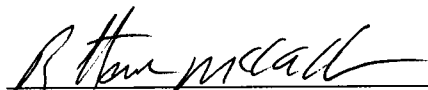
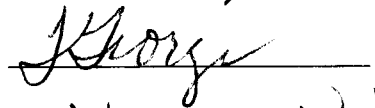
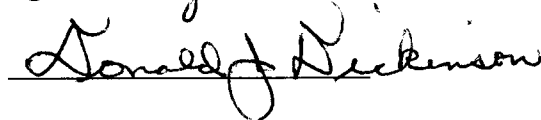


To the Graduate Council:

I am submitting herewith a dissertation written by Francine Lydia Reynolds entitled "Construct and Predictive Validity of Inattention/Hyperactivity." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.


R. Steve McCallum, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:


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Dean of The Graduate School

CONSTRUCT AND PREDICTIVE VALIDITY OF
INATTENTION AND IMPULSIVITY/HYPERACTIVITY

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Francine Lydia Reynolds
August 1997

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DEDICATION

This dissertation is dedicated to the memory of my grandfather

Mr. Paul Kirkpatrick

who taught me the most important lessons of life
patience, perseverance and love.

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ABSTRACT

This study examined the construct validity of the current model of ADHD. A multi-trait - multi-method procedure (MTMM) was utilized to determine the extent to which inattention and impulsivity/hyperactivity occur independently of the method employed to assess the constructs. The predictive validity of the constructs, as operationalized by the Behavior Assessment System for Children (BASC) inattention subscale, BASC hyperactivity subscale, Auditory Continuous Performance Test (ACPT) omission error score, ACPT commission error score and the Freedom from Distractibility Index, for school achievement was also addressed. Participants included 112 children ranging in age from 6 years to 11 years. Construct validity was investigated by using two methods of assessment to measure the two traits; inattention and impulsivity/hyperactivity. The BASC rating scale was used as a subjective measure and the ACPT was used as an objective measure. Results from the MTMM matrix failed to produce compelling evidence for the construct validity of the current model of ADHD. Specifically, results of this study suggest that although there is a significant amount of variance explained by the traits, there is a greater amount of shared variance between similar methods of measurement than traits. Therefore, the method of assessment (rating scale versus objective measure) may explain more of the variance within the data than the theoretical constructs.

Results of the multiple regression analyses indicated that the Freedom from Distractibility Index was consistently the most significant predictor of academic achievement in areas of basic reading, reading comprehension, math calculation and spelling skills. Surprisingly, the ACPT omission error score was found to be a significant predictor for spelling, basic reading and math calculation skill. Rating scales

did not prove to be significant predictors of academic achievement.

In conclusion, this study did not find the theoretical constructs of inattention and impulsivity/hyperactivity to be robust. Therefore, assessment specialists should be aware that assessment results may be partly a function of the type of instrument used. Results of the multiple regression analyses provided evidence that the Freedom from Distractibility Index is the strongest predictor for academic achievement. The ACPT omission score emerged as a statistically significant predictor although it added only a relatively small amount of the variance predicted by the equation. The rating scales were not significant predictors for academic performance.

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Chapter I

Introduction

The primary purpose of this study is to examine the construct validity of the current diagnostic components of ADHD; the constructs are inattention and impulsivity/hyperactivity. This study will also examine the predictive validity of instruments purported to operationalize inattention and impulsivity/hyperactivity for school achievement.

Background Information

The identification and diagnosis of children with attention deficits with and without hyperactivity, presents a challenge to psychologists working both within the school setting as well as in private practice and hospital environments. Although currently deficits in attention are associated most commonly with attention deficit disorder, disturbances in attention processes can be associated with a wide number of other conditions including depression, head injury, stroke, degenerative diseases, anxiety as well as many other physical conditions. Interest in attentional ability has been prevalent since the first publication of an official diagnostic text for identifying mental disorders; The Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1952). Recent heightened awareness of the condition of attention deficit hyperactivity disorder (ADHD) has forced school psychologists to face increasingly greater demands for assessment of this condition. Subsequently, the need for reliable and valid measures to assess symptoms associated with ADHD are at a premium. Although school psychologists are encouraged to provide thorough and comprehensive evaluations, the multimethod assessment approach utilizing a variety of

assessment instruments is problematic due to inconsistencies in empirical data regarding assessment of the constructs, the relationship between measures and the ecological validity of objective tests such as the continuous performance test of sustained attention (DuPaul, Anastopoulos, Shelton, Guevremont, & Metevia, 1992; Koriaath, Gualtieri, Van Bourgondien, Quade, & Werry, 1985; Cohen, Becker, & Campbell, 1990; Melnyk & Das, 1992).

Historical Review of Diagnostic Criteria for ADHD

The Diagnostic and Statistical Manual of Mental Disorders (DSM) serves as one important reference source for diagnosis of mental conditions including ADHD and therefore warrants mention. The first edition of the DSM was published in 1952 by the American Psychiatric Association. It identified eight broad categories of mental disorders and provided a label and code for disorders falling under each of the eight categories. However, no specific diagnostic criteria for diagnoses were listed placing a heavy reliance on the clinical judgment of the practitioner. ADHD was not labeled as such in the DSM-I, although a group of symptoms that we currently include in the diagnostic criteria for ADHD were present. These symptoms were loosely grouped as related symptoms of a disorder identified as "adjustment reaction of childhood" (Coded 000-x64) (American Psychiatric Association, 1952). This disorder was subdivided into three groups according to the prominence of symptoms displayed. The three groups included: (1) Habit disturbances (000-x841); (2) Conduct disturbances (000-x842) and (3) Neurotic traits (000-x842). the later subclassification, neurotic traits, most closely approximates the pattern of behaviors we currently define as ADHD as it lists overactivity as a symptom (American Psychiatric Association, 1952).

The second edition of the DSM was published in 1968. It continued to rely heavily on a theoretical rather than empirical basis for the description of mental conditions. It also presented for the first time a disorder listed as "hyperkinetic reaction of childhood" (308.0) (American Psychiatric Association, 1968). The DSM-II's description of this disorder represented the first presentation of Barkley's synthesis of the "holy trinity" symptoms associated with ADHD; inattention, impulsivity and overactivity (Barkley, 1990). Identification of three discreet categories of symptoms has had a major impact on subsequent assessment procedures for ADHD. The DSM-II also placed hyperkinetic reaction of childhood under the broad umbrella of childhood behavior disorders which has continued to effect assessment procedures with regard to the current heavy reliance on behavior rating scales as a major component of the ADHD evaluation process.

The third edition of the DSM emerged in 1980 and represented the most dramatic change in diagnostic procedures as well as conceptualization of mental disorders. The DSM-III was novel in its' addition of specific diagnostic criteria required to make clinical diagnoses, although criteria continued to be based on a theoretical rather than empirical base. The DSM-III also shifted the focus of ADHD from primarily being associated with overactivity to being pervasively characterized by inattentiveness, and categorized the diagnosis of ADHD with and without the symptom of hyperactivity present.

A revision of the DSM-III was published in 1987 and once again represented a major shift in the conceptualization of ADHD. For the first time, the DSM III-R represented utilization of empirical evidence in determining diagnostic criteria.

Diagnostic criteria for ADHD was selected primarily from factor analyses of items from standardized parent and teacher rating scales (Barkley, Spitzer, & Costello, 1990). This characteristic of the DSM III-R not only spurred the need to provide actual assessment data to diagnose ADHD but also established the use of rating scales as routine components of behavioral assessment. The DSM III-R also collapsed the with and without hyperactivity division and placed more emphasis on hyperactivity and impulsivity. A residual category of disorders with primary characteristics of inattentiveness was utilized to encompass the previous ADHD without hyperactivity diagnosis. The DSM-IV was published in 1994. Its' format was similar to its' predecessor with even greater reliance on empirical bases for the diagnostic criteria. ADHD was once again grouped with the disruptive behavior disorders in the infancy, childhood, and adolescence, portion of the manual due to the requirement that "some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years" (American Psychiatric Association, 1994). The DSM-IV presents two sets of symptomatology groups. The first group represents nine symptoms associated with inattentiveness and the second group lists six symptoms of hyperactivity as well as three symptoms associated with impulsivity. Based on the presentation of symptoms within the two broad diagnostic groups, a diagnosis is determined. The DSM-IV again divided ADHD based on whether symptoms were primarily associated with inattentiveness or hyperactivity/impulsivity. If six or more of the nine criteria are met within the inattentive group but not in the hyperactivity/impulsivity group the diagnosis of "Attention Deficit/Hyperactivity Disorder, Predominantly Inattentive Type" (American Psychiatric Association, 1994) is made. If criteria are met for the

hyperactive/impulsive group are met but not for the inattentive group, a diagnosis of "Attention Deficit/Hyperactivity Disorder, Predominantly Hyperactive-Impulsive Type" (American Psychiatric Association, 1994) is made. However, if criteria is met for both the inattentive and hyperactivity/impulsivity groups a diagnosis of "Attention-Deficit/Hyperactivity Disorder, Combined Type" (American Psychiatric Association, 1994) is made. Finally, the DSM-V also listed a residual category labeled "Attention-Deficit/Hyperactivity Disorder, Not Otherwise Specified" (American Psychiatric Association, 1994). This category reflected a clinical presentation of symptoms associated with inattentiveness and/or hyperactivity-impulsivity which were prominent but failed to meet the full diagnostic criteria for ADHD combined type, inattentive type or hyperactive/impulsive type.

Historical Review of Inattentiveness and Impulsivity/Hyperactivity

Prior to the 1900's there was little nonmedical literature concerning inattentiveness or deficits of impulse control and overactivity. From roughly 1900 to 1960 literature focused on the subconstructs of inattentiveness and impulsivity/hyperactivity that we now associate with ADHD as a type of minimal brain dysfunction. A series of lectures was presented in 1902 by a physician, Dr. Still, who described children in his practice who were "excessively emotional, showed little inhibitory volition, were passionate, spiteful and cruel" (Barkley, 1990). Still was the first to refer to these symptoms as abnormal based on his comparison to other children's behavior of the same age (Barkley, 1990). An age-based criterion continues to be utilized today for determining the significance of scores on behavioral based rating instruments as well as objective measures of inattention and impulsivity/hyperactivity.

