INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

VALIDITY OF OBJECTIVE MEASURES OF INATTENTION, IMPULSIVE RESPONDING, AND HYPERACTIVITY IN A SAMPLE OF SECOND AND THIRD GRADE STUDENTS

by

ILENE KOPSTEIN

A dissertation submitted to the Graduate Faculty in Educational Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

2004

This manuscript has been read and accepted by the Graduate Faculty in Educational Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

1/27/04
Date

Georgiana Shick Tryon, Ph.D., Chair of Examining Committee

Jan 27, 2004
Date

Carol Kehr Tittle, Ph.D., Acting Executive Officer, Educational Psychology

Georgiana Shick Tryon, Ph.D., Professor of Educational Psychology

Carol Kehr Tittle, Ph.D., Professor of Educational Psychology

Jeffrey M. Halperin, Ph.D., Professor of Neuropsychology

Supervisory Committee

Abstract

VALIDITY OF OBJECTIVE MEASURES OF INATTENTION, IMPULSIVE RESPONDING, AND HYPERACTIVITY IN A SAMPLE OF SECOND AND THIRD GRADE STUDENTS

by

ILENE KOPSTEIN

Advisor: Professor Georgiana Shick Tryon

This study was an attempt to validate objective measures of overactivity, poor impulse control, and inattention using standard paper-and-pencil measures of these constructs. Standardized measures including an omnibus rating scale of children's behavior (the Behavior Assessment System for Children, BASC), a structured diagnostic parent interview (the Diagnostic Inventory Schedule for Children, DISC-IV), and a teacher-derived rating of specific DSM-IV symptoms (the Diagnostic Rating Scale-Teacher version, DRS-T) of Attention Deficit/Hyperactivity Disorder (AD/HD) were used to predict scores on laboratory measures of attention (solid state actigraph), impulsivity (Continuous Performance Test, CPT; Impulsivity scores), and inattention (CPT Inattention scores).

Participants were a self-selected group of 2nd and 3rd grade students from a public elementary school in suburban New York State. Of 550 total students, 47 participants

(8.5%) completed the protocol. A small group of children (n = 6) who were being treated with stimulant medication received physician permission to miss one dose of medication on the morning of testing.

Analyses of the data indicated that the magnitude of movement was greater in the classroom *vs.* individual testing sessions. In addition, medicated children exhibited higher levels of activity than non-medicated children during individual testing but not in the classroom setting. Combined parent data (i.e., Hyperactivity T scores plus the average number of hyperactivity or impulsivity symptoms endorsed on the interview) did not predict children's activity in either setting nor did these predict CPT Impulsivity scores. However, there was a trend in the prediction of CPT Inattention scores from parent ratings of Attention Problems and endorsements of DISC inattention symptoms. Similarly, combined parent and teacher Attention Problem ratings approached significance in the prediction of CPT Inattention. Additional predictive evidence for the CPT Inattention measure was indicated by the finding that parent ratings of Attention Problems significantly predicted CPT Inattention scores. No combination of teacher ratings predicted activity levels in either setting nor did these predict CPT Impulsivity or Inattention scores.

The potential influences of informant bias, symptom attenuation, and inter- and intra-situational context on these results are discussed.

Acknowledgments

I would like to express my appreciation to the Board of Education of the Ossining (New York) Public Schools for allowing me to conduct my research at the Brookside School. It was a pleasure to work with the administration, students, parents, teachers, secretarial, and custodial staffs who assisted me with all aspects of this research project. I would like to thank the school principal, Ms. Angela White, who was instrumental in arranging a place for me to work at the school and facilitated many of the details regarding scheduling. I especially wish to thank Dr. Rick Dale, school psychologist, whose encouragement and wonderful relationship with the faculty and administration helped to make my study a reality. I am also grateful to the many parents and teachers who were willing to give their time to complete forms, do interviews, and insure that the children would be ready to participate when asked. The children were friendly, helpful, and a delight to work with. The secretaries and custodians assisted me on numerous occasions with their expert advice. I am honored that I was able to come to know everyone affiliated with the Brookside School.

Thanks also to the staff at Ambulatory Monitoring, Inc. particularly Tom Kaslausky and Lillian Dilluvio who answered a million questions and were able to provide me with equipment that worked. A generous loan of equipment from Mr. Gruen, the president of the company, allowed me to "field test" the actigraphs without an initial monetary investment.

My deepest thanks to Drs. Georgiana and Warren Tryon (Mrs. and Mr. Dr. Tryon) for assisting me with finding the site for my study. My attempts to find a location to do

my research were mostly unsuccessful. If not for the Tryon's connection with the Brookside school, this study would not have taken place. In addition, I would like to thank my mentor, Mrs. Dr. Tryon, for her feedback and encouragement at every step of the dissertation process.

I am very appreciative of the assistance of Dr. Jeffrey Halperin, professor of neuropsychology at Queens College who was instrumental in helping me develop my original idea for this study. I learned many important lessons working in Dr. Halperin's laboratory, and my experience there enhanced my enthusiasm for clinical research. Dr. Halperin's expertise in the field of AD/HD was an enormous help with this project. His willingness to give his time responding to my phone calls and e-mails is indicative of his dedication to the field.

Finally, I would like to thank my family for their encouragement and support. If it were not for my husband, David, I would have given up long ago. Thank you for being "Mr. Mom" when I was engrossed in my studies and writing. I would also like to thank my two sons, Joshua and Scott. I cannot express the extent of my appreciation for the sacrifices that you made and how difficult it was for me to not to participate in all of your activities because of my hectic schedule. It is my hope that you realize that these sacrifices were worthwhile because I am doing what I love. I hope that you understand how important it is to do something in life that makes you happy. Whatever path you choose, please know that I will always support and love you.

TABLE OF CONTENTS

List of Tables

Chapter 1

Introduction

The most common reasons for referring a child for school psychological services are complaints of excessive motor activity, lack of impulse control, and/or difficulty focusing on the task at hand (Landau & Burcham, 1995). Although these types of behaviors have been found in children with various disabilities including Mental Retardation, Pervasive Developmental Disorders, and Tic Disorders, primary deficits in these areas are most often associated with the diagnosis of Attention Deficit/ Hyperactivity Disorder (AD/HD).

AD/HD is a neurodevelopmental disorder of uncertain etiology. As outlined in the Diagnostic and Statistical Manual of the American Psychiatric Association - Fourth Edition (DSM-IV; APA, 1994), inattention symptoms include an inability to sustain attention, disorganization, forgetfulness, distractibility, an avoidance or dislike of tasks that require persistence, not listening when spoken to, and incomplete or careless work. Inappropriate running and/or climbing, difficulty remaining seated, fidgetiness, "driven" motor movement, excessive talking, and noisiness are behaviors that are used to define hyperactivity. Symptoms of impulsivity include problems with turn-taking, blurting out answers before the question has been asked, and interrupting or intruding on the conversations or activities of others (APA, 1994). Additional DSM-IV criteria for AD/HD require that the above-mentioned behaviors be developmentally inappropriate, that some symptoms be present before the child's seventh birthday, and that impairment from these symptoms occurs in more than one setting such as in school and at home

(APA, 1994; Arnold & Jensen, 1995).

