels in reading and .74 grade levels in math. This shows the stimulant group making twice as much progress as the non-medicated group in these two school subjects on a standardized test. The spelling results were less impressive with the medicated group gaining only .66 grade levels and the non-medicated group achieving just .78 grade levels.

These low levels of grade status achievement in spelling could have been confounded by what is known as the "ceiling effect". For example, subject 3R from the stimulant group had a pretest spelling grade level score of 12.9 and a standard score of 118. On his post test, his grade level remained at 12.9 (the highest or ceiling score of the test) but his standard score improved to 126, a difference of +8 points. While this child may now be spelling at the college level the test still shows his level at 12.9, the ceiling level of the test.

Similarities and Differences to Previous Research

As reported by Gadow (1983), stimulant used did not have a robust effect on standardized scores. This research study's results are consistent with Gadow's in that here too there were no statistically significant findings using standardized scores in regards to ADHD subjects and stimulants. However, in the Evans and Pelham (1991) study conducted on adolescents, significant achievements were noted by the stimulant group when compared to the non-stimulant group using curriculum-based assessment procedures

as opposed to this study's use of standardized test scores.

In a study by Tannock, Schachar, Carr, and Logan (1989) it was also demonstrated that stimulants enhanced academic functioning and improved overt behavior. This study, however, was conducted on children between the ages of 6 and 11, not adolescents. Time trailed arithmetic and letter search tasks were also used instead of standardized tests.

One noted problem in respect to dosage levels was discussed in an article by Swanson, Cantwell, Lerner, McBurnett, and Hanna (1991). They found that often larger or older children were given higher doses of methylphenidate which had gone past the .6mg/kg level and this caused "cognitive toxicity". While the higher dose had a positive effect on behaviors not achieved at a lower dose, this higher dose tended to hinder academic achievement. The students in this research study had a mean daily stimulant dose of .802 which had a stronger behavioral effect than academic effect.

In a more recent study (Schachar, Tannock, Cunningham, & Corkum, 1997), it was noted that the optimal dosage of stimulants would be .7mg/kg. This increase from the earlier study still is less than the mean average dose used in this research study. Furthermore, the main focus of the study by Schachar et. al. was on ADHD behaviors (hyperactivity and impulsiveness) in the classroom and at home and did not focus on academic improvements (reading and math level achievements).

Implications

Due to the small sample size implications from this study are weak. However, the results implied that stimulants can help ADHD children improve areas of their behavior as well as areas of academics such as reading and math. ADHD adolescents need to see some improvement in their achievements by the time they reach junior high school or thoughts of dropping out may become a concern. It is important to provide these children with the tools they need to be successful in school, and to maintain their motivation to remain in school when they reach high school.

The use of stimulants in ADHD adolescents may improve the child's self-esteem by allowing the child to achieve success. The medicated students in this study achieved higher levels of success in a work-based level improvement system. The behavior modification

system developed by the school district and used in this study involved a career advancement level system and a token economy that includes wages per hour (class period) at the different levels (job titles). The levels in this system start at "unemployment" which is the most restrictive level to be on. As behavior improves, the student then becomes eligible for a promotion to the "clerk" level. After four weeks on that level, an interview is conducted by the assistant principal and possibly a promotion to "manager". The next level of achievement is the "executive" level. Finally, if a child has met all required behavior improvements at the various levels, he is then allowed to make an appointment for a retirement interview. Retirement is the least restrictive level and contains the most rewards and benefits. It was noted at the site of this research that students demonstrated a stronger desire to be a "manager" than to be "unemployed". More students receiving methylphenidate had achieved levels like "clerk", "manager", "executive", and "retirement" than those students receiving no medication. When asked their levels for this research it was noted by the surveyor that the responses of the higher achievers in the medicated group answer the question with an upbeat and proud tone. Conversely, those on "unemployment" tended to answer with, "I don't know what level I'm on."

Limitations

This study was conducted with 5 members in both groups for a total of 10 students (n = 10). With such a small sample, no reliable data were collected to support the use of stimulants to improve the academic or behavioral levels of ADHD adolescents (no scores derived from testing were significant at the .05 level using an ANOVA).

All students did not receive their morning doses at the same time. Some students received their medications at home around 7:30AM and some others received their dose at school around 8:30AM. Those that received their medication at school, are those who we are sure received their doses. If the child took their medication at home, there was no way of insuring that a strict regimen was followed.

Another confounding variable was that 2 students in each group were from another classroom with another teacher. The teaching styles may have differed enough to have interfered with the test scores as well as the consistent use of the behavior modification

system. The student population in each room also develops its own dynamics and the aggression level, distractible situations that emerge, as well as the personalities of each child may play a part in learning.

Misclassification sometimes does occur by the child study teams. Children who are actually learning disabled are classified as emotionally disturbed and vice versa. Some students who had a single classification of E. D. may have in fact had a learning problem as well. This would have resulted in unequal groups as far as learning potential.