Still also suggested that the disorder he was describing usually presented prior to age eight (Barkley, 1990). The current DSM-IV criteria requires a documented onset of symptoms prior to age seven. Still also identified some physical characteristics such as "abnormally large head size, malformed palate, or increased epicanthal fold" (Barkley, 1990). Barkley (1990), however, points out that during this period of time the medical field exhibited a tendency to be "obsessed with head size and physical stigmata". Interestingly, Still also indicated some interest in the family circumstances of his patients with the previously described symptoms. He found that the disorder could occur in both dysfunctional homes as well as homes with intact structure and the presence of adequate parental models. Still suggested that children who exhibited the disorder but were from dysfunctional environments should not be classified as deficit in the areas of impulse control, attention, aggressiveness, cruelty or spitefulness as their behavior could be associated with their upbringing (Barkley, 1990). The idea of the environment as a factor to be examined when assessing behavioral of children displaying characteristics of ADHD remains important today. Still hypothesized that the deficits he observed with regard to "inhibitory volition, moral control, and sustained attention" were all related to a unitary neurological deficit. Interest in the minimal brain dysfunction model was fueled by a North American epidemic of encephalitis in 1917 through 1918 which left surviving children with both behavioral as well as cognitive difficulties (Barkley, 1990). Survivors exhibited symptoms which would come to be coined as the "holy trinity" of ADHD today (Barkley, 1990). Children who survived the epidemic were noted to exhibit deficits such as, "inattention, poor regulation of activity and impulse control" (Barkley, 1990). The symptoms that were described during the

early 1900s and were then associated with a type of brain dysfunction now describe the subconstructs of the disorder we define as ADHD (inattentiveness and hyperactivity/impulsivity). It is interesting that this epidemic also historically set the stage for educational implications as survivors were thought to be in need of special treatments outside of the regular schools (Barkley, 1990).

Animal research during the early 1900s focused on the relationship between frontal lobe lesions in primates that resulted in excessive activity levels, poor sustained interest in activities, aimless wandering, and excessive feeding (Blau in Barkley, 1990). Researchers of the day hypothesized that children who exhibited similar symptoms of excessive activity and diminished attention likely also had suffered a defect in the forebrain structure. When evidence of such damage was not readily apparent it was presumed to have occurred. Cases in which symptoms were present without evidence of pathology eventually led to the idea of “minimal brain damage” and then “minimal brain dysfunction” (Barkley, 1990).

Dissatisfaction with the concept of “minimal brain damage” began around the 1950s and led to a body of literature on the “hyperactive child syndrome” which was described by Laufer and Denhoff in 1957 and Chess in 1960 (Laufer & Denhoff; Chess, in Barkley, 1990). Chess defined hyperactivity as “The hyperactive child is one who carries out activities at a higher than normal rate of speed than the average child, or who is constantly in motion, or both” (Chess, in Barkley, 1990). Chess clearly placed heavy emphasis on overactivity although she did not associate it as having a neurological basis. In a paper on the topic, Chess reported that inattention and impulsivity were related characteristics (Barkley, 1990). By the 1970s, research on hyperactive syndrome had

increased and the concept began to be defined as also encompassing the features of inattentiveness, impulsivity, low frustration tolerance distractibility and aggressiveness (Barkley, 1990). Douglas developed a theory of hyperactivity that suggested the syndrome could be defined by deficits in four areas. These were: (1) deficits in maintenance of attention and effort; (2) inability to inhibit impulsive responding; (3) inability to modulate arousal levels to meet situational demands; and (4) an unusually strong inclination to seek immediate reinforcement (Douglas in Barkley, 1990). Towards the end of the 1970s, there began to emerge some research that challenged the "attentional construct" (Barkley, 1990). These studies were fueled by the failure to find consistency in inattentiveness across different environmental domains. Barkley notes that these research findings led to theories about the motivational aspects of children who exhibited attentional deficits and a relationship between inattentiveness and failure to respond appropriately to consequences in the environment (Barkley, 1990). By the end of the 1980s many improvements had been made in assessment techniques, therapeutic treatments, medical management, and public awareness. The upsurge of interest in the constructs of inattentiveness and overactivity among researchers and clinicians has continued through the present time.

The current DSM-IV definition of ADHD incorporates the subconstructs of inattentiveness as well as impulsivity/hyperactivity. The later behavioral characteristics have been grouped together as they are purported to be a unitary construct. Research on the validity of the subconstructs, inattention and impulsivity/hyperactivity, of ADHD has produced inconsistent results. Attention is a process that has been identified by researchers as broad, complex, ambiguous and difficult to define (Seidel & Joschko,

1990; Ostrom & Jenson, 1988). Stankov in Ostrom and Jenson (1988) defines attention as “an attempt to specify the human subject’s ability to deal with increasing amounts of information”. Luria in Seidal and Joschko (1990) hypothesizes that there are three interrelated components of attention. These components are “alertness- the basic waking state, selective attention, and vigilance-voluntary attention”. Attention is often divided into two major subtypes, sustained attention and selective attention (Halperin, 1991). Halperin describes sustained attention as involving the “maintenance of information processing over time” (Halperin, 1991). Selective attention is further subdivided into focused attention and divided attention (Halperin, 1991). Focused attention is related to the ability to attend to one stimulus while ignoring other extraneous stimuli. Divided attention reflects the process of attending to two or more stimuli at the same time.

Halperin indicates that research frequently produces poor correlations between measures such as rating scales and continuous performance test, both of which purport to measure attention, due to differences in the attentional process being measured. According to Halperin (1991), rating scales might be measuring a teacher’s perception of divided attention in the classroom while the continuous performance tests may be measuring focused attention. Alternative reasons that might account for the absence of robust correlations among measures in that the method that is employed to measure attention is also measuring many other cognitive processes that are different than that being measured by the other instruments. In this case, the variance accounted for by the attention factor might be small relative to the variance from other factors being measured (Halperin, 1991).

Cambell, D'Amato, Raggio and Stephens, 1991, investigated the construct validity of a computer version of the continuous performance test. Their research utilized a principal-component analysis with varimax rotation to investigate the relationship between the continuous performance test and measures of intelligence, achievement, visual-perceptual ability. Results indicated a four factor solution that accounted for 79% of the total variance. The continuous performance test loaded on only one factor, that being the academic achievement factor. This research finding is contradictory to a later study that found no significant relationship between the continuous performance test and academic performance (Lassiter, D'Amato, Raggio, Whitten, & Bardos, 1994). Interestingly, the Freedom from Distractibility index on the Wechsler Intelligence Scale for Children- Revised (WISC-R) loaded on the verbal abilities factor. The Peabody Individual Achievement Test (Reading Comprehension subtest) also loaded on this factor. Cambell, D'Amato, Raggio, and Stephens, (1991), research produces evidence that the continuous performance test may be related to academic achievement but was not supportive of a unitary construct of attention. Lovejoy and Rasmussen (1990) found a significant correlation, however, between the WISC-R Freedom from Distractibility index and omission errors on two different continuous performance tests. Interestingly, however, the two continuous performance tests did not correlate significantly with each other. Lovejoy and Ramussen's research also found no significant correlations between rating scale data of inattention and overactivity and either of the continuous performance tests. However, other research has demonstrated a significant relationship between continuous performance scores and behavioral ratings (Aman & Turbott in Lovejoy & Rasmussen, 1990; Klee & Garfinkel

in Lovejoy & Rasmussen, 1990). Research has inconsistently produced evidence that the continuous performance measures which purport to measure sustained attention and impulsivity have discriminant validity with regard to detecting differences between normal and clinical groups (Dainer et al., 1981; Douglas, 1972; Klorman, Salzman, Pass, Borgstedt, & Dainer, 1979).

Shaywitz, Fletcher and Shaywitz (1994) propose that differences among measures which purport to measure attention are related to the difference between a "behavioral syndrome labeled ADD and the psychological construct of attention". This article points out that research investigating the relationship between the construct of inattentiveness and the behavioral syndrome of ADD is lacking. Research has historically compared laboratory measures of attention such as the continuous performance tests with behavioral ratings. Shaywitz, Fletcher and Shaywitz (1994) indicate that the laboratory tests provide measures of the psychological construct of attention while the rating scales provide data on the behavioral disorder.

Educational Impact of Attentional Deficits

Attentional ability is an important factor in a child's capability to benefit from academic instruction. Attentional deficits which may but are not always associated with ADHD impact students educationally across different academic domains. Studies documenting the relationship between ADHD and academic achievement have yielded inconsistent results. Some studies have found that children with ADHD are far more likely to experience academic difficulties. According to Barkley, academically, children with ADHD are at greater risk for school underachievement and 20 to 30% may have an associated comorbid learning disability (Barkley, 1990). Students with

ADHD are also more likely to be placed in special education programs for the learning disabled or to be retained (Barkley, Anastopoulos, Guevremont & Fletcher, 1991). Some research has shown that 60% of students with ADHD are at least two years below grade level in reading, spelling math and written language (Anderson, Williams, McGee & Silva, 1987). Rubenstein and Brown, 1981, found that students with ADHD are two to three time more likely than other students with similar intelligence to experience school failure (Zentall, 1993). The presence of impulsivity often creates poor school performance on both daily work as well as classroom and standardized tests as students do not take adequate time to consider all alternatives, read directions thoroughly or recheck their work. Hoy, Weiss, Minde and Cohen, 1978, reported that on multiple choice tests, students with ADHD performed worse than controls if five choices were available but not if only two choices were presented. Many times difficulty with sustained attention results in poor attention to details such as in reading comprehension tasks and math calculation tasks that require solving different types of problems necessitating careful attention to changes in arithmetic symbols. Finally, one study found that students with ADHD exhibited a greater number of auditory memory errors and were able to sit for shorter periods of time and listen to auditory instructions that were not presented in combination with visual cues (Carter & Shostak, 1980). Certainly, results of this study have potential implications for teaching and educational programming choices.

Studies using clinical samples of children with ADHD have yielded discrepant results. Many studies have found achievement within the average range (Forness, Youpa, Hanna, Cantwell, & Swanson, 1992; Goldstein, 1987; Horn, Ialongo,

Greenberg, Packard, & Smith-Winberry, 1990). Inconsistencies in research findings may be related to differences in samples as children with ADHD represent a highly heterogeneous group of individuals. Although consistent demonstration of academic under achievement in ADHD populations is lacking, some researchers, suggest that rather than evaluate achievement utilizing a discrepancy approach between standard tests scores and ability, it may be more useful to consider the discrepancy between ability and productivity in the classroom setting (Bloomindale, Swanson, Barkley & Satterfield, 1991).

Reading Achievement. Approximately nine percent of students with ADHD have corresponding learning disabilities in reading (Halperin, Gittelman, Klein & Rudel, 1984). Other studies have found even higher rates of reading disabilities within ADHD populations, ranging from 24 to 39% (August & Garfinkel, 1989). Some studies have supported the hypothesis that differences in reading achievement are attributable to differences in verbal ability as measured by performance on standardized intellectual test batteries (Ackerman, Dykman & Gardner, 1990; McGee, Partridge, Williams & Silva, 1991). These studies suggest that students with ADHD as well as reading disabilities have significantly lower verbal IQs.

Mathematics Achievement. Within specific academic areas, math computation has been found by some researchers to be the area in which students with ADHD are most likely to exhibit below grade level performance (Nussbaum, Grant, Roman, Poole & Bigler, 1990). Several other studies have also found that students with ADHD exhibit slower speed in performing math calculation tasks as compared to controls with equivalent intelligence (Ackerman, Anhalt, Holcomb & Dykman, 1986; Zentall, 1990;

Zentall, Smith, Lee & Wieczored, 1993). Differences in speed of calculation has been hypothesized to relate to ADHD students' greater difficulty with sustained attention/concentration skills. Furthermore, it may also account for difficulty with completion of daily assignments in the classroom.