Impairments associated with an AD/HD diagnosis include conduct problems, anxiety, low self-esteem, and academic failure (APA, 1994). Although some studies have indicated that as many as 50% of cases remit in adolescence (Fisher, Barkley, Fletcher, & Smallish, 1993) or

adulthood (Weiss & Hechtman, 1993), others have found that as many as 80% of hyperactive children retain symptoms into adulthood (Barkley, Fisher, Edelbrock, & Smallish, 1990; Klein & Manuzza, 1991; Weiss & Hechtmann, 1993). The recent focus on adults with AD/HD (Weiss & Hechtmann, 1993) provides further evidence that this condition may have lifelong consequences.

AD/HD has been the focus of much empirical study and debate. Interest in this disorder stems in part from the relative frequency of its occurrence in the population. Various studies estimate the prevalence of AD/HD at a low of 2.4% (Gomez, Harvey, Quick, Scharer, & Harris, 1999) to a high of 19.8% and 12.3% in a random sample of boys and girls respectively (Pineda, Ardila, Rosselli, Arias, Henao). Barkley (1998) indicates that the variation in prevalence statistics among these studies is due to differences in the diagnostic criteria used (i.e., research diagnostic criteria, DSM-III-R *vs.* DSM-IV criteria), the sample (i.e., referred, non-referred, boys, girls), the assessments used (i.e., ratings scales, interviews) and the method used to determine caseness (endorsement of symptoms by any informant *vs.* agreement among respondents on the presence of symptoms).

Studies seeking to further identify the primary deficit or deficits associated with an

AD/HD diagnosis have suggested that children lack motivation and have limited persistence particularly on tasks that are perceived as uninteresting and/or unrewarding (Barkley, 1991; Douglas & Parry, 1983; Sonuga-Barke, Taylor, Sembi, & Smith, 1992). Interestingly, anecdotal and laboratory reports of children who have difficulty remaining attentive during highly structured school-like tasks indicate that these children evince few symptoms while viewing educational television programs (Landau, Lorch, & Milich, 1992). Similarly, anecdotal reports of parents claim that hyperactive children can remain still and attend for long periods of time when watching the television or playing video games (Zentall, 1993). The reason for this apparent inconsistency between school and at-home behavior may be related to the perceived attractiveness or novelty of the stimulus. When presented to distractible children, colorful, unusual, or moving stimuli may reduce the inattentive behavior that is typically associated with repetitive, school-like tasks (Radosh & Gittleman, 1981). Based on these studies, some investigators propose the presence of an "attentional bias" rather than a complete inability to focus (Zentall, 1993).

The underlying mechanism that has been proposed for purported attentional biases is that symptomatic children have high thresholds for arousal and thus require attractive or novel stimuli to hold their attention (Barkley, 1998; Zentall, 1993). Impulsive behaviors have been attributed to a characteristic aversion for delays of gratification among children with AD/HD symptoms (Sonuga-Barke et al., 1992). Cognitive hyper-arousal and an aversion for delayed rewards are two hypotheses that have been used to explain the poor performance of inattentive and/or hyperactive children on academic tasks that require "drill and practice" and repetitive rehearsal techniques. If these hypotheses are correct,

then it is possible that the underdevelopment of self-regulatory abilities and poor social comprehension of children who manifest overactivity, poor impulse control, and inattention may lead to greater instances of academic failure, grade retention, and impaired social relationships compared to their non-affected classmates (Barkley, 1998; Landau & Burcham, 1995; Zentall, 1993).

It is important to note that AD/HD is not a classification under which school children are mandated to receive federally funded school-based services. According to the Individuals with Disabilities Education Act (IDEA), federal monies are not specifically provided for the identification and provision of services for children with attention and activity problems. However, children who suffer with AD/HD frequently receive school-based services under related classifications such as "learning disabilities," or "other health impaired." (Barkley, 1998). As a result of this legislation, school psychologists are not responsible for making a DSM-IV diagnosis of AD/HD. Instead, the school-based clinician assesses the self-regulatory capacities, peer relationships, and academic progress of children who display symptoms in order to develop targeted interventions for these deficits (DuPaul, 1992; Landau & Burcham, 1995).

Following a referral for overactivity, impulsivity, and/or attention problems, school psychologists begin a systematic examination of the child's behavior. Best practices in the assessment of AD/HD (Landau & Burcham, 1995) and federal legislation such as IDEA require the use of a multimodal and multisource assessments when evaluating the child's need for school-based support services. Multiplex evaluation generally includes classroom observations, interviews, and standardized measures of the child's personality, cognitive

functioning, and academic achievement (DuPaul, 1992, Sattler, 1992).

The use of various types of evaluation techniques is important for several reasons. First, different measures may be used to "rule out" other conditions with symptoms that are similar to those of ADHD. This is important because many other disorders have features that are similar to those of AD/HD. For example, anxiety or mood disorders may inhibit one's ability to concentrate and remain attentive. As these disorders require different forms of intervention, it is important to clarify the exact nature of the child's difficulty so that appropriate treatment may be devised. The use of multimodal assessment procedures insures that all areas of concern regarding the child's functioning are addressed by the intervention.

Secondly, the triangulation of the results of various assessments may serve to further validate suspected AD/HD symptoms (DuPaul, 1992; McConaughy & Ritter, 1995). Data from the classroom setting, for example, might include observations of the child's actual classroom behavior that can be compared to teacher and parent reports and/or ratings of the child's classroom behavior. Considering all information regarding classroom deportment may validate or cast doubt on the validity of any one particular report.

Thirdly, the use of multiple measures can serve to enhance the psychologist's understanding of the problem. For example, rating scales alone may indicate the frequency with which particular symptoms occur; however, an interview might be necessary to obtain information regarding the age when symptoms first appeared and the extent of social and/or academic impairment caused by the symptoms.

As mentioned above, the use of a variety of assessments may also clarify the existence of co-occurring conditions. AD/HD has been found to co-exist with an number of childhood disruptive (Kuhne, Schachar, & Tannock, 1997), anxiety (Jensen, Shervette, Xenakis, & Richters, 1993; Pliszka, 1992), mood (Biederman, Faraone, Mick, Moore, & Lelon, 1996; Jensen et al., 1993), and learning disorders (Cantwell & Baker, 1991; Pliszka, 1998). An assessment of AD/HD symptoms exclusively is therefore considered to be an incomplete evaluation particularly as the impact of comorbid conditions on AD/HD symptoms has been shown to influence the presenting symptoms of the disorder. Pliszka (1992), for example, found that impulsivity symptoms were reduced in children with AD/HD who had a concomitant anxiety disorder.

Collecting data from multiple informants (i.e., teacher, parent) has become common practice in determining AD/HD status in both school (DuPaul, 1992; Landau & Burcham, 1995) and clinical (Young, Kaplan, Pascualvaca, & Brasic, 1995) settings. Although it would appear that teacher, parent, and child assessments of the behaviors in question would reveal clearly defined patterns, this is often not the case. The low to moderate concordance between various respondents regarding children's activity levels, ability to inhibit responses, and maintain attention and concentration has been well documented (Bidaut-Russell, Reich, Cottler, Robins, Compton, & Mattison, 1995; Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000; Sawyer, Baghurst, & Mathias, 1992; Swanson, Lerner, March, & Gresham, 1999; Verhulst & Akkerhuis, 1989; Weiler, Bellinger, Marmor, Rancier, & Waber, 1999). Inconsistent agreement between different respondents has been related to respondent biases (Kazdin, Esterveldt-Dawson, & Loar,

1983; Schachar, Sandberg, & Rutter, 1986), situation-specific behavior of the child (Porrino, Rapoport, Behar, Sceery, Ismond, et al., 1983; Sleator & Ullmann, 1981), and properties of the assessment instruments (Crocker, & Algina, 1986; McClelland & Werry, 2000; Sattler, 1992).