The way each teacher administers the KTEA test may have effected the results. If a non-medicated student has developed a caustic relationship with the teacher, the teacher may not give the student equal opportunity to respond to the questions. Teacher attitudes towards abrasive students were documented by Whalen, Henker, and Dotemoto in 1980. They found that teachers tended to be more intense and controlling towards unmedicated hyperactive subjects.

The standard deviations demonstrated a much larger variation from the mean with the medicated group than it did from the non-medicated group. While the non-medicated group had a standard deviation on the composite KTEA pre and post test of 8.60 and 9.43 respectively, the medicated group's standard deviation was 24.52 (pre) and 25.64 (post) on the same test. The difference between the medicated groups' standard deviation is more than twice that of the non-medicated groups'. The larger deviation suggests that the medicated group had a wide spectrum of individual differences with members having both high and low scores obtained from pre and post test composites. This pattern was repeated across all academic areas. The behavior scores of both groups had more consistent standard deviations with the post scores' standard deviation being 4.67 for the medicated group and 4.98 for the non-medicated group.

Areas of Possible Future Research

Research pertaining to the use of stimulants and ADHD children has been extensive through the years. More and more doctors are looking to continue medication into adulthood. Future research should focus on the effects of stimulants on academic growth and behavioral improvements in the teen years as well as with adults on medication.

Research on stimulant use with ADHD teens could expanded to include college performance, SAT scores, HSPT scores, job performances, and drop out rates between medicated and non-medicated students.

One of the first research studies conducted involving junior high school students and the use of stimulants was done in 1991 by Evans and Pelham. Instead of the structure and dynamics of an elementary classroom where all work is basically completed in the room, Evans and Pelham used a lecture hall. Furthermore, students were to take notes and use their notes in the study hall that followed the class to answer questions. Curriculum-based assessment was used in the form of quizzes and tests. This format was designed to simulate a junior high school setting. Future studies involving adolescents with ADHD should focus on settings that more closely represent the mainstream junior senior type high school. Even college settings could yield useful data in our attempts to remediate the behaviors and academic achievements of this population.

Another consideration for future studies is to compare the achievements based on a variety of assessment tools. Much of the research from the past was based on tools designed for each individual study. What measures could we take to improve the ADHD adolescent's standardized test scores?

Conclusion

In summary, this study looked to support the use of stimulants with ADHD adolescents in order to improve their academic and behavioral achievements. The results of this study demonstrated positive academic growths when the grade level achievements of the pretest and post-test grade level equivalent scores from the Kaufman Test of Educational Achievement were compared. Furthermore, positive behavioral growth was demonstrated by the behavior levels achieved by the stimulant group which surpassed the non-medicated group's behavior achievement levels. Although statistical tests were not significant, these results hold practical significance for teachers and other staff working with this population of ADHD adolescents as well as the students themselves. It is important at this age for the ADHD student to see the benefits of his efforts and to feel some success.

Does this imply that stimulants may or may not be beneficial with ADHD in the teen years? No, but more research needs to be conducted. Furthermore, this study used standardized test scores as a measure and past research had similar results with these types of tests. Conversely, significant improvements were found in other research that used curriculum-based assessment practices. Stimulant drugs have been shown to increase academic productivity in some hyperactive children (Gadow, 1983). Douglas, Barr, O'Neil, and Britton (1985) also found that stimulant use improved academic, learning, cognitive, and behavior measures in the classroom in children with ADHD as well as with adults in similar situations. Future studies that focus on using curriculum-based assessment to see the benefits of what the ADHD adolescent can learn in the classroom instead of standardized achievement measures based on a nationally normed population could be the focus of research. It could be that ADHD adolescents could benefit from the the use of stimulants in the classroom but further research needs to be conducted in order to find a long term solution to help these children on standardized tests.

References:

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: Author.

Cantwell, Dennis P., M.D. (1996). Attention deficit disorder: A review of the past 10 years. Journal of the American Academy of Child and Adolescent Psychiatry, 35, (8), 978-987.

Douglas, V. I., Barr, R. G., O'Neill, M. E., & Britton, B. G. (1986). Short term effects of methylphenidate on the cognitive, learning and academic performance of children with attention deficit disorder in the laboratory and the classroom. Journal of Child Psychology and Psychiatry, 27, 191-211.

Dulcan, Mina, M. D. (1997). Practice parameters for assessment and treatment of children, adolescents, and adults with attention deficit/hyperactivity disorder. Journal of the American Academy of Child and Adolescent Psychiatry, 36, (10) supplement, Oct. 1997, 85S-121S.

Evans, S. W., & Pelham, W. E., Jr. (1991). Psycho stimulant effects on academic and behavioral measures for ADHD junior high school students in a lecture format classroom. Journal of Abnormal Child Psychology, 19, (5), 537-52.

Gadow, Kenneth D., PhD. (1983). Effects of stimulant drugs on academic performance in hyperactive and learning disabled children. Journal of Learning Disabilities, 16, (5), 290-299.