Written Language Achievement. Fewer studies exist addressing the achievement of students with ADHD in the area of writing skills. One study found that 38% of students with ADHD also had academic deficits in spelling even when effects of IQ were controlled for (August & Garfinkel, 1989). Handwriting, which is a component of written expression requires both manual dexterity as well as visual-motor coordination. Research is inconsistent in finding deficits in either area, although when visual-motor deficits were found and partialled out of the analyses, group differences were no longer present which suggests that poor handwriting exhibited by students with ADHD may be the result of visual-motor deficits. However, poor visual-motor skill could also be attributable to failure to sustain attention to a repetitious task over a period of time (Zentall & Kruczek, 1988). Zentall and Kruczek's 1988 study also found that students with hyperactivity exhibited a greater number of errors and poorer handwriting than controls after repetitive practice on a copying task.

Disability Certification of Children with Attentional Deficits

Currently, there is much discussion and argument among professionals, advocacy groups and the general public concerning whether children who have attentional deficits and who have been diagnosed with ADHD should constitute a separate disability category (Reid, Maag, Vasa & Wright, 1994). Much of the argument concerning the validity of ADHD as a disability category rests on the controversy

regarding valid methods of diagnosing, assessing and treating the disorder (Reid, Maag, Vasa & Wright, 1994). Presently, students who are diagnosed with ADHD are considered as having a disability under Section 504 of the Rehabilitation Act. This mandates a free and appropriate education as well as necessary related services to attain benefit from a public education. Some advocacy groups have argued that ADHD should also be considered a disability category under the Individuals with Disabilities Educational Act (IDEA) as they purport that ADHD "interferes with educational performance and because people with ADHD currently do not meet federal criteria for established categories (Reid, Maag, Vasa & Wright, 1994). Professional organizations such as the National Association of School Psychologist have spoken against recognition of ADHD as a separate disability category arguing that children with ADHD can be served under existing disability categories (Aleman, 1991). The U.S. Department of Education currently recognizes that students with ADHD can be eligible for special education services under the "other health impaired" category if symptoms of the disorder have a significant negative impact on their educational performance.

Research regarding the current placement and specific services provided to students with ADHD is limited. Reid, Maag, Vasa, and Wright, 1994, collected data from a grade-school population of 14,000 and found that of 136 students identified with ADHD, 77 were receiving special education services. Forty of these students were certified as behavior disordered and 22 as learning disabled. Ysseldyke, Algozzine, and Thurlow, 1992, propose that a separate category of ADHD is unnecessary as students whose symptoms are severe enough to impact them significantly in the educational

setting would be eligible for services under existing categories such as learning disabled, emotionally disturbed, behavior disordered or health impaired.

Methods of Assessing ADHD

Rating Scales. The use of rating scales to assess characteristics associated with ADHD is widespread and has played a central role in both clinical and research efforts (Edelbrock & Rancurello, 1985). It is common practice to utilize rating scale data generated from parents and teachers. In addition, for older students self-report rating scales may also be used. The majority of rating scales require that the rater, either parent or teacher, respond to a series of questions concerning the presence or absence of behavior as well as the severity of behavior. Current DSM-IV diagnostic criteria requires that symptoms of ADHD be present across different environmental domains such as home and school and therefore ratings in both the home and school setting is essential. Many rating scales such as the Achenbach Child Behavior Checklist (Achenbach & Edelbrock, 1983) and the Behavior Assessment System for Children (Reynolds & Kamphaus, 1992) also produce data on symptomatology profiles for other clinical disorder such as conduct disorder, oppositional defiant disorder, mood disorders and anxiety disorders. A benefit of both instruments is that they tend to be less transparent since there are many questions not related to ADHD symptoms thus making it more difficult for the rater to respond in an overly negative or positive manner about the student's behavior due to their own preconceived belief that the student does or does not have ADHD. Research suggests that teacher ratings are affected by an inflation of scores simply by making them aware that a child has been identified as "disturbed" or "learning disabled" (Foster & Salvia, 1977; Foster, Ysseldyke & Reese, 1975).

Perhaps the most salient weakness in rating scales is their subjective nature. Data is inconsistent among instruments concerning interobserver agreement; however, Barkley's 1990 review of rating scales found that fewer than half even reported interobserver correlations and those that did found interobserver agreement to be insufficient for valid diagnosis (Barkley, 1990). Problems related to interobserver agreement may be due to raters understanding of the attribute to be rated as well as a basis to judge frequency and severity of behavior (Reid & Maag, 1994). For example, a teacher may be asked to respond to a statement such as, the student often fidgets, by giving a rating on a Likert type scale. Obviously the question is subjective in that there is no operational definition to guide the rater in what frequency constitutes "often fidgets" or what behaviors can be considered to fall into the category of "fidgeting behaviors". Characteristics of the informant have significant impact on results of rating scale data. Teachers display varying degrees of tolerance to childrens' behavioral problems which affect their ratings of behavior and its' severity (Edelbrock, 1983). Furthermore, ratings are relative to the raters experience and exposure to maladaptive behavior. Research using videotapes of normal, "neurotic, and psychotic" children found that professionals such as child psychiatrists, psychologists and pediatricians rated children's behavior as less severe than did teachers who viewed the same videotape (Sonis & Costello, in Edelbrock, 1983). Due to the problems related to interrater agreement, Salvia and Ysseldyke, 1991, (in Reid & Maag, 1994) recommended that assessment instruments should possess a minimum reliability of .80 for screening purposes and .90 for diagnostic decisions.

Positive aspects of using rating scale data include that they are less costly and time consuming than direct observations, psychological testing or clinical interviews (Edelbrock, 1983). It is also possible to collect data from several different informants which yields greater diagnostic power in that it allows the diagnostician to rule out that behavior is specific to a particular environment, circumstance or relationship with one or more of the raters. In addition, several of the more recently developed rating scales include validity indices to aid the diagnostician in determining the interpretive usefulness of the protocol and the reliability of the rater's responses.

Continuous Performance Tests. The continuous performance tests (CPT) are considered to be objective measures of sustained attention to a visual and/or auditory stimulus. Continuous Performance Tests were introduced originally around 1956 as a measure to detect brain damage (Rosvold, Mirsky, Sarason, Bransome & Beck, in DuPaul, Anastopoulos, Guevremont & Metevia, 1992). The CPT utilizes a format that requires an examinee to identify a target stimulus while inhibiting responses to a series of randomly presented nontarget stimuli. For example, the CPT that utilize a visual stimulus may require that the examinee respond only to an "X" presented on a screen. More complicated versions of the visual CPT requires that the examinee respond only when the "X" is preceded by another specified letter (Wohlberg & Kornetsky, 1973). Continuous performance tests that utilize an auditory stimuli require that the examinee listen to a set of words repeated randomly and must respond to only one target word. Both the visual and auditory CPTs take on the average 15 to 25 minutes to complete. Some require little examiner involvement as the examinee completes the task

independently on a computer. These CPTs offer the additional advantage of computerized scoring and more detailed error analyses.

The Conners' version of the CPT (Conners, 1994) offers two visual presentation modes, one in which the examinee must respond to all letters presented except the "X" stimulus on the computer screen, and another in which the subject must respond only when the "X" is preceded by an "A". The latter mode of presentation is considered to be a more of a continuous performance task as it requires a more frequent rate of responding. Because the Conners' CPT is administered on a computer, several different error analyses are possible including analysis of the examinee's response accuracy and speed. Response accuracy is measured in terms of omission errors (failures to respond to the target stimulus) and commission errors (responding to nontarget stimuli). The examinee's response speed is analyzed in terms of the time from the presentation of the target stimulus to the examinee's response to the stimulus. This measure may be important as some research suggests that children with ADHD have greater variability in response time with slower response time as well as less accuracy in responding as the test progresses (Klorman, Brumaghim, Fitzpatrick & Borgstedt, 1991).

Auditory versions of the continuous performance test utilize a similar test format to those with the visual stimuli. Auditory CPTs typically require that the examinee listen to repetitive stimuli and selectively respond to a target stimulus. One of the most recently developed auditory continuous performance test, the Auditory Continuous Performance Test (Keith, 1994) requires that the examinee listen to a set of 96 words that are presented six times. The examinee must respond to only one stimulus

word while inhibiting responses to other words. The Keith CPT takes approximately 15 - 18 minutes to administer and requires an audio cassette player and two sets of headphones so that the examinee and examiner can listen to the test words simultaneously. The Keith CPT offers less sophisticated error analysis than the Conners; CPT due to the later computerized administration format. However, the Keith CPT offers computation of a vigilance decrement which reflects the change in error rate from trial one to trial six, although it does not reflect intratrial variation.

Direct Observational Methods. The direct observation method requires that a trained examiner/observer go directly into a specified setting such as the classroom to observe and document type and frequency of behaviors that are exhibited in a specified block of time. In the past, observational data tended to be collected in less defined manners that relied heavily on the clinical judgment of the observer. Recently, however, more systematic objective methods have been developed. For example, the Behavior Assessment System for Children (Reynolds & Kamphaus, 1992) offers a structured Student Observation System: (SOS). The SOS is a form that allows the observer to record an observation on a child using systematic coding with momentary time sampling. Behavior is recorded in three-second intervals spaced 30 seconds apart for a 15 minute period. Both positive and negative behaviors are listed and recorded. Unfortunately, the SOS is not a norm-referenced instrument which makes interpretation difficult.

The State-Event Classroom Observation System (SECOS; Saudargas, 1992) is a structured observational system that can be used to observe elementary aged children in a variety of large and small group settings. The SECOS has 17 behavior categories

that include student behavior, as well as precipitating events and consequences. Behaviors are coded according to the extent to which they represent child state behavior, child event behavior or teacher event behavior. Momentary time sampling technique is used to code state behaviors and event behaviors are coded separately as they occur during a 15-second interval. The percent of intervals containing state behaviors is calculated to describe the amount of time a child engages in a behavior. Event behaviors are summarized into rate per minute which provides data on the frequency of behaviors. The SECOS is a well researched instrument and yields impressive reliability data. The SECOS is purported to have discriminant validity for distinguishing between nondisabled and disabled populations including learning disabled, gifted and behaviorally disordered children. The SECOS also provides normative data from a sample of 486 nondisabled elementary students (Haile-Griffey et al., 1992). Research utilizing the SECOS indicates that it is a useful instrument in the assessment of ADHD as it is sensitive to treatment effects (Hulse-Trotter, 1996).

Utilizing a systematic coding system in observational assessment of behavior adds to the objectivity of the data and allows for direct comparisons across observers and/or time as it yields quantifiable data, i.e., frequency counts of behavior. This type of objective data collected in the classroom obviously has greater external validity than that yielded by many other methods. It is also useful in planning interventions and measuring a student's progress towards meeting goals established to modify specific behaviors. A negative aspect of direct observation is that it may require a greater amount of the examiner's time than other methods as the examiner may need to observe the student in more than one setting (classroom versus playground, lunchroom or resource

setting) or for example during different instructional periods (math versus reading class).