One factor that is postulated to be responsible for inter-rater disagreement is informant response bias. Response biases may be intentional (e.g., raters may knowingly attempt to make the child appear unaffected) or unintentional (e.g., informants may not realize that they are responding in such a way as to make a child look impaired or unaffected). Regardless of intent, these biases differentially influence the data and may result in the creation of spurious discrepancies. For example, at least one study of externalizing and internalizing symptoms in clinic-referred children (Verhulst & Akkerhuis, 1989) indicated that parents and teachers are more likely to report overt externalizing symptoms such as aggression, hyperactivity, and non-compliance, whereas on self-report, children are more likely to endorse internalizing symptoms such as depression and anxiety (Loeber, Green, Lahey, & Stouthamer-Loeber, 1991; MacLeod, McNamee, Boyle, Offord, & Friedrich, 1999; Verhulst & Akkerhuis, 1989). It is possible that behavior such as aggression and non-compliance may be more apparent to others, whereas, less salient, internalizing symptoms, such as anxiety and depression, may be more apparent to the child him/herself (MacLeod et al., 1999).

A second form of response bias that may produce discrepant findings among various informants is the respondent's tendency to "fake good" or "fake bad." Parents, for example, may deny or amplify the presence of symptoms in their child (Reynolds &

Kamphaus, 1998). Teachers may generalize the child's problem behavior to other unaffected areas of his or her functioning resulting in "negative halo effects" (Schachar et al., 1986). Although "lie" and other validity scales have been employed to assess the respondent's tendency to minimize or maximize the target child's symptoms, many rating scales and interviews used in the literature do not include validity scales. These measures rely on the examiner's clinical acumen to determine if the respondent is giving overly negative or positive reports of the target child's behavior. Unidentified respondent bias may, therefore, play a role in the creation of inter-informant discrepancies. The finding of respondent biases further supports the need for collecting data from various informants in order to offset biased reporting. However, biases that contaminate the responses of all informants may lead to erroneous conclusions about the child's behavior.

Another reason for discrepant reports among informants may be the situation-specific behavior of the child. It has been suggested that children with attentional and/or activity problems behave differently depending on the amount of structure imposed and the demands of the task. (Porrino et al., 1983; Sleator & Ullman, 1981). One study of hyperactive children indicated that differences in activity level among disordered and non-disordered children were not apparent during unstructured playground activities (Porrino et al., 1983). Similarly, Sleator and Ullmann (1981) reported that hyperactive and impulsive children frequently displayed no or few symptoms during individual sessions with a clinician. From these studies, it would appear that developmentally inappropriate behaviors may be a function of the particular setting in which the child finds him or herself, and that particular situations may attenuate or exacerbate symptoms.

Another important consideration when evaluating children for attention and activity problems is that the assessment instruments used may be subject to errors of measurement, insufficient construct validity, and other psychometric limitations (Crocker & Algina, 1986; McClelland & Werry, 2000; Sattler, 1992). The diagnostic instrument itself, therefore, may yield inaccurate or biased data. Fortunately, many scales used to assess AD/HD symptoms include updated normative data and use factor analytic and other statistical techniques to reduce the overlap between the various symptom scales. Although these procedures improve the interpretability of the data (Reynolds & Kamphaus, 1998 ; Weiler et al., 1999), they do not account for the subjectivity of the data collected.

Rating scales, questionnaires, and interviews commonly used to identify behavioral problems in children rely heavily on the retrospective reports of respondents. Concerns have been expressed about the validity of retrospectively collected data particularly regarding the tendency for informants to become confused or forget important information (Conners, 1998; Sattler, 1992). Accurate retrospective reporting is essential for establishing the presence or absence of AD/HD symptoms particularly because of the temporal considerations associated with the disorder (i.e., symptoms must be present for at least 6 months with some symptoms present before the child's seventh birthday; APA, 1994).

The problems inherent in the above-mentioned assessment instruments illustrate the lack of a "gold standard" in the assessment of AD/HD. As such, objective laboratory measures that purport to assess activity level, inattention, and impulsivity were examined

in this study.

The purpose of this study was to provide further support for the use of objective measures in the identification of activity levels, vigilance, and impulse control in a general sample of second and third grade students from a public elementary school. Although mechanical and computerized measures have shown limited validity as "stand alone" diagnostic measures (Barkley, 1998; Matier-Sharma, Perachio, Newcorn, Sharma, & Halperin, 1995), it is postulated that these instruments may provide additional unbiased data as part of an assessment battery. However, before using such measures as part of a diagnostic battery, it is important to clarify exactly what it is that is being assessed by these instruments (Barkley, 1991; 1998). As such, this study was designed to assess the validity of objective measures by establishing their relationship with criterion measures of the constructs of interest. This study was conducted to determine if parent and/or teacher reports and ratings of activity, impulsivity, and inattention, predict actigraph and Continuous Performance Test (CPT; Halperin, Matier, Bedi, Sharma, & Newcorn, 1992; Halperin, Newcorn, Matier, Sharma, McKay, & Schwartz., 1993) measures of these constructs. It was hypothesized that objective measures would provide unbiased data that may be an important addition to the armamentarium of standardized paper-and-pencil measures, clarifying and enhancing the evaluation process.

The following chapters give a brief history of the development of the current diagnostic category of AD/HD in terms of the DSM-IV and IDEA. An overview of previous research on the various assessment measures that have been used to identify children with behavioral difficulties in schools and laboratories follows. Both standardized

paper-and-pencil and objective measures are reviewed. The strengths and limitations of each of these measures in the identification of childhood behavior disturbances are also discussed.

Chapter 2

The Evolution of the Current Diagnostic Category of AD/HD

This chapter presents a brief history of childhood psychopathology and classification of disabled children within the public education system. Children with AD/HD represent one group of students who require assessment to ascertain the need for special educational and/or related services (i.e., counseling, occupational therapy, etc.). This assessment may include an evaluation of the extent to which children meet specific DSM-IV diagnostic criteria for particular disorders. In the case of AD/HD, the diagnostic criteria have undergone considerable evolution over the years. The evolution of this diagnostic category is briefly reviewed.

History of Child Psychopathology and School-Based Classification

The notion that children suffer with mental illnesses similar to those found in adults is relatively new in the history of psychopathology (Kovacs, 1996). In her work in the field of childhood depression, for example, Kovacs (1996) states that, until very recently, children were not typically screened for depression because psychodynamic conceptions implied that youngsters had not developed the intra-psychic mechanisms necessary to develop this disorder. Aside from the notion that children were incapable of developing particular mental disorders, mental illness has historically been a source of fear and embarrassment for the families of disturbed youth. Reports of parents neglecting, hiding, and/or abusing their affected offspring have attracted the attention of the public both in the past and in more recent years.

Changes in the assessment and treatment of children and adults with mental

disorders first occurred during the period of Enlightenment in Europe. Prior to this time, disturbed individuals were removed from society and warehoused in large prison-like environments where they were shackled and given no form of treatment (Davison & Neale, 1994). Rather than simply imprisoning mentally ill individuals in asylums, Philippe Pinel began a movement to give mentally ill individuals greater freedom. Some patients were released from these large asylums, others were given treatments such as speaking about their problems and engaging in non-stressful activities (Davison & Neal, 1994). Pinel's idea that patients could be active in their own recovery foreshadowed more modern approaches to treatment.