Gittelman-Klein, R., & Mannuzza, S. (1988). Hyperactive boys almost grown up. III. Methylphenidate effects on ultimate height. Archives of General Psychiatry, 45, 1131-1134.

Hechtman, L., Weiss, G., & Perlman, T. (1984). Young adult outcome of hyperactive children who received long-term stimulant treatment. Journal of the American Academy of Child and Adolescent Psychiatry 23, 261-269.

Johnston, C., Pelham, W. E., Hoza, J., & Sturges, J. (1988). Psycho stimulant rebound in attention deficit disordered boys. Journal of the American Academy of Child and Adolescent Psychiatry 27, 806-810.

Klorman, R., Brumaghim, J. T., Fitzpatrick P. A., Borgstedt, A. D., & Strauss J. (1994). Clinical and cognitive effects of methylphenidate on children with attention deficit disorder as a function of aggression/oppositionality and age. Journal of Abnormal Psychology, 103, (2), 206-221.

Lambert, Nadine M. (1988). Adolescent outcomes for hyperactive children: Perspectives on general and specific patterns of childhood risk for adolescent educational, social, and mental health problems. American Psychologist, 43, (10), 786-799.

Milich, R., Licht, B. G., Murphy, D. A., & Pelham, W. E. (1989). Attention deficit hyperactivity disordered boys' evaluations of and attributions for task performance on medication versus placebo. Journal of Abnormal Psychology, 98, (3), 280-284.

Pelham, W. E., Bender, M.E., Caddell, J., Booth, S., Moorer, S. H. (1985). Methylphenidate and children with attention deficit disorder: Dose effects on classroom academic and social behavior. Archives of General Psychiatry 42, 948-952.

Pelham, W. E., Jr, Carlson, C., Sams, S. E., Vallano, G., Dixon, M. J., & Hoza, B. (1993). Separate and combined effects of methylphenidate and behavior modification on boys with attention deficit hyperactivity disorder in the classroom. Journal of Consulting and Clinical Psychology, 61, (3), 506-15.

Pelham, W. E., Greenslade, K. E., Vodde-Hamilton, M., Murphy, D. A., Greenstein, J. J., Gnagy, E. M., Guthrie, K. J., Hoover, M. D., & Dahl, R. E. (1990). Relative efficacy of long-acting stimulants on children with attention deficit hyperactivity disorder: A comparison of standard methylphenidate, sustained-release methylphenidate, sustained-release dextroamphetamine, and pemoline. Pediatrics 86, 226-237.

Pelham, W. E., Sturges, J., Hoza, J., Schmidt, C., Bijlma, J. J., Milich, R., & Moorer, S. (1987). Sustained release and standard methylphenidate effects on cognitive and social behavior in children with attention deficit disorder. Pediatrics 80, 491-501.

Rosen, L. A., O'Leary, S. G., & Conway, G. (1985). The withdrawal of stimulant medication for hyperactivity: Overcoming detrimental attributes. Behavior Therapy 16, 538-544.

Schachar, R. J., Tannock, R., Cunningham, C., & Corkum, P. (1997). Behavioral, situational, and temporal effects of treatment of ADHD with methylphenidate. Journal of the American Academy of Child and Adolescent Psychiatry, 36, (6), 754-763.

Seidman, L. J., Biederman, J., Faraone, S. V., Weber, W., & Ouellette, C. (1997). Towards defining a neuropsychology of attention deficit hyperactivity disorder: Performance of children and adolescents from a large clinically referred sample. Journal of Consulting and Clinical Psychology, 65, (1), 150-159.

Spencer, T. J., Biederman, J., Harding, M., O'Donnell, D., Faraone, S. V., & Wilens, T. E. (1996). Growth deficits in ADHD children revisited: Evidence for disorder associated growth delays? Journal of the American Academy of Child and Adolescent Psychiatry, 35, (11), 1460-1469.

Swanson, J. M., Cantwell, D., Lerner, M., McBurnett, K., & Hanna, G. (1991). Effects of stimulant medication on learning in children with ADHD. Journal of Learning Disabilities, 24, (4), 219-30.

Tannock, R., Schachar, R. J., Carr, R. P., & Logan, G. D. (1989). Dose-response effects of methylphenidate on academic performance and overt behavior in hyperactive children. Pediatrics 84, 648-657.

Whalen, C. K., & Henker, B. (1991). Social impact of stimulant treatment for hyperactive children. Journal of Learning Disabilities, 24, (4), 231-41.

Whalen, C. K., Henker, B., Buhrmester, D., Hinshaw, S. P., Huber, A., & Laski, K. (1989). Does stimulant medication improve the peer status of hyperactive children? Journal of Consulting and Clinical Psychology, 57, (4), 545-549.

Whalen, C. K., Henker, B., & Dotemoto, S. (1980). Methylphenidate and hyperactivity: Effects on teacher behaviors. Science, 208, 1280-1282.

Wiener, J. M. (1991). Ritalin: Theory and Patient Management. (Greenhill, L. L., & Osman, B.B., Eds.). Larchmont, NY, Mary Ann Liebert.