Research suggests that when using observational methods, classroom observations distinguish between children with ADHD better than laboratory observations (Platzman, et al., 1992). Behaviors that have been found to most consistently distinguish children with ADHD include measures of attention, activity level and vocalization (Platzman, et al., 1992). Off-task behaviors, excessive activity level and negative vocalizations were found to most consistently distinguish children with ADHD from comparison groups. The Platzman et al., findings are based on a review of 39 empirical studies in which direct observational methods were used to assess children with ADHD.

Multimethod Assessment of Attention Deficit Hyperactivity Disorder.

Although the relationship between different measures of attention is not well established, researchers tend to agree that diagnosis should incorporate more than one method of assessment (Cohen, Becker, & Campbell, 1990; Thompson & Nichols, 1992; Halperin, Sharma, Greenblatt, & Schwartz, 1991; Koriath, Gualtieri, Van Bourgondien, Quade, & Werry, 1985; Irwin & Mettelman, 1989). Use of the CPT alone is criticized primarily due to its questionable ecological validity and poor relationship to parent and teacher ratings of behavior (Koriath, Gualtieri, Van Bourgondien, Quade, & Werry, 1985; DuPaul, Anastopoulos, Shelton, Guevremont, and Metevia, 1992). Rating scales can be effected by the bias of the rater and therefore may not always provide accurate information about a child's behavior but rather are indicative of the rater's own perception of the child and/or their personal relationship with the child. The

multimethod approach to assessment utilizes a combination of objective and subjective data to provide a comprehensive evaluation of behavior associated with attention and concentration skills.

Rationale for the Study

Although the need for multimethod assessment of attentional skills is generally agreed upon, the relationship between measures of attention is not well established. Controversy about the appropriate assessment of ADHD in part has to do with whether the constructs are robust and unitary as well as the quality of measures.. This study will investigate the robustness of the constructs (inattention and impulsivity/hyperactivity) using different measures to operationalize the construct. A Multi-Trait - Multi-Method analysis will be used to assess the constructs of inattention and impulsivity/hyperactivity. Two different methods will be utilized to assess the two traits. These will include an objective approach to assessment, the continuous performance test, as well as a subjective approach; use of rating scales data for assessment. Both instruments provide measures of inattention and impulsivity/hyperactivity.

Much of the current research focusing on measurement of attention deals primarily with diagnosis of Attention Deficit Hyperactivity Disorder. Current literature suggests that this approach may be flawed due the assumption that the psychological construct of attention is the same as the behavioral syndrome known as ADHD. To date, research concerning the relationship of attention, as operationalized by objective as well as behavioral measures, to academic achievement is sparse and existing studies have produced inconsistent results. In the educational setting, students may exhibit attentional deficits for many reasons, including but not limited to the presence of

attention deficit disorder. In order to make important decisions concerning educational certification and programming for children with attentional deficits a clearer picture of the educational impact of inattentiveness is needed. The present study will provide information about educational implications of attentional skills in the school setting. This study will also address the need to clarify the relationship between different measures of attention and their ability to predict school achievement.

Research Questions

- (1) To what extent can construct validity of the current model of ADHD be demonstrated by use of the multi-trait - multi-method (MMTM) procedure? Specifically to what extent do inattention and impulsivity/hyperactivity occur independently of the method utilized to assess the constructs?
- (2) To what extent do the constructs of inattention and impulsivity/hyperactivity predict reading comprehension?
- (3) To what extent do the constructs of inattention and impulsivity/hyperactivity predict basic reading skill?
- (4) To what extent do the constructs of inattention and impulsivity/hyperactivity predict spelling?
- (5) To what extent do the constructs of inattention and impulsivity/hyperactivity predict math calculation skills?

Chapter II

Methodology

Subjects

The total sample consisted of 112 children ranging in age from 6 years, 0 months to 11 years, 9 months. Within each age group the sample consisted of 15 six year olds, 21 seven year olds, 15 eight year olds, 25 nine year olds, 17 ten year olds, and 19 eleven year olds. There were 75 males and 42 females included in the study. Children resided in the suburb of a major southeastern city and attended a kindergarten through fifth grade elementary school with an approximate enrollment of 1000 students. The sample consisted of four kindergarten students, 25 first grade students, 18 second grade students, 21 third grade students, 15 fourth grade students and 29 fifth grade students. Both regular education and special education students were included in the sample. There were 37 regular education students in the sample and 75 students who were identified as disabled according to the Tennessee State Criteria and were receiving special education services. Children in the disabled group were identified as having one or more of the following disabilities, specific learning disability, health impaired, language impaired, serious emotional disturbance and developmentally delayed. Students in the disabled group included 40 children certified as learning disabled, 22 certified as health impaired (ADHD), eight certified as language impaired, one certified as developmentally delayed and four certified as seriously emotionally disturbed. All children in the sample were Caucasian. Students in the sample had all been referred to a school support team by parents and /or teachers due to educational concerns or were being assessed as part of the mandatory three year reevaluation of

students who are certified as disabled. Therefore, the present study does not reflect a purely random sample of students from the school population.

Measures

Rating Scale. The Behavior Assessment System for Children (BASC) by Cecil R. Reynolds and Randy W. Kamphaus, was utilized as a measure of teacher ratings of student behavior (Reynolds & Kamphaus, 1992). The BASC is a comprehensive system for evaluating children's behavior that includes parent, teacher and a youth self-report component. The BASC can be used with children aged 4-18 years. The BASC yields information on behavior associated with different clinical diagnoses as well as adaptive behaviors. The current study utilized the BASC teacher rating scales (BASC-TRS) for children aged 6-11. The BASC-TRS requires that teachers respond on a 4 point scale to statements concerning the frequency that a child displays a specified behavior. The teacher must circle only one of four choices; "N" to indicate that the behavior "never" occurs, "S" to indicate that the behavior "sometimes" occurs, "O" to indicate that the behavior "often" occurs or "A" to indicate that the behavior "always" occurs.

Dimensions that are rated on the BASC-TRS include: hyperactivity, aggression, conduct problems, anxiety, depression, somatization, attention problems, learning problems atypicality, withdrawal, leadership, adaptability, study skills, and social skills.

Composite scores are generated by combining scores on groups of individual scales.

Composite scores include the externalizing composite which is comprised of scales for hyperactivity, aggression and conduct problems. The internalizing composite is comprised of the scales for anxiety, depression and somatization. The school problem composite is made up of the attention problems and learning problems scales. The

adaptive skills composite is comprised of the adaptability, leadership, study skills and social skills scales. Finally, the BASC-TRS also provides validity scales to determine the utility of the protocol for interpretive purposes.

Studies report good reliability indices for the BASC. The BASC manual reports that for the TRS internal consistencies for individual scales across age ranges averages .80 (Reynolds & Kamphaus, 1992). Across age ranges, the aggression, hyperactivity, social skills, study skills and attention problems scales had the highest internal consistency reliabilities. For children ages 6-7 these were .93, .92, .93, .92 and .89, respectively. For children ages 8-11, reliability coefficients for these scales were .93, .93, .92, .93 and .93, respectively.

To establish test-retest reliability for each of the three TRSs, the same teacher was asked to rate a sample of children with a time interval of 2-8 weeks between ratings. Test retest correlations reported in the BASC manual were high with a median value of .89, .91, and .82 for the three age levels. For the child level TRS, test retest reliability coefficients for the attention problems scale was .92; conduct problems, .80; hyperactivity, .92; learning problems, .93; social skills, .94; and study skills, .94. Composite scores also had high test retest reliability. The externalizing problems scales reliability coefficient was reported to be .91; internalizing problems composite, .81; school problems composite, .94; adaptive skills composite, .96.

Interrater reliability for the child version of the BASC TRS ranged from .44 (depression scale) to .93 (learning problems scale). Other correlations included aggression (.74), social skills (.70), study skills (.88) and hyperactivity (.75). The interrater reliability coefficients for composite score were as follows: externalizing

problems composite (.79), internalizing composite score (.69), school problems (.89) and the behavioral symptoms index (.84) (Reynolds & Kamphaus, 1992).

The BASC yields impressive validity data. As a component of the norming process, data were collected on 50 children aged 6-11 and 38 adolescents aged 12-18. Teachers completed the BASC TRS as well as the Achenbach teacher report form. For children aged 6-11, high correlations were found for the majority of comparable scales. Both instruments have an attention problems scale. The correlation between the two measures on this scales was .81. The hyperactivity scale of the BASC TRS correlated highly with the Achenbach Teacher Report Form (TRF), $r = .86$. Composite scores on the two instruments were highly correlated for the externalizing problems (.88) and moderately correlated for the internalizing problems (.73). The BASC behavior symptoms index was highly correlated with the Achenbach total problems score (.92).

The BASC manual reports that the TRS has been correlated with four other instruments other than the Achenbach whose format it most closely resembles. These instruments include the Revised Behavior problem Checklist, Conner's Teacher Rating Scales, Burks Behavior rating Scale and the Behavior Rating Profile. Overall, the BASC scales tend to be more highly correlated with other measure on externalizing and school problem behavior. Highest correlations were found with the Achenbach TRF, Revised Behavior Problem Checklist and Burks Behavior Rating Scales. Correlations between the BASC and the Conner's and the Behavior Rating Profile were reported as "moderate". (Reynolds & Kamphaus, 1992). The BASC authors attribute lower correlations to the BASC's inclusion of a wider range of adaptive behaviors.

Continuous Performance Test. The Auditory Continuous Performance Test (ACPT) (Keith, 1994) was designed to measure auditory attention in children aged 6-11

years. The ACPT is described as a measure of auditory vigilance. It is unique in that most continuous performance tests utilize visual stimuli. The ACPT measures a child's selective attention by indicating the correct responses the child makes to a target auditory stimulus. It also measures sustained attention by assessing the child's performance over a six trial period.

The ACPT requires that a child listen to twenty monosyllabic words that are familiar to young children. These words are arranged randomly into sets of 96 each set containing 20 presentations of the target word "dog". The ACPT takes approximately 15 minutes to administer. It provides criterion scores that indicate if a child's performance matches the scores of children the same age who have been identified as having ADHD. The ACPT includes trial tests that are administered prior to beginning the formal test to assure that the child understands the test task. The ACPT requires use of a high quality cassette player that meets the following specifications:

Tape speed, 1 7/8 ips (4.75 cm/sec); Playback, 4 tracks, 2 channel stereo; motor, 6 volt DC with governor; frequency response, +6 dB, 63-80000 Hz; Signal to noise ratio, 52 dB; Wow and Flutter, .2%; Volume control, single or dual. Two sets of earphones are required so that the examinee and examiner can both listen to the ACPT stimuli presentation simultaneously. The ACPT can also be administered with a two-channel clinical audiometer. The ACPT is not suitable for use with children with hearing loss and/or middle ear dysfunction. The ACPT is also not suitable for children with auditory discrimination difficulties.