Prior to the 1970s, children with behavioral and/or emotional difficulties received little or no education in American public schools. After the Civil Rights Movement in the 1960s, individual lawsuits were filed that compelled public school districts to consider the right of minorities and those with physical, emotional, and/or behavioral disabilities to obtain a publicly-funded education. This litigation resulted in the enactment of federal legislation tied to the funding of public schools. Public Law 94-142, the Education of All Handicapped Children, was the first piece of federal legislation that required the public schools to provide free and appropriate educational experiences for children with specific emotional, learning, and behavioral difficulties. States that did not comply with this 1975 mandate risked losing federal funding (Jacob-Timm & Hartshorne, 1994).

Although children who lack impulse control, demonstrate motor excesses, and display inappropriate attentional capacities compared to peers are not specifically mentioned in Public Law 94-142, they are included in broader anti-discrimination

legislation that requires the free and appropriate education of all children. Anti-discrimination laws such as Section 504 of the Rehabilitation Act of 1973 require that disabled individuals must be hired in all publicly funded institutions. This piece of legislation is more broadly interpreted to include the education of handicapped children including those with AD/HD in the public schools. Although not tied to federal funding as described above, public schools are required to make modifications that would allow children with all types of disabilities to attend. Section 504 modifications for children with emotional or behavior problems include: extended time on tests, individual testing in separate locations, the use of scribes for children who have writing difficulties, and having test directions and questions read to impaired students (Jacob-Timm & Hartshorne, 1994). Generally speaking, the Civil Rights movement fueled the attempts of citizens to ensure that children with special needs, including those with AD/HD, would receive equal educational opportunities that would be paid for by the state.

The History of the AD/HD Diagnostic Category

The diagnosis of disorders similar to that which we now call AD/HD has had a long history in the annals of education and psychiatry (Arnold & Jensen, 1995; Barkley, 1998).

In the early part of the 20th century, George Still (1902) identified a group of children who were highly distractible and overactive. Such children were commonly labeled "Fidgety Phil " in early medical journals. Similarly, patients with a disorder known as Von Economu's Encephalitis were described as having motor overactivity and difficulty sustaining attention for more than a short time (Arnold & Jensen, 1995). Another

syndrome that was characterized by these encephalitis-like symptoms was later labeled Minimal Brain Disorder. However, when electroencephalograms revealed no brain damage in adults with these symptoms, the disorder was re-named Minimal Brain Dysfunction (Arnold & Jensen, 1995). The latter title implies a functional rather than structural etiology for the symptoms of distractibility, overactivity, and lack of impulse control.

Early diagnostic systems such as the Diagnostic and Statistical Manual - second edition (DSM-II, APA, 1968) and the Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death- sixth edition (ICD-6; World Health Organization, 1968) attempted to classify and organize medical and psychological syndromes for the purposes of standardizing the nomenclature. The DSM-II presented a new classification with symptoms similar to those found in descriptions of Von Economu's Encephalitis and Minimal Brain Disorder/Dysfunction - Hyperkinetic Reaction of Childhood. The term "reaction" was employed to indicate the presumed psychosocial etiology of the disorder. This conceptualization was changed in 1980 with the publication of the third edition of this manual. The DSM-III (APA, 1980) was touted as being grounded in empirical study and used operational criteria to make diagnoses. This revision resulted in the re-labeling of the syndrome in terms of deficits in attention - Attention Deficit Disorder (ADD). In this version of the manual, difficulties maintaining attention over extended periods of time or focusing on relevant stimuli took precedence over symptoms associated with hyperactivity. When accompanied by excessive motor activity, the classification Attention Deficit Disorder with Hyperactivity (ADD/H) was

given. Attention Deficit Disorder Without Hyperactivity (ADD/WO) was the label given when hyperactivity was not a significant part of the symptom picture. Moreover, the DSM-III ADD classification represented an important shift in the understanding of the disorder. Whereas the DSM-II Hyperkinetic Reaction of Childhood emphasized a psycho-social perspective, the DSM-III classification (Attention Deficit Disorder) highlighted the cognitive deficits associated with the syndrome.

The DSM-III-R (APA, 1987) unitary conception of this syndrome gave equal weight to inattention, impulsivity, and hyperactivity symptoms. Positive endorsement of any 8 of the 14 symptoms listed in the manual was considered indicative of the presence of Attention-Deficit Hyperactivity Disorder (ADHD). One form of this disorder — undifferentiated ADHD— was primarily characterized by inattention symptoms. This form of the disorder was not well studied but its inclusion in the diagnostic manual reflected research indicating that attention deficits might be diagnosed in the absence of motor overactivity.

Consistent with factor analyses of AD/HD symptoms (Bauermeister, Allegria, Bird, Rubio-Stipec, & Cannino, 1992; Frick, Lahey, Applegate, Kerdyk, Ollendick, et al., 1994), the DSM-IV (APA, 1994) returned to the notion of separate dimensions of this disorder. The two-factor solution found by Frick and his colleagues (Frick et al., 1994) is consistent with DSM-IV criteria such that inattention and hyperactive/impulsive factors are considered to be distinct entities. These two symptom domains resulted in the three subtypes of AD/HD that are currently in use: predominantly inattentive, predominantly hyperactive/impulsive, and combined inattentive/hyperactive/impulsive subtypes. These

factor analytic findings challenge previous (DSM-III-R) conceptions of AD/HD as a unitary disorder and stress the heterogeneity inherent in the overall classification.

In summary, it is only recently that children have been considered to have the potential to suffer with emotional disorders similar to those found in adults (see Kovacs, 1996). The importance of studying these disorders in order to devise interventions cannot be overstated. The study of AD/HD and other forms of child pathology, however, is fraught with difficulties. One such difficulty— finding the appropriate means to assess the presence of this disorder— is discussed in the following chapter.

Chapter 3

Assessment Issues

In 1975, Public Law 94-143 also known as the Education of All Handicapped Children Act, was enacted to provide free and appropriate educational opportunities to children with all kinds of disabilities. This law was the first to make public education accessible to children with physical, developmental, and behavioral disorders. Whereas such children were formerly educated separately from their unaffected peers in special schools or at home, laws that mandated equal access to public education increased the likelihood that disabled children would be educated alongside of their non-disabled peers. As a result, a growing need to determine the best way to obtain data that would allow for an appropriate classification of childhood disorders ensued. Unlike psychiatric diagnosis that is based on DSM criteria, the purpose of educational classification is twofold: to determine whether the child qualifies for special services and to match the child's particular pattern of strengths and weaknesses with specific school-based interventions. Appropriate and timely classification was mandated to enable children with emotional, behavioral, and physical disabilities to function maximally in educational settings that were deemed most similar to those of their unimpaired peers (i.e., in the least restrictive environment; Jacob-Timm & Hartshorne, 1994).

Subjective Measures

The use of standardized, paper-and-pencil measures is common in the identification of children with activity, attention, and impulsivity problems. The following is a description of the various types of subjective measures and the issues surrounding

their use.

Rating Scales, Checklists, Questionnaires, and Interviews

Standardized measures that are commonly used to assess AD/HD in schools, clinics, and for research purposes have particular advantages and disadvantages. Ratings scales and checklists are brief, cost effective, and easily scorable (Conners, 1998) particularly when computerized scoring programs are used. Some of these measures (Kamphaus & Frick, 1996) contain validity scales that are used to assess the tendency for the respondent to "fake good" making the child seem unimpaired or "fake bad" making him or her seem disturbed. The ease of administration and the low cost of these measures make them highly attractive as part of a diagnostic battery. As with any other single measure, the use of ratings scales alone is not recommended for diagnostic or placement purposes (Kamphaus & Frick, 1996; Sattler, 1992).