After the trail test is administered and the child clearly understands the task, the examiner begins the test by reminding the child to raise his/her thumb each time the target word "dog" is presented. The examiner then begins the test tape and marks the child's responses on a record form which indicates the number of correct responses, number of failures to respond to the target stimulus, and responses to words other than the target stimulus. At the end of the test session, an error analysis is performed to determine the type and frequency of errors. Failures to respond to the target word are purported to represent lapses in attention while inappropriate responding to words other than the target word are associated with impulsivity. A total error score is generated which is the sum of the two types of errors. This score is compared to an age based criterion score to determine if the child's performance is considered a passing or failing one. A vigilance decrement can also be calculated by comparing the number of correct responses to the target stimulus on the first trial versus the last (sixth) trial. Unfortunately, however, this fails to account for significant fluctuations in performance within trials two through five.

The ACPT was standardized on 510 children between the ages of 6 and 11 years who had not been diagnosed as having ADHD. All children in the standardization sample were required to pass a hearing test prior to participation with pure-tone audiometric screening at the frequencies 500, 1000, 2000 and 4000 Hz with thresholds no poorer than 20 dB HL at 500 Hz and 15 dB HL at higher frequencies (Keith, 1994). Children were tested at 72 sites located across the United States. Racial composition was based on the racial/ethnic proportions of children ages 6 through 11 in the U.S. population. Racial composition was as follows: white, 354; African-American, 79;

Hispanic, 59; Other, 18. Eighty-five children at each age level were tested. Two-hundred and fifty-five children participating in the standardization sample were males and an equal number were females.

The ACPT is reported to be a reliable instrument. Research outside of that reported by the test author is limited as the ACPT is a relatively new instrument. However, the test manual reports a test-retest study in which 86 children ages seven and 9 years were tested two time with the interval between testing ranging from 1 to 14 days. The test-retest reliability for the 7 year old group ($N = 46$) was .67. For 9 year olds ($N = 40$) the test-retest reliability was .74. Information on the construct validity is provided in the test manual. A discriminate function analysis was performed to determine the extent to which the ACPT could accurately distinguish between normal children and a group of children who were diagnosed with ADHD according to the DSM-IV(1994) criteria. Four hundred and forty children ages 6 through 11 participated in the study. Half of the sample were identified as having ADHD. The children were matched for age, race and gender. Children who were taking prescription medication for treatment of ADHD were not on medication for 48 hours if they were being treated with Ritalin, (methylphenidate) or dextroamphetamine. Children who were being treated with Cylert (pemoline) did not take their medication for two or more weeks prior to testing. Total error scores for children with ADHD were significantly higher than scores for normal children ($p, .01$). A signal detection model was utilized for the discriminate analysis to determine if the ACPT correctly differentiated between the two groups of children. Using the signal detection model, four possibilities were explored. These represented:

- (1) Children who had been previously diagnosed with ADHD and who were also

identified by the ACPT as having ADHD. Children with this pattern of results were termed "hits"; (2) Children who had previously been identified as having ADHD but were not identified according to the ACPT. These were considered "misses"; (3) Children who were not identified previously with ADHD and who were not identified by the ACPT. These were considered "correct rejections"; and (4) Children who had not previously been identified as having ADHD but were identified by the ACPT as having ADHD. These were considered to be "false alarms". For all ages combined, the ACPT correctly identified children 70% of the time. The "miss" rate was reported to range from 18% to 29% across ages. The "false alarm" rate was reported to be a low 2% to 8% across age ranges. Results of this study yielded evidence of the ACPT's construct validity. Based on this study, the authors conclude that if a child fails the ACPT there is a high probability that an actual deficit in auditory attention exists. However, passing the ACPT was noted to be a less conclusive event as some students' who exhibit attentional difficulties in the classroom apparently are able to exhibit attention under the more structured, one-on-one test setting. Authors recommend that passing ACPT test results be supplemented with observational data and historical data from parents and teachers.

Academic Achievement. The Woodcock Johnson Academic Achievement Test-Revised (WJ-R) was utilized as an individual measure of academic performance (Woodcock & Johnson, 1989) for grades kindergarten and first grade.. The WJ-R is a comprehensive achievement battery measuring performance in areas of reading, math and written language. It can be administered to students in preschool as well as in college populations. The normative sample for the WJ-R was comprised of 6,359

participants. The preschool age sample consisted of 705 children. The school age sample (kindergarten through 12th grade) consisted of 3,245 students. Nine hundred and sixteen students in the normative sample were enrolled in college and 1,493 adults in the sample were not enrolled in college. The sample consisted of a random stratified design. Racial composition of the sample resembled population characteristics according to census data. Data for the school aged sample were gathered from September, 1986 to April, 1988.

Normative data from the WJ-R includes grade and age equivalents, percentile ranks as well as standard scores. Standard scores have a mean of 100 and standard deviation of 15. The WJ-R includes both a standard battery of achievement subtests as well as supplementary battery of additional subtests. The standard battery is comprised of the Letter-Word Identification subtest, Passage Comprehension subtest, Calculation subtest, Applied Problems subtest, Dictation subtest, Writing samples subtest, Science, Social Studies and Humanities subtests. Broad Scores representing areas of reading, math, and written language are available. The Broad Reading score is comprised of the combined Letter-Word and Passage Comprehension subtests scores. The Broad Math score consists of the Calculation and Applied Problems subtests. The Broad Written Language score is made up of the Dictation and Writing Samples subtests scores. Within the standard battery, the Letter -Word Identification subtest measures a student's ability to identify isolated letters and words while the Passage Comprehension subtest requires that the student exhibit both reading comprehension and vocabulary skills. Under the math domain, the Calculation subtest is a paper and pencil task that measures a student's skill in performing mathematical procedures including addition,

subtraction, multiplication, division, and advanced skills that involve geometry, trigonometry and calculus operations. The Applied Problems subtest requires that a student analyze and solve mathematical problems such as applied word problems in which the student must determine the correct mathematical manipulations to perform as well as which information in the problem is relevant. The Dictation subtest of the written language domain requires that a student exhibit a number of different skills including letter formation, spelling, punctuation, capitalization, and word usage. The Writing Samples subtest requires that a student produce written responses to a variety of different prompts which evaluate the students quality of written expression.

The WJ-R is a widely used instrument that is reported to be both reliable and valid. The WJ-R test manual reports good concurrent validity. Correlations with other measure of achievement were moderate to high. Validity studies included in the normative process included one study of nine year olds in which the WJ-R, Kaufman Achievement Battery (KABC), Kaufman Test of Educational Achievement (KTEA), Peabody Individual Achievement Test (PIAT) and Wide Range Achievement Test-Revised (WRAT-R) were administered to 70 students. The WJ-R Broad Reading score correlated highly with the KABC Reading Composite (.80), KTEA Reading Composite (.85) PIAT Reading Composite (.85) and WRAT-R reading score (.83). The WJ-R Broad Math score highly with the KABC Arithmetic score (.71) and KTEA Math composite (.83). Moderate correlations were reported between the WJ-R Broad Math score and PIAT math score (.41) and WRAT-R math score (.63). Correlations between the WJ-R Broad Written Language score and other tests is difficult as the other batteries primarily offer only measures of spelling skill. Correlations between the Broad score and

the KTEA Spelling score (.68) PIAT Spelling score (.53) and WRAT-R spelling score (.69) were moderate.

The WJ-R manual also provides information on construct validity which was investigated by calculating intercorrelations among tests within the battery. Correlation matrices were calculated that indicated stronger relationships within curricular areas as opposed to between different curricular areas which provides evidence of the construct validity of the test. The WJ-R manual does not provide intercorrelations collapsed across age ranges, however, the correlation between the reading subtests ranged from .51 (age 4) to .84 (age 70-79). Intercorrelations between the math subtests ranged from .57 (age 6) to .81 (age 70 - 79). Within the written language cluster, intercorrelations between subtests ranged from .50 (age 13) to .75 (age 6).

Data are provided from studies comparing WJ-R scores with other commonly used instruments with children ages 3, 9 and 17. A study conducted at the University of Kansas utilized a sample of children aged 2-6 to 3-7. WJ-R scores were correlated with scores on the Boehm, Bracken, KABC-Expressive Vocabulary, KABC-Faces and Places, KABC- Arithmetic, KABC-Riddles, KABC-Total Achievement, and PPVT-R. The correlation was highest between the KABC-Arithmetic subtest and the WJ-R skills cluster (.63). The lowest correlation was found between the KABC-Faces and Places subtest and the WJ-R skills cluster (.10). Correlations between the WJ-R skills cluster and the Boehm, Bracken and KABC-Total Achievement were .53, .49, and .52, respectively. Data for the nine year olds was collected at Texas Woman's University. Correlations are provided between the WJ-R Cluster scores and the BASIS, KABC, KTEA, PIAT and WRAT-R. The WJ-R broad reading cluster score was correlated .63

with the BASIS reading score, .80 with the KABC Reading Composite, .85 with the KTEA Reading Composite, .86 with the PIAT reading composite and .83 with the WRAT-R reading score. The WJ-R broad math cluster score correlated .71 with the BASIS math score, .71 with the KABC Math composite, .83 with the KTEA composite, .41 with the PIAT Math score, and .63 with the WRAT-R math score. The WJ-R broad written language cluster score was correlated .63 with the BASIS spelling score, .68 with the KTEA spelling score, .53 with the PIAT spelling score and .69 with the WRAT-R spelling score. Lower correlations between the WJ-R broad written language cluster score and other tests may reflect differences in the tests formats as the WJ-R includes a writing sample portion that is more comprehensive in nature than other tests which tests only spelling skill.

The Wechsler Individual Achievement Test (WIAT) (The Psychological Corporation, 1992), was utilized as an individual measure of academic performance for participants in second through fifth grade. The WIAT was developed for use with children from age five to 19 years. The WIAT manual encourages its use in children six to 16 due to the normative sample being linked to the normative sample for the Wechsler Intelligence Test for Children, Third Edition (The Psychological Corporation, 1991). The WIAT measures performance in reading, math and written language. There are six basic subtests in the standard battery that measure components of reading, math and writing skill. The WIAT also offers a language composite score that is derived from scores on the Listening comprehension and Oral Expression subtests.

The subtests that comprise the reading composite are the Basic Reading and Reading Comprehension subtests. The Basic Reading subtest consists of items that

measure decoding skills and word reading. Words selected for the subtest were selected from a variety of word lists and are purported to include basic sight words as well as words with an array of vowel and consonant combinations. The Reading Comprehension subtest is described by the test authors as measuring a broad range of reading comprehension skills including utilization of picture clues, recognizing details in passages, sequencing events in a passage, identifying causal relationships, making inferences and comparing and contrasting. Within the mathematics composite score are the Mathematics Reasoning and Numerical Operations subtests. The Mathematics Reasoning subtest is designed to measure problem solving skill, number concepts, graphing, geometry and measurement. The Numerical Operations subtest incorporates measurement of operations such as addition, subtraction, multiplication, and division. Older children are measured on skills such as fractions, decimals, percentage, and introductory algebraic equations. The test authors caution against use of the WIAT for measurement of giftedness in adolescents due to the lack of advanced algebra, trigonometry and calculus items on the Numerical Operations subtest.