Several investigators (Achenbach & Edelbrock, 1983, 1986, 1991; Reynolds & Kamphaus, 1998) have demonstrated the utility of rating scale systems with related forms for different respondents as a means to obtain cross-informant measures of children's behavior and functioning. One omnibus measure that has been widely used in the assessment of children's deportment and affect was originally developed by Achenbach and Edelbrock (1983). The Achenbach system includes separate child (Youth Self Report, YSR; Achenbach & Edelbrock, 1991), parent (the Child Behavior Checklist, CBCL; Achenbach & Edelbrock, 1983), and teacher questionnaires (Teacher Report Form, TRF; Achenbach & Edelbrock, 1986). The Achenbach system yields broadband externalizing and internalizing dimensions as well as specific clinical scales (i.e., withdrawal,

inattention/passivity, etc.). The externalizing domain consists of items that are consistent with the disruptive behavior disorders (i.e., Oppositional Defiant Disorder, AD/HD, and Conduct Disorder) whereas the internalizing dimension covers mood and anxiety symptoms. Importantly, the Achenbach rating scales have been used as criterion measures in the development of newer instruments (see Reynolds & Kamphaus, 1998). While the literature indicates that rating scales, questionnaires, and behavioral checklists generally have adequate psychometric properties, these assessments rely on the retrospective reports of informants that are subject to forgetting, distortion, and bias (Sattler, 1992). As such, these measures are never used exclusively in diagnosis or educational placement decisions.

Interviews are commonly used in making clinical or research diagnoses. As part of a multi-informant/multi-method clinical assessment battery, interviews are well suited for determining the extent of children's behavioral difficulties and the extent to which the diagnostic criteria are met. In-depth diagnostic interviews are more time consuming and costly than ratings scales and questionnaires. Therefore, they are not used as extensively as part of school-based assessments.

Interviews are generally classified as being in one of three formats: structured, semi-structured, and unstructured or clinical.(McClellan & Werry, 2000). Structured diagnostic interviews are administered in a standardized manner. The consistency of administration procedures is designed to increase the reliability of the measure, and thus makes this method of data collection ideal for research purposes. Structured interviews also contain closed-ended "yes" or "no" questions that are read verbatim by the interviewer. This feature facilitates scoring. Complete coverage of particular DSM

symptom domains is assured as these interviews generally adhere to the DSM diagnostic criteria. The standardized nature of structured interviews allows for administration by non-clinicians, an economical method compared to employing experienced clinicians to administer clinical interviews. The standard administration procedures inherent in structured interviews also ensure that all relevant probes are queried. Diagnoses are then made by a scoring algorithm that is consistent with DSM criteria and accounts for all the data. Like questionnaires and rating scales, interviews are also subject to the bias and inaccuracies associated with retrospective reports of children's behavior. Additionally, the lengthiness of these interviews can be a disadvantage. Although dependent on the number of items endorsed by the informant, the average administration time for a structured interview is more than one hour (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000). Thus, structured interviews are rarely used in the school setting.

Unstructured and semi-structured interviews allow the interviewer greater freedom to probe and clarify the informant's responses. Although unstructured clinical interviews lack standard administration and scoring procedures, the unique nature of the patient's problems may be more thoroughly examined using this less structured format. Unlike structured interviews, unstructured and semi-structured interviews have no or few pre-determined items. The effectiveness of the clinical interview, therefore, is based solely upon the ability of the clinician (Sattler, 1992). The savvy clinician using an unstructured interview, for example, may discover important information that can inform treatment. The disadvantage of this format is that interviewer biases may influence diagnostic outcome (McClellan & Werry, 2000; Sattler, 1992). For example, there may be an

increased tendency for clinicians to prematurely formulate diagnoses based on the interviewee's initial responses to unstructured interview questions (Sattler, 1992). Early diagnostic decision-making may preclude asking about symptoms of other disorders that might better describe the patient's condition or identify potential co-occurring conditions. The importance of extensive training and experience in clinical interviewing cannot be overstated for the appropriate administration of clinical interviews.

Structured and unstructured diagnostic interviews may also be viewed in terms of who is making the diagnosis. In their introduction to a series of articles on the Diagnostic Interview Schedule for Children (DISC), a structured psychiatric interview, McClellan and Werry (2000) point out that interviews vary not only in terms of the amount of structure imposed on the interview situation (i.e., closed- *vs.* open-ended questions) but also in the amount of input that the interviewer has in making the diagnosis. According to these authors, highly structured interviews require little clinical input in the diagnostic process. Interviewers simply read the questions verbatim and then score responses "yes" or "no." Thus, diagnosis using a structured interview is said to be interviewee- rather than clinician- or interviewer-based. Here, the scoring algorithm produces a classification based on the informant's responses. Furthermore, interviewers are not permitted to probe the interviewee's responses for more information unless specific probes are part of the protocol. Clarification of items is also not permitted. As such, interviewee misunderstandings are not resolved and the resulting responses may be inaccurate (Shaffer et al., 2000).

In contrast, semi-structured and unstructured clinical interviews rely on the

interviewer to make the diagnosis. This interview format allows the clinician to probe interviewee responses that are not clear and to ask questions in different ways to ensure that the interviewee understands what is being asked. While this non-standard administration may be problematic in research protocols where generalization of the results is important, when used for clinical purposes, such interviews may shed more light on the nature of the individual's problems. Although clinician-determined semi- and unstructured interviews free the interviewer to pursue areas of inquiry that may be most revealing regarding the client's problem, this method is more susceptible to interviewer error and biases as noted previously. The decision regarding the best format to use is therefore dependent on the purpose of the interview.

Multi-informant assessment. As discussed previously, the use of various assessment procedures derived from different informants is considered to be "best practice" in the identification of childhood emotional and behavior problems both in school (Landau & Burcham, 1995; McConaughy & Ritter, 1995; Zentall, 1993) and clinical (Arnold & Jensen, 1995; Swanson et al., 1999) settings. Among school-based populations, such assessment is mandated by the reauthorized Individuals with Disabilities Education Act — a more recent version of the original Education for All Handicapped Children Act (PL-94-142). Data derived from varied perspectives (i.e, teacher, student, parent) provide a wealth of information about the child's functioning across settings. Cross-informant data may also indicate the extent of the child's impairment (i.e., severity) and/or the consistency (i.e., pervasiveness) of the problem. An assessment of the severity and pervasiveness of the child's symptoms may be of great utility in educational (i.e., class

placement, curriculum modifications) and intervention (i.e., remediation) planning.

Specific to the diagnosis of AD/HD, multi-informant data are useful in determining if a child meets the DSM-IV criteria that require cross-situational (i.e., home, school) and multiple areas (i.e., social, academic) of impairment (APA, 1994). Additionally, the DSM-IV requirement that there be at least some impairment due to symptoms before the child's seventh birthday necessitates the input of parents or other early caregivers. All of these diagnostic criteria are addressed by the use of multiple sources of information. The following sections provide a review of studies that have examined the utility of multi-informant assessment in the identification of the core features of AD/HD.

Parents and teachers each have unique perspectives on child behavior and functioning (Conners, 1998). Teachers have the advantage of an available normative comparison group on which they may base their ratings of a particular child. In effect, the target child's non-affected peers serve as the comparison group on which teacher assessment is based (Conners, 1998; Sattler, 1992). Parents, on the other hand, may have more opportunities to observe their child in a number of less structured situations, whereas teacher reports generally reflect behavior in a highly structured setting (i.e., the classroom). Given these different perspectives regarding child functioning, it is not surprising that parent and teacher reports and ratings of children's behavior are frequently discrepant (Bidaut-Russell et al., 1995; Mitsis et al., 2000; Sawyer et al., 1992).

Multi-informant assessments may also include the target child's self-report of symptoms. Children may be an important source of information particularly regarding covert conduct disorder symptoms (Pelham, Gnagy, Greenslade, & Milich, 1992) such as

stealing, vandalism, arson, and other behaviors that are not typically displayed in the classroom or at home. The validity of children's reports, however, has been questioned by several investigators (Edelbrock, Costello, Dulcan, Kalas, & Conover (1985); Schwab-Stone, Fallon, Briggs, & Crowther, 1994). These researchers suggest that children who are younger than 11 years may be limited in their ability to give consistent and accurate reports particularly on interviews that ask for temporal information such as the duration or onset of symptoms (Edelbrock et al, 1985; Schwab-Stone et al., 1994). As such, children's responses on the DSM-III-R-based Diagnostic Interview Schedule for Children-Revised (Shaffer, Schwab-Stone, Fisher, Cohen, Piacentini, et al., 1993) were found to have poor to fair test-retest reliability for AD/HD and separation anxiety disorder respectively. Schwab-Stone and her colleagues (1994) suggest that immature cognitive abilities and difficulties in their ability to reflect on their own behavior may reduce the reliability of the reports of children ages 6 to 11 years of age. Edelbrock and his co-investigators (Edelbrock et al., 1985) came to a similar conclusion in an earlier study of children's self-reports using the same structured diagnostic interview.

Inter-informant agreement. Although multi-informant assessment provides useful information for the purposes of diagnosis and classification, limited concordance among the ratings and reports of various respondents has been well documented (Bidaut-Russell et al., 1995; Mitsis et al., 2000; Sawyer et al., 1992; Swanson et al., 1999; Verhulst & Akkerhuis, 1989). Importantly, several authors (Barkley, 1998; Swanson et al., 1999) conclude that these discrepancies may not be artifactual. Discrepant ratings and reports may reflect actual differences in children's behavior that are associated with the various

behavioral expectations and varying amounts of structure embedded in each setting (Swanson et al., 1999).

Several studies of disruptive child behavior using the Achenbach questionnaires (i.e., CBCL and TRF) found statistically significant low to modest correlations among parent and teacher ratings of broadband internalizing (i.e., anxiety, mood disorder symptoms), externalizing (i.e., aggression, hyperactivity), and individual symptoms (Briggs-Gowan, Carter, & Schwab-Stone, 1996 Verhulst & Akkerhuis, 1989). Significant intraclass correlations indicating parent and teacher agreement were in the range of .17 to .32 and .24 to .50 for internalizing and externalizing scales respectively (Briggs-Gowan et al., 1996). Briggs-Gowan and her co-investigators (1996) found the highest informant correlations among ratings of observable problems such as speech difficulties and obesity in 4- and 5-year-old children. In older children (ages 6 to 12), parents and teachers were more likely to agree on symptoms related to conduct disorder (i.e., fighting in girls; r = 0.11 and boys; r = 0.35; Verhulst & Akkerhuis, 1989). The low magnitude of these statistically significant Pearson Product Moment correlations suggests a tenuous relationship between the ratings of parents and teachers. One reason for the low magnitude of these correlations was offered by Barkley (1998). He concluded that low inter-rater agreement coefficients may be the result of a restriction of range that places a ceiling of approximately .70 on such correlations. As a result, relationships that would normally be assessed as moderate (r =.50) may in effect be substantial. As such, inter-rater agreement may be much greater than previously believed. It should be noted, however, that among the studies cited here, the highest correlation between parent and teacher

AD/HD ratings was generally less than .40 (see, Briggs-Gowan et al., 1996, Verhulst & Akkerhuis, 1989). If, as Barkley suggests, .70 is the highest possible correlation that may be attained, then these studies indicate that cross respondent agreement on children's AD/HD symptoms is, at best, only modest.

Studies suggest that particular factors may influence the documented limited correspondence in reporting children's behavioral problems. These factors include the nature of the syndrome or behavior (i.e., internalizing/covert symptoms, externalizing/overt symptoms; Briggs-Gowan et al., 1996, Loeber et al., 1991; Sawyer et al., 1992), the nature of the sample (i.e., clinic referred *vs.* community; MacLeod et al., 1999) and proband characteristics such as age and gender (Verhulst & Akkerhuis, 1989).

Several investigations of childhood disruptive behavior disorders revealed significant similarities among the reporting patterns of children and adults depending on the nature of the target problem (Briggs-Gowan et al., 1996; Loeber et al., 1991; Sawyer et al., 1992). For instance, in one community sample (Loeber et al., 1991), the prevalence of overactive, inattentive, and oppositional behaviors was significantly lower when assessed by children *vs.* adults using an early version of the Diagnostic Interview Scale for Children (Costello, Edelbrock, Dulcan, Kalas, & Klaric, 1984). In contrast, this same study found that serious conduct problems such as school suspension and aggression were consistently reported regardless of informant. Similarly, Loeber et al. (1991) and Briggs-Gowan and colleagues (1996) found significantly greater agreement among informants' reports of externalizing compared to internalizing symptoms. This pattern was found despite the low to moderate overall intraclass correlations between parent and

teacher reports of children's internalizing and externalizing symptoms. These findings suggest that agreement among informants improves when serious conduct and externalizing problems are targeted. Oppositely, greater disagreement characterizes the ratings of less serious externalizing (e.g., inattention) and internalizing (i.e, worry) symptoms (Briggs-Gowan et al., 1996; Loeber et al., 1991).

In terms of internalizing disorders such as anxiety and depression, Sawyer et al. (1992) found greater consistency among the reports of different respondents as a function of the gender of the proband. Irrespective of the type of sample from which subjects were drawn, significant differences in the mean ratings of internalizing symptoms characterized the ratings of mothers and their sons as well as teachers *vs.* their male pupils. Moreover, males in the clinic group self-reported significantly higher rates of internalizing symptoms compared to their teachers. This result is consistent with that of Briggs-Gowan et al. (1996) who found that boys tended to self-report more internalizing symptoms than adult respondents. Furthermore, when sample type was considered, the mean difference between boys' self-reports and mothers' reports of their sons' internalizing symptoms was significantly larger in the community compared to the clinical sample. The Briggs-Gowan et al. study suggests that boys' internalizing symptoms may be less apparent to mothers of non-referred *vs.* referred boys. Greater concordance, however, was found between mother/daughter and teacher/female pupil ratings of internalizing symptoms. Significant concordance for internalizing symptoms was found between adult and child ratings in both referred and non-referred samples of female students. One may therefore conclude that non-referred boys may express anxiety or depression in a more subtle manner, such that it

is not identified by mothers or teachers. Female adolescents, on the other hand, may be more likely to openly express internalizing problems to mothers and teachers regardless of their clinical status. Differences in the socialization patterns among males and females in Western society may, in part, account for these findings.