The writing composite score is made up of the Spelling and Writing Expression subtests for children in grades 2 through 12. Children in kindergarten and first grades take only the Spelling subtest and therefore a writing composite test score is not available for these grades. The Spelling subtest is a direct measure of spelling skill. Selection of words on this subtest was determined by examination of words that frequently appear in children's writing and from lists taken from seven basal spelling series. Words are read to the student and then read in a sentence. The student is then expected to write or print the word on a test form. The Written Expression subtest is

designed to evaluate a child's ability to construct a written response, formulate and develop ideas, and utilize correct grammar, punctuation and spelling. The WIAT requires that a student compose a written response to one of two possible prompts. These prompts are designed to reflect four types of writing that are frequently included in a school curriculum: description, narration, exposition, and persuasion (WIAT reference). The first prompt is designed to measure descriptive writing and the second prompt is designed to measure narrative writing. The Written Expression subtest can be scored either analytically or holistically. Criteria for scoring include grammar and usage, capitalization and punctuation, sentence structure and variety, vocabulary, organization, unity, and coherence, and ideas and development.

Norms for the WIAT were derived from a sample representative of the U.S. population according to the 1988 U.S. Bureau of the Census. Stratification of the normative sample was according to the following variables: age, gender, grade, race/ethnicity, geographic region, and the educational level of the child's parents/guardian. The normative sample consisted of 4,252 children in 13 age groups ranging from five through 19 years. Students were enrolled in kindergarten through 12th grade. With the exception of the kindergarten sample, all groups contained at least 330 children. The kindergarten sample, however, contained only 173 children. Representation of males and females were roughly even with the sample consisting of 2,160 females and 2,092 males. The WIAT manual reports that there were approximately equal numbers of males and females broken down into grade and age levels. The racial/ethnic background of the WIAT normative sample was reportedly consistent with the proportion of racial/ethnic groups in the U.S. population.

Information of the parents/guardians' level of education was obtained from responses to a questionnaire. Educational categories included: (1) 8th grade or less; (2) 9th through 11th; (3) high-school graduate or equivalent; (4) 1 through 3 years of college or technical school; (5) 4 or more years of college. If a student was living with two parents who had differing levels of education, the average of both parents' levels of education was utilized. The normative sample was collected from both public as well as private schools. Stratified random sampling was utilized to select students for the normative sample. Students who were identified as disabled and were attending regular schools were included in the normative sample. The WIAT manual reports that 6% of the standardization sample were identified as disabled, including the following disability groups: (1) learning disabled; (2) speech/language impaired; (3) emotionally disturbed; (4) physically impaired. Gifted students were also included in the sample (4.3%) as were children who fell in the borderline or mildly mentally retarded range according to the DSM III-R criteria (American Psychiatric Association, 1987) (1.4%). The WIAT also has the advantage of having a direct connective link with the development of the third edition of the Wechsler Intelligence Scale for Children. According to the WIAT manual, 1,284 children aged 5 - 19 participated in the norming process for both the WIAT and the WISC-III.

The WIAT purports to have good reliability. Test-retest reliability coefficients are reported for grades 1, 3, 5, 8, and 10. These data were available from a portion of the standardization sample that was retested from 12 to 52 days later. The sample consisted of a total of 367 children. The median retest interval was 17 days. Grade based reliability coefficients for 1st graders for the six academic subtests ranged from

.78 (Numerical Operations) to .96 (Spelling). Test-retest reliability coefficients for the third grade sample ranged from .80 (Numerical Operations) to .93 (Basic Reading and Spelling). Grade 5 reliability coefficients ranged from .73 (Written Expression) to .92 (Basic Reading). The 8th grade sample yielded test-retest coefficients from .80 (Reading Comprehension) to .94 (Spelling). Finally the test-rest reliability for the 10th grade sample ranged from .62 (Written Expression) to .91 (Basic Reading and Mathematics Reasoning). The average test -retest reliability coefficients for all grades on subtest were as follows: Basic Reading, $r = .94$; Reading Comprehension, $r = .85$; Mathematics Reasoning, $r = .89$; Numerical Operations, $r = .86$; Spelling, $r = .94$; and Written Expression, $r = .77$.

The WIAT yields impressive internal reliability data. Split-half reliability coefficients are reported for each age group and subtest as well as for the composite scores. Grade based coefficients are also provided for fall and spring scores. Split-half coefficients were derived by the Spearman-Brown formula for the subtests and by a formula for calculating reliability of composites for the Composite scores. Age-based coefficients for the subtests ranged from .69 (age 5, Numerical Operations) to .95 (age 7, Basic Reading). The average split -half reliability coefficient across age ranges was .92 (Basic Reading), .88 (Reading Comprehension), .89 (Mathematics Reasoning), .85 (Numerical Operations), .90 (Spelling), and .81 (Written Expression). Grade-based split-half coefficients for the fall norms ranged from .59 (kindergarten, Basic Reading) to .94 (2nd grade, Basic Reading). Average reliability coefficients across grades for each of the subtests for the fall norms were: Basic Reading, $r = .89$; Reading Comprehension, $r = .84$; Mathematics Reasoning, $r = .85$; Numerical Operations, $r = .77$; Spelling, $r =$

.86; and Written Expression, $r = .81$. Grade-based split-half coefficients for the spring norms ranged from .71 (6th grade, Written Expression) to .94 (Grade 1, 2, 3, 4, 5, Basic Reading). Average reliability coefficients across grades for each of the subtests for the spring norms were: Basic Reading, $r = .91$; Reading Comprehension, $r = .87$; Mathematics Reasoning, $r = .89$; Numerical Operations, $r = .84$; Spelling, $r = .89$; and Written Expression, $r = .80$.

Interrater reliability is reported in the WIAT manual for the four subtest that require a greater degree of judgment on the examiner's part. These subtests include the Reading Comprehension, Listening Comprehension, Oral Expression, and Written Expression subtests. Reliability of the two academic subtests will be reviewed as the other two subtests were not utilized in this study. To establish interrater reliability two studies using the standardization data are reported in the WIAT manual. Fifty test protocols from the normative sample were randomly selected and scored independently by four different scorers. The first study examined scores on the dichotomously scored subtests (Reading Comprehension and Listening Comprehension). The average correlation between pairs of scores was reported to range from .89 to .99 with an average correlation of .98 on the Reading Comprehension subtest. The second study examined the interrater reliability on the Written Expression and Oral Expression subtests. The average correlation was .89 for prompt 1 and .79 for prompt 2 on the Written Expression subtest. Test authors conclude that WIAT subtests that require a greater degree of examiner judgment can be scored reliably.

The WIAT yields impressive validity data. The WIAT manual presents validity studies that present evidence of the tests' construct validity, concurrent validity, and

predictive validity. Evidence of the WIAT's construct validity was demonstrated by use of a multitrait-multimethod approach. The WIAT manual reports a study by Roid, Twing, O'Brien, and Williams (1992) in which patterns of correlations between scores on the WIAT and three other group administered achievement tests were analyzed. Correlations were calculated between the WIAT subtests and subtests from the Stanford Achievement Test, Seventh Edition Plus (SAT7 +; Gardner et al., in WIAT Manual, 1992), the Iowa Tests of Basic Skills, Form G (ITBS-G; Hieronymus, Hoover, & Lindquist, in WIAT Manual, 1992), or the California Achievement Tests, Form E. Convergent correlations between the WIAT Reading Composite scores and the SAT7 +, ITBS-G, and CAT-E were .71, .74, and .77, respectively. Scores for the WIAT Mathematics Composite were .69, .67, and .78, respectively. Finally, for the WIAT Spelling, correlations of .73, .72, and .75, respectively were reported. The test authors conclude that the high correlations found to exist between pairs of measures representing the same skills provide evidence of the tests construct validity.

The correlations between the WIAT and other tests of achievement were moderate to high. The WIAT manual reports that correlations between the WIAT and the Basic Achievement Skills Individual Screener (BASIS) for a group of 80 children in either grade 3 or 8 was .80 for Basic Reading, .81 for Reading Comprehension, .82 for Mathematics Reasoning, .79 for Numerical Operations and .88 for Spelling.

The WIAT and the Kaufman Test of Educational Achievement (K-TEA) (Kaufman & Kaufman, 1985) were administered to a group of 28 children aged 6 -16. The sample included both disabled and nondisabled children. Correlations between similar subtest were moderate to high. The correlation between the WIAT Basic

Reading and the K-TEA Reading/Decoding subtest was .86. The Reading Comprehension subtests of both batteries yielded a correlation coefficient of .78. The Mathematics Reasoning subtest of the WIAT was correlated with the Math Application subtest of the K-TEA, $r = .87$. The Numerical Operations subtest of the WIAT and the Math Computation subtest of the K-TEA were correlated, $r = .81$. Finally, analysis of the relationship between the Spelling subtest on both instruments yielded a correlation coefficient of .73.

Scores on the Woodcock Johnson Psycho-Educational Battery-Revised, Tests of Achievement (WJ-R) (Woodcock & Johnson, 1989) and the WIAT were examined for a sample of 43 children aged 7 - 14. Correlations were calculated between the WIAT Basic Reading and the WJ-R Letter-Word Identification subtests, $r = .79$; WIAT Reading Comprehension and the WJ-R Passage Comprehension subtests, $r = .74$; WIAT Mathematics Reasoning and the WJ-R Applied Problems subtests, $r = .67$; WIAT Numerical Operations and the WJ-R Calculations subtests, $r = .68$; WIAT Written Expression and the WJ-R Dictation subtests, $r = .72$; and the WIAT Spelling and the WJ-R Dictation subtests, $r = .88$.

Procedure

Data for this study were available in the cumulative and confidential cumulative records of students. For the purpose of this study, students' names were not identified with test scores when data were recorded from student records. The only personal information recorded with test scores from students' records were the students' chronological age at the time that testing occurred, gender, grade placement and disability condition if applicable. No birthdates were recorded to further protect the

students' confidentiality. A code number was assigned to each case of data for the purpose of creating a computer data file. Code numbers were not associated in any manner with the students' identity. All data reflected test scores produced from the previous school years; 1995- 1996 and 1996 - 1997. Test data taken from student records included: (1) BASC-TRS scores; (2) Woodcock Johnson achievement scores; (3) Wechsler Individual Achievement Test scores ; (4) Wechsler Intelligence Scale test scores and (5) Auditory Continuous Performance Test Scores. Data were not always available for all students on all measures.

Data Analysis

Descriptive statistics were computed for demographic information including grade, gender, age and disability classification. Means and standard deviations were calculated for participants' age. Frequency counts were utilized to describe the sample characteristics of gender, grade and disability conditions. Construct and predictive validity of the two components of ADHD were determined.

Construct validity of the subconstructs of ADHD were investigated utilizing a multi-trait - multi-method (MTMM) model. A correlation matrix including measures of the two constructs was constructed measured by two separate methods. Homotrait-Heteromethod correlations were computed to determine the relationship between different methods of assessment for the same trait. Heterotrait-homomethod relationships were represented by correlations between similar methods of assessment measuring different constructs. Heterotrait-heteromethod relationships reflected the correlations between different methods of assessment and different constructs. Convergent validity was determined by the significance of the homotrait-heteromethod

correlations. Homotrait-heteromethod correlations that were significantly greater than their corresponding heterotrait-heteromethod correlations were taken as evidence of discriminant validity. A t-test for correlation coefficients for correlated samples was utilized to test for significant differences between the correlation coefficients.

Heterotrait-homomethod correlations indicated method variance within component measures.

A multiple regression analysis was utilized to determine the predictive validity of the subconstructs of inattentiveness and impulsivity/hyperactivity as measured on the BASC-TRS inattention and hyperactivity indexes, the ACPT omission and commission errors, and the Freedom from Distractibility Index of the WISC-III. Four separate step-wise multiple regression analyses were computed to explore the predictive validity of the constructs of inattention and impulsivity/hyperactivity as operationalized on the ACPT, BASC and Freedom from Distractibility Index score of the WISC-III. Criterion variables included the following academic achievement areas: (1) math calculation; (2) reading comprehension; (3) basic reading and (4) spelling.

Chapter III

Results

The purpose of the study is to examine the robustness of the constructs of inattention and impulsivity/hyperactivity. In addition, this study explores the utility of these constructs, as operationalized by rating scales and objective measures, for predicting academic achievement.

Descriptive data for the portion of the sample that was utilized in the MTMM matrix are presented in Table 1. The MTMM sample consisted of 108 students from the 112 total sample. The mean t-score for the sample on the BASC Inattention subscale was ($X = 64.67$) and ($sd = 7.87$). The mean t-score on the BASC Hyperactivity subscale was ($X = 57.50$) and ($sd = 11.92$). The mean ACPT Omission error score was ($X = 13.66$) and ($sd = 13.68$). The mean ACPT Commission error score was ($X = 6.0$) and ($sd = 6.54$).

Construct Validity of Inattention and Impulsivity/Hyperactivity

A multi-trait - multi-method (MTMM) matrix was developed to ascertain the convergent and discriminant validity of the constructs inattention and impulsivity/hyperactivity. Pearson correlation coefficients were computed from the sample data and placed into the MTMM matrix. The MTMM matrix is presented in Table 2.

Construct validity of inattention and impulsivity/hyperactivity was addressed by examining convergence and divergence of the MTMM matrix. Convergent validity was evaluated by examining the diagonal elements of the matrix (A1A2, B1B2 from Table

Table 1

Descriptive Statistics for the Multi-Trait - Multi-Method Sample

	M	SD	Range	N
BASC-Hyperactivity	57.50	11.92	40-85	108
BASC-Inattention	64.67	07.87	39-78	108
ACPT Omissions	13.66	13.68	0-58	108
ACPT Commissions	06.00	06.54	0-28	108

Table 2

Multi-Trait - Multi-Method Matrix of Inattention and Impulsivity/Hyperactivity

	Method 1 (Rating Scale - BASC)		Method 2 (Objective-ACPT)	
	BASC Inattention A1	BASC Hyperactivity B1	ACPT Omissions A2	ACPT Commissions B2
A1	.85			
B1	.40*	.92		
A2	.23*	.35*	—	
B2	.07*	.25*	.59*	—

Diagonal values are reliability estimates from test manuals; a reliability estimate is not available for ACPT omission and commission

* $p \leq .05$

1). These elements represent assessment of the same trait using different types of measures, i.e., rating scale vs. continuous performance test to measure the trait inattention. Evidence of convergent validity would be demonstrated by coefficients that are significantly greater than zero. Results of this study indicated statistically significant correlations between the two measures of inattention ($r = .23$, $p < .05$) as well as impulsivity/hyperactivity ($r = .25$, $p < .05$).

Discriminant validity can be investigated by examining the column and row values in adjacent heterotrait-heteromethod triangles. Discriminant validity is evidenced when correlations representing same trait - different measures are greater than correlations of different trait - different measures. Results of this study fail to provide compelling evidence for discriminant validity of the model. The inattention coefficient (A1A2) ($r = .23$) did not exceed the correlation for variable (B1A2) ($r = .35$) which had neither trait nor method in common. The impulsivity/hyperactivity coefficient, (B1B2) ($r = .25$) was larger than the variable (A1B2) ($r = .07$) which had neither trait nor method in common. To determine the significance of the difference, a t-test for correlated sample correlation coefficients was calculated. Results were not significant, $t = 1.73$, with a corresponding p-value of .10 (two-tailed test).

The third method of determining construct validity using the MTMM matrix requires examination of the relationship of a trait measure with other measures of the same trait, i.e., inattention evaluated by both the rating scale and objective measures. Evidence for construct validity would be indicated by higher same trait correlation coefficients as compared to different trait, same method coefficients. In this study, neither of the trait correlations, inattention (A1A2; $r = .23$) or impulsivity/hyperactivity

(B1B2; $r = .25$) exceeded the corresponding different trait - same method correlations; rating scale (A1B1; .40) and ACPT (A2B2; .59), respectively.

Predictive Validity of Inattention and Impulsivity/Hyperactivity

Descriptive statistics for the portion of the sample utilized in the four multiple regression analyses are presented in Table 3. The regression sample consisted of 100 students from the total sample of 112 children. Means and standard deviations for the independent variables were similar to those of the standardization samples with the exception of the sample mean for the BASC Inattention subscale. The mean for the sample on the BASC inattention subscale was ($X = 64.87$, $sd = 7.77$). This score was almost 1.5 standard deviations above the average t-score for the population ($X = 50.00$). However, the elevation in the t-score for this sample likely represents the composition of the sample, i.e., a referred sample of children whose teacher had expressed concern with their attention in the classroom and therefore rated them higher on behavioral rating scales. Other independent variable means and standard deviations were as follows: BASC Hyperactivity ($X = 57.50$, $sd = 12.24$), Freedom from Distractibility Index ($X = 90.70$, $sd = 12.90$), ACPT Omission score ($X = 13.13$, $sd = 13.38$), and ACPT Commission score ($X = 6.00$, $sd = 6.00$).

Means and standard deviations for the sample on the four dependent variables were as follows: Basic reading ($X = 85.99$, $sd = 13.46$); Reading comprehension ($X = 86.92$, $sd = 12.92$); Math calculation ($X = 92.74$, $sd = 15.99$); and Spelling ($X = 85.89$, $sd = 12.38$). Although the standard deviation was similar to that of the normative group ($sd = 15.0$), the mean for each achievement level with the exception of math calculation, was almost one standard deviation below the mean for the normative sample ($X = 100$).

Table 3

Descriptive Statistics for the Constructs of ADHD

	Mean	SD	Range
Independent Variables			
Freedom from Distractibility	90.70	12.90	56-122
BASC Inattention	64.87	07.77	39-78
BASC Hyperactivity	57.50	12.24	40-85
ACPT Omission	13.13	13.38	0-58
ACPT Commission	06.00	06.00	0-28
	M	SD	Range
Dependent Variables			
Basic Reading	85.99	13.46	60-119
Reading Comprehension	86.92	12.92	52-116
Math Calculation	92.74	15.99	39-127
Spelling	85.89	12.38	59-115

N = 100 for each variable

BASC = Behavior Assessment System for Children

ACPT = Auditory Continuous Performance Test

This finding is likely accounted for by the composition of the sample being a referred sample of children who were experiencing school difficulties and therefore were obviously not performing acceptably in the classroom. Therefore it would be expected that this sample would represent children with lower achievement levels.

Four multiple regression analyses were used to examine the predictive capabilities of inattention as operationalized by the BASC inattention scale, the ACPT omission error score, and the freedom from distractibility index of the WISC-III as well as impulsivity/hyperactivity as operationalized by the BASC hyperactivity scale and the ACPT commission error score. Basic reading, reading comprehension, math calculation and spelling were the dependent variables. The standard multiple regression analysis was utilized to build a model which estimated the amount of variance contributed by the independent variables. Tables 4 presents a correlation matrix showing the relationship between each independent variables and the dependent variables. Table 5 presents a correlation matrix showing relationships among the independent variables.

Basic reading achievement. With the five independent variables entered into the regression equation, 37% ($F = 11.10, p < .01$) of the total variance in reading achievement was predicted. However, when all other variables were controlled, only the Freedom from Distractibility Index ($Beta = .50, p < .01$) and the ACPT omission score ($Beta = -.30, p < .01$) emerged as significant predictors of reading achievement. These two variables accounted for 36% of the total variance in basic reading achievement ($F = 27.74, p < .01$). Specifically, the Freedom from Distractibility Index accounted for 31% of the variance with the ACPT omission error score adding only 5%

Table 4

Correlation Matrix for Constructs of ADHD

	Basic Read.	ReadingComp.	Math	Spelling
FD	.56*	.58*	.62*	.52*
BASCHYP	-.11	-.21*	-.03	.01
BASCINAT	.00	-.02	-.15	.13
ACPTOM	-.37*	-.40*	-.32*	-.30*
ACPTCOM	-.24*	-.37*	-.16	-.20*

N = 100

* = $p < .05$ (two tailed)

FD = Freedom from Distractibility Index, BASCHYP = BASC Hyperactivity Scale
 BASCINAT = BASC Inattention Scale, ACPTOM = ACPT Omission Score
 ACPTCOM = ACPT Commission Score

Table 5

Correlation Matrix

	BASCHYP	BASCINAT	ACPTOM	ACPTCOM	FD
BASCHYP		.44*	.40*	.26*	-.08
BASCINAT			.23*	.05	.00
ACPTOM				.58*	-.27*
ACPTCOM					-.30*

N = 100

* = $p < .05$ (two tailed)

BASCHYP = BASC Hyperactivity Scale, BASCINT = BASC Inattention Scale
 ACPTOM = ACPT Omission Score, ACPTCOM = ACPT Commission Score
 FD = Freedom from Distractibility Index

to the total variance predicted by the equation. Results of the regression analysis are presented in Table 6.

Reading comprehension achievement. With the five independent variables entered into the regression equation, 41% ($F = 13.10$, $p < .01$) of the total variance in reading comprehension was predicted. However, only the Freedom from Distractibility Index ($Beta = .49$, $p < .01$) emerged as a significant predictor accounting for 33% of the variance. Results of the regression analysis are presented in Table 7.