Informant agreement on the presence of broadband internalizing and externalizing symptoms has also been shown to be a function of the age and gender of the target child (Verhulst & Akkerhuis, 1989). Comparatively speaking, higher inter-informant correlations were found for internalizing symptoms (i.e.: shy, moody, fearful) among 4- and 5-year-old boys than for 4- and 5-year-old girls or older children of either gender (Verhulst & Akkerhuis, 1989). Verhulst and Akkerhuis (1989) also found that parent and teacher ratings of older school-aged children (6 to 12 years) were significantly correlated but only on measures of externalizing symptoms. Although considered to be relatively high, these significant correlations fell in the poor to modest range ($r = 0.11$ to 0.42). The highest correlation between adult respondents was demonstrated for the item "overweight" ($r = .58$) but only when it was applied to female participants ages 6-12 years (Verhulst & Akkerhuis, 1989). These results suggest that particular symptoms, behaviors, and child characteristics (i.e., moodiness in young boys, weight in older females) are more socially salient depending on the age and gender of the proband and therefore differentially influence agreement among informants.

One may further conclude from the above-mentioned studies that inter-informant agreement is due to the differential impact of particular symptoms. For example, overactivity and inattention may not be recognized as problematic behavior by the child

but may be identified more frequently as deviant behavior by adults, particularly when these behaviors are viewed as annoying or intrusive. As a result, parents and teachers, but not children, may be more likely to agree on the presence of these symptoms. In contrast, salient symptoms such as school suspension and physical aggression are less likely to be ignored or dismissed by children and may foster agreement among child and adult informants.

Based on the literature cited above, it is plausible that behaviors that are associated with the AD/HD hyperactive/ impulsive subtype (i.e., excessive motor movement, noisiness) will elicit greater agreement from various informants than less disruptive behaviors such as inattention, distractibility, and "off task" behavior that characterize AD/HD inattentive subtype. Importantly, the relationships among the reports and ratings of parents, teachers, and children, while statistically significant, have been described only in relative terms (i.e., more agreement on conduct disorder symptoms than internalizing symptoms). Finally, the correlations cited, while significant, are considered to be modest.

Aside from the influences of the nature of the symptom (e.g., internalizing *vs.* externalizing) and participant characteristics (e.g., sex and age), informants' ratings of child behavior have been demonstrated to vary as a function of the population from which children were sampled (MacLeod et al, 1999; Sawyer et al., 1992; Weiler et al., 1999). In one Australian study (Sawyer et al., 1992), for example, clinic-referred children received higher ratings of behavior problems compared to children from a community sample. This is not surprising considering that clinic-referred children are typically perceived as more impaired than those from the general population regardless of informant. Similar to the

findings of Loeber et al. (1991) and Verhulst and Akkerhuis (1989), Sawyer and his co-investigators found that overall agreement among parents and teachers was greatest for externalizing compared to internalizing symptoms regardless of the sample from which children were drawn. However, as compared to the self-reports of clinic-referred children, parents and teachers rated referred children higher on the externalizing domain that included AD/HD symptoms. In contrast, when the community sample was examined, all respondents (i.e., teachers, parents, and children) gave consistently low ratings of externalizing behaviors (Sawyer et al., 1992). One may therefore conclude that referred children will receive consistently high ratings of externalizing symptoms on parent and teacher ratings, whereas non-referred children will tend to receive low ratings on these dimensions regardless of informant. Greater consistency in the assessment of externalizing symptoms is apparently due, in part, to the nature of the sample (i.e., clinic *vs.* community).

Based on the studies cited above, it is expected that parents and teachers will not agree on symptoms of inattention such as distractibility, inability to complete tasks, lack of perseverance on repetitive tasks, and other related behaviors. It is also expected that children will receive higher teacher ratings of inattention problems compared with those of their parents. This discrepancy is expected because attention difficulties are more likely to impact the child's functioning in school than at home. Furthermore, overactivity and the lack of impulse control will elicit more agreement between raters because of the saliency and overt nature of these behavior regardless of setting.

In contrast to the above-mentioned studies, several investigators have indicated

that parent endorsement of a behavior disorder was found to be highly predictive of teacher reports of the same disorder. This effect was noted for individual DSM-III (Biederman, Keenan, & Faraone, 1990) and DSM-III-R symptoms (Biederman, Faraone, Milberger, & Doyle, 1993; Zeiner, 1997) as well as symptom clusters such as hyperactivity, impulsivity, and inattention (Biederman et al., 1990; Biederman et al., 1993). Evidence of parent and teacher correspondence regarding the behavior of children with attention and activity problems was demonstrated in three studies that employed a categorical approach to data analysis (Biederman et al., 1990; Biederman et al., 1993; Zeiner; 1997). In a sample of referred boys and girls between the ages of 4 and 17 Biederman and his colleagues (1990) used Positive Predictive Power (PPP) to assess the ability of parent identified DSM-III ADD to predict teacher-based ADD diagnoses. Based on reports ascertained via structured interviews, these investigators found that 90% of the cases were consistently identified by both informants. Further, this result was replicated in a later study using DSM-III-R criteria (Biederman et al., 1993).

The use of PPP rather than correlations makes sense because this method is consistent with the way in which clinicians and school psychologists make decisions about diagnosis and classification (Biederman et al., 1990). In diagnosis, PPP is used to determine if one can predict the presence of a disorder based on the presence of a single symptom. In this series of studies, however, PPP was calculated to determine inter-rater reliability. Here, PPP is the probability that parent reports of hyperactivity, impulsivity and inattention predict positive teacher reports of these symptoms. The PPP statistic may also yield a more accurate analysis because, unlike correlations or other statistical

methods, it accounts for base rates of the symptom or disorder in the sample (Biederman et al., 1990).

A similar study of referred boys by Zeiner (1997) reported a PPP of 80% for DSM-III-R symptoms of AD/HD. Unlike the Biederman studies, Zeiner employed a more comprehensive diagnostic procedure including rating scale, questionnaire, and structured interview data. Zeiner reported that Phi Correlations between parent and teacher reports of individual symptoms were low (r = .00 to .30) and nonsignificant. In addition, Negative Predictive Power (NPP), the likelihood that the absence of parent-based endorsement of AD/HD would predict the absence of the disorder according to teacher reports, was, on average, 43%. Taken together, these results indicate a high probability that parent reports predict teacher reports of the presence of a disruptive behavior disorder like AD/HD. However, the probability that parents can predict the absence of the teacher-reported disruptive behavior is poor (Zeiner, 1997). Despite the authors' conclusions, these data suggest that there is limited agreement between parents and teachers regarding children's behavioral difficulties.

Although results from the above-mentioned studies might argue for single informant assessment, at least one study by Mitsis and her colleagues (2000) found that parent reports of children's classroom behavior did not predict teacher endorsements of AD/HD symptoms in the school setting. Like the Biederman et al. studies, symptoms of AD/HD were assessed using teacher and parent versions of a structured psychiatric interview. Mitsis and her colleagues, however, examined DSM-IV subtype criteria using a referred sample. Modest conditional agreement (74%, k = 0.20) was noted for AD/HD

any subtype, whereas agreement was 31% for AD/HD Combined subtype diagnoses. Inter-informant agreement in the identification of Hyperactive/Impulsive (H/I) and Inattentive (INATT) subtypes was poor and agreement was found for only one and two children respectively. Furthermore, when parent reports of AD/HD symptoms at home were statistically controlled, agreement on INATT and H/I symptoms remained modestly, but significantly, correlated ($r = .28, p < .05$). These correlations are consistent with those found by others (Briggs-Gowan et al., 1996; Verhulst & Akkerhuis, 1989) and suggest that the data obtained from parents is not reflective of the child's behavior in the school setting. It would be interesting, however, to compute PPP and NPP for the Mitsis et al. data in order to compare these results with that of Biederman et al. and Zeiner.