Math calculation achievement. With the five independent variables entered into the regression equation, 45% of the variance in math calculation scores was accounted for. For math calculation, the Freedom from Distractibility Index ($Beta = .60$, $p < .01$) ACPT omission score ($Beta = -.27$, $p < .01$) and the BASC Inattention score ($Beta = -.17$, $p \leq .05$) were the only three variables that contributed significantly to the regression equation. These three variables accounted for 42% of the variance in math calculation scores. The Freedom from Distractibility Variable emerged as the strongest predictor of math calculation skill accounting for 37% of the variance. The ACPT omission error score added 3% to the variance prediction and the BASC Inattention score added 2% to the variance prediction. Results of the regression analysis are presented in Table 8.

Spelling achievement. For spelling, 33% of the variance was accounted for by the five independent variables ($F = 9.31$, $p < .01$). However, only the Freedom from Distractibility Index ($Beta = .46$, $p < .01$) and ACPT omission ($Beta = -.29$, $p < .01$) emerged as significant predictors when all other variables were controlled. These two variables accounted for 29% of the variance in spelling scores. The Freedom from

Table 6

Multiple Regression Analysis for Basic Reading Achievement

Independent Variable	B-Value	Standardized B-Value	t-test	p-value
FD	.50	.52	5.81	<.01
ACPTOM	-.30	-.30	-2.75	.01
ACPTCOM	.08	.16	.76	.45
BASCINAT	.07	.11	.71	.48
BASCHYP	.00	.00	.03	.98

N = 100

FD = Freedom from Distractibility Index, ACPTOM = ACPT Omission Score,
 ACPTCOM = ACPT Commission Score, BASCINAT = BASC Inattention Score,
 BASCHYP = BASC Hyperactivity Score

Table 7

Multiple Regression Analysis for Reading Comprehension Achievement

Independent Variable	B-Value	Standardized B-Value	t-test	p-value
FD	.49	.49	5.84	<.01
ACPTOM	-.19	-.18	-1.81	.07
BASCHYP	-.11	-.12	-1.16	.25
ACPTCOM	.09	-.17	.89	.38
BASCINAT	.08	.13	.87	.39

N = 100

FD = Freedom from Distractibility Index, ACPTOM = ACPT Omission Score,
 BASCHYP = BASC Hyperactivity Scale, ACPTCOM = ACPT Commission Score
 BASCINAT = BASC Inattention Scale

Table 8

Multiple Regression Analysis for Math Calculation Achievement

Independent Variable	B-Value	Standardized B-Value	t-test	p-value
FD	.60	.74	7.39	<.01
ACPTOM	-.27	-.32	-2.63	.01
BASCINAT	-.17	-.35	-1.95	.05
BASCHYP	.16	.21	1.78	.08
ACPTCOM	.13	.32	1.39	.17

N = 100

FD = Freedom from Distractibility Index, ACPTOM = ACPT Omission Score,
BASCINAT = BASC Inattention Scale, BASCHYP = BASC Hyperactivity Scale,
ACPTCOM = ACPT Commission Score

Distractibility score accounted for 26% of the variance. The ACPT omission score added only 3% to the total variance predicted by the equation. Results of the regression analysis are presented in Table 9.

Table 9

Multiple Regression Analysis for Spelling Achievement

Independent Variable	B-Value	Standardized B-Value	t-test	p-value
FD	.46	.46	5.20	<.01
ACPTOM	-.29	-.27	-2.60	.01
BASCINAT	.16	.26	1.69	.09
ACPTCOM	.08	.15	.73	.47
BASCHYP	.07	.07	.68	.50

N = 100

FD = Freedom from Distractibility Index, ACPTOM = ACPT Omission Score,
BASCINAT = BASC Inattention Scale, ACPTCOM = ACPT Commission Score,
BASCHYP = BASC Hyperactivity Scale,

Chapter IV

DiscussionConstruct Validity

Results of this study did not produce compelling evidence for the construct validity of the current model of ADHD. This research specifically addressed the extent to which the components of the current model (inattention and impulsivity/hyperactivity) occur independently of the method utilized to assess the constructs. This research produced some evidence of convergent validity of the constructs, however, the amount of variance explained by the traits (inattention and impulsivity/hyperactivity) did not exceed the amount of variance associated with the method of measurement. Results of this study suggest that although there is a significant amount of variance explained by the traits, there is a greater amount of shared variance between similar methods of measurement than traits. Therefore, the method of assessment (rating scale versus objective measure) may explain more of the variance within the data as do the theoretical constructs.

One possible hypothesis would be that the constructs are not particularly robust. According to Halperin (1991) attention may actually be comprised of interrelated components of both sustained and selective processes. Halperin hypothesizes that selective attention is further divided into areas of focused and divided attention. Rating scales are purported to be measures of teachers' perceptions of divided attention while continuous performance tests measure focused attention. It is possible that two different processes are actually being assessed even though they purport to be assessing a similar

construct, i.e., inattention. Another possibility is that the measures utilized to assess attention are also measuring many other different cognitive processes. The variance accounted for by attention might be small relative to that accounted for by other factors being measured. Another possibility according to Shaywitz, Fletcher and Shaywitz (1994) is that current measures do not distinguish between a theoretical psychological construct of attention and a separate behavioral syndrome, i.e., ADHD. Results of this research are consistent with the previous research by Cambell, D'Amato, Raggio and Stephens (1991) and do not support the existence of unitary constructs of attention or impulsivity/hyperactivity.

Results of this research suggests that practitioners who utilize the multimethod approach to assessment of inattention and impulsivity/hyperactivity should be cautious in making diagnostic decisions based on consistency or lack of consistency in test data due to the significant amount of variance that occurs due to method of assessment. However, this research produced some evidence suggesting that the objective measures of the constructs have ecological validity, as the omission error score of the ACPT was significantly related to school achievement. Results of this research are consistent with those of Cambell, D'Amato, Raggio and Stephens (1991) who found that utilizing a principal-component factor analysis, the continuous performance test loaded on only one factor, that being the academic achievement factor. Results of this research support that of the Cambell, D'Amato, Raggio and Stephens study (1991) in suggesting that the continuous performance test may be related to achievement although it does not provide compelling evidence for the existence of a unitary construct of inattention or impulsivity/hyperactivity.

Furthermore, results of this study were consistent with other studies that failed to find a significant relationship between measures, i.e., rating scales and continuous performance tests (Lovejoy & Rasmussen, 1990).

Predictive Validity

Four multiple regression analyses were used to examine the predictive capabilities of inattention, as operationalized by two types of measurement; the rating scale method (BASC) as well as objective methods (ACPT and the Freedom from Distractibility Index). The predictive capabilities of impulsivity/hyperactivity as operationalized by the rating scale method (BASC) and objective measures (ACPT) was also examined.

Previous research addressing the relationship of the constructs of inattention and impulsivity/hyperactivity as operationalized by different assessment methodologies was sparse. Cambell, D'Amato, Raggio and Stephens (1991) research found that the continuous performance test loaded on only one factor that being the academic achievement factor. Their research did not look at omission versus commission errors separately but rather used the total score. However, their research showed that the other measure of attention, the Freedom from Distractibility Index loaded only on the verbal abilities factor. This finding is not particularly surprising since the two subtests that comprise the Freedom from Distractibility Index (Arithmetic and Digit Span) are both verbal subtests of the WISC-III intelligence test.

Results of this research were consistent with Cambell, D'Amato, Raggio and Stephens (1991) research in providing evidence of a significant relationship between the

continuous performance measure of inattention, the omission error score, and three of the four areas of academic achievement addressed in this study (Basic Reading, Math Calculation, and Spelling). The continuous performance measure of inattention was not found to be a significant predictor for reading comprehension. Only the Freedom from Distractibility Index was a significant predictor for reading comprehension. Since the Freedom from Distractibility Index has been shown to correlate significantly with the verbal IQ, it may be possible that verbal intelligence is actually a strong indicator of reading comprehension skill.

The Freedom from Distractibility Index was also the most significant predictor for the other three academic areas. Abilities measured by Freedom from Distractibility that relate highly to verbal intelligence (e.g., facility with symbols and sequencing) may influence academic performance; thus, measures used to assess attention are actually measuring other cognitive processes that underlie verbal intelligence. The WISC III test manual indicates that across all age ranges there is a .68 correlation between the Freedom from Distractibility Index and the Full Scale IQ which may explain why the Freedom from Distractibility Index was the strongest predictor of academic achievement in this study. Previous research has also found a significant relationship between the WISC-R Freedom from Distractibility Index and two different continuous performance tests (Lovejoy & Rasmussen, 1990). A weakness of the current study is the lack of statistical control for intellectual ability in the regression equation.

The rating scales subscales of inattention and hyperactivity failed to serve a significant purpose in the prediction of academic achievement with the exception of mathematics calculation skill. The BASC inattention score, although a statistically

significant predictor, accounted for a mere 2% of the total variance in math calculation scores.

The ACPT commission error score was not a significant predictor of any of the four achievement areas. Overall, this research provides evidence of a stronger relationship between inattention and achievement as compared to impulsivity/hyperactivity and achievement.

Conclusion

The current research did not produce compelling evidence for the presence of inattention and impulsivity/hyperactivity as unitary constructs. Due to the large amount of variance due to method of assessment, the constructs are unlikely to provide a strong basis for intervention and decisions concerning educational programming. Although two of the objective measures of attention, the Freedom from Distractibility Index of the WISC-III and the ACPT omission error score emerged as a consistently significant predictors of academic achievement the actual amount of variance predicted in achievement scores may have relatively limited practical use in applied settings. Practitioners should be cautious in making diagnostic decisions based on psychometric data as a significant amount of variance is due to the method utilized to assess the constructs of inattention and impulsivity/hyperactivity. Results of this study indicate that the constructs are not particularly robust and may not represent unitary constructs.

Suggestions for Future Research

Future research efforts could focus on investigation of the relationship between measures of attention, particularly objective measure such as continuous performance

tests and verbal intelligence. It would be useful to examine the predictive capability of the construct with the effect of verbal intelligence statistically controlled for. Future research might also focus on investigating the possibility of a model of attention with different components such as focused versus divided attentional processes and how these types of attention relate to school achievement.

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VITA

Francine L Reynolds was born in Rogersville, Tennessee on August 8, 1964. Her childhood was spent being educated by the beautiful nature that she encountered daily living on her grandparent Kirkpatrick's farm and through the Hawking County Public School System. After graduating from Cherokee Comprehensive High School in 1982, Francine enrolled at The University of Tennessee where she received a B.A. in psychology in December, 1986. Immediately after receiving her Bachelor's degree, Francine enrolled in a Master's degree program at East Tennessee State University. She received her M.A. in Psychology in August, 1988. While attending ETSU, Francine worked as a graduate research assistant with Dr. Booney Vance. Dr. Vance's research in the area of test development interested her and she decided to pursue a doctoral degree in psychology. Francine's interest in assessment led her to enroll in the Ph.D. program in School Psychology at The University of Tennessee in August, 1988. At The University of Tennessee, Francine worked as a graduate teaching assistant which led to her development of an interest in curriculum and teaching strategies. The doctoral degree was received in August, 1977.

Francine has worked as a self employed licensed psychological examiner and school psychologist for five years. She is currently employed as a school psychologist for a public school system.