In examining the underlying causes for the disparity among parent and teacher assessments of children's behavior, Mitsis et al. (2000) found that parents report more home- than school-related symptoms whereas teachers report more school-related symptoms. Mitsis et al. concluded that since parent reports of H/I and INATT symptoms in school are more highly correlated with their reports of at-home behavior, they may be erroneously assuming that behaviors that occur at home are also present in school. It is therefore possible that negative haloing may be characteristic of parent reports of children's behavior at school.

Informant agreement may also be impacted by characteristics of the respondent. For example, rater biases may spuriously alter perceptions of children's behavior that could result in a child being rated more or less favorably. Rater biases have been found to characterize teacher (Kazdin et al., 1983; Schachar et al., 1986) as well as parent (Mitsis

et al., 2000) ratings and interview responses. As such, the validity of the ratings and reports of adult informants may be questionable.

Some studies have indicated a tendency for teachers to give biased reports of their students' deportment. Two studies (Kazdin et al., 1983; Schachar et al., 1986) that compared direct observations and retrospective teacher ratings of children's classroom (Kazdin et al., 1983; Schachar et al., 1986) and play (Kazdin et al., 1983) behavior indicated the presence of "negative halo effects" on teacher ratings of children with problem behavior. Kazdin et al. (1983), for example, found that observers who were naive to teacher, target child, and school characteristics tended to agree with each other more often than with teachers when identifying student problem behaviors. This occurred despite the fact that observations were conducted using a one-way mirror to limit reactive changes in teacher or student behavior. Moreover, observer agreement was considerable even though these assessors were not permitted to confer with each other. Kazdin and his collaborators found that teachers gave their students higher ratings on the Inattention-Passivity, Conduct Problems, and Total Problem domains of the Conners Teacher Rating Scale (CTRS) compared to outside raters who used the same measure. Teachers and raters did agree, however, that all children were more deviant during structured work compared to unstructured (i.e., free play) periods (Kazdin et al., 1983). Kazdin et al. concluded that teacher ratings may have been influenced by teachers' past experience with students rather than by current student behavior.

A similar study by Schachar et al. (1986) found that both a teacher questionnaire based on direct observations (the Direct Observation Questionnaire; DOQ) and the CTRS

were more highly correlated for dissimilar than for similar cross-scale items. In this study, CTRS Hyperactivity scores and DOQ ratings of activity were found to be more highly correlated with negative teacher-pupil interactions than with observed fidgeting or other forms of motor excess. Schachar et al. suggested that teacher ratings of student activity level are better predicted by student-teacher conflict than by direct observation of the child's motor activity. Taken together, the Kazdin et al. and Schachar et al. studies suggest that teachers may generalize negative ratings of children to unaffected domains of their behavior resulting in negative haloing. This effect speaks to the need for multiple informants of child behavior to counteract these potential biases (see Conners, 1998).

The above-mentioned findings of teacher rating biases should be interpreted with caution. Although it is reasonable to assume that behaviors associated with AD/HD will be evident upon direct observation, this method is not a "gold standard" criterion by which AD/HD or any other behavior disorder can be measured. Indeed, observers may also have biases. "Criterion drift" or a change in the operational definition of the target behavior during observation, may have resulted in inaccurate data in the studies cited above (Sattler, 1992). Additionally, the potential for reactivity to classroom observers in the Schachar et al. study, may have spuriously influenced these data (Sattler, 1992). The presence of an observer in the classroom may have caused reactive changes in the teacher and/or target child's behavior that may have influenced the outcome of the observation.

The question of the validity of parent and teacher reports must play a role in determining a child's diagnosis. As indicated previously, halo effects may impact on teacher (Kazdin et al., 1983; Schachar et al., 1986) and parent (Mitsis et al., 2000) reports

and ratings of children's behavior. Validation of parent and teacher reports of disruptive behavior symptoms with external criteria was attempted in a longitudinal study of 946 Dutch children ages 4 to 11 years by Verhulst, Koot, and van der Ende (1994). These investigators found that parent and teacher ratings of ODD and CD were highly correlated with police contacts and school suspensions six years after children were initially rated. However, no significant correlations were found between parent and teacher endorsements of AD/HD symptoms and fidgeting, motor movement, or school failure six years later. It is not known if fidgeting and school failure are appropriate outcome criteria to determine the predictive validity of AD/HD because these behaviors are also associated with other conditions (i.e., Anxiety, Conduct Disorder, etc.).

In summary, although multi-informant assessments have been touted as "best practice" in clinical (Swanson et al., 1999), school (Zentall, 1993), and research (Barkley, 1998) examinations of AD/HD symptoms, there are several problems inherent in this technique. First, the data from adult respondents (i.e., teachers and parents) have demonstrated low to moderate inter-informant correlations. Second, disagreements among children and their parents, children and their teachers, and the limited validity of child self-reports of symptoms and temporal factors that are used to make diagnoses have resulted in a limited reliance on ratings and reports of children younger than 11 years. Third, the literature cited above suggests proband characteristics such as age and gender and the saliency or disruptiveness of the symptoms as judged by the informant may contribute to the consistency of adult informant ratings and reports of children's behavior. Lastly, adult respondent reports may be biased such that teachers and parents generalize

children's behavior in one setting or situation to other settings or situations.

Incorporation of parent and teacher data. The problem of presumably valid but disparate ratings and reports of various informants requires a determination of how best to integrate potentially conflicting information in the diagnosis or classification of the target child. In the diagnosis of an individual child, clinical judgement often serves to integrate disparate ratings and reports. For the purposes of research, however, Barkley (1998) and Swanson et al. (1999) suggest that respondent discrepancies not be ignored. However, the best method for incorporating discrepant information is not clear (Barkley, 1998; Offord et al., 1996; Piacentini, Cohen, & Cohen, 1992; Swanson et al., 1999).

Consistent with the conclusion that parent and teacher reports each reveal unique and equally valid information, a simple combinatorial algorithm has been used in a majority of studies. Diagnoses based on this conclusion are said to use the "or" rule where a symptom is considered present if it is endorsed by any respondent. Piacentini and his colleagues (1992) found that giving equal weight to all informants' reports by combining reports and ratings of all respondents was just as or more effective in diagnosing disruptive behavior disorders than using more complex algorithms where some respondents' reports were differentially weighted. However, conflicting reports were presented by other researchers (Offord et al., 1996; Verhulst et al., 1994). In validating the diagnoses of Conduct (CD), Oppositional Defiant Disorder (ODD), and AD/HD, Verhulst and his team (1994) found that combined parent and teacher information improved the power to predict outcome for CD and ODD six years after the initial evaluation. However, when AD/HD diagnoses were based on combined reports, there

was no improvement in the prediction of dysfunction six years later. Similarly, a study by Offord et al. (1996) using a general sample of children ages 6 to 16, found that parent-identified CD and ODD were distinct from teacher-identified disorders in terms of associated features such as the child's gender, SES, and parent mental health status. When cross-informant information was used, this unique pattern of associated features was obscured. Based on these findings, the authors concluded that the combined use of positive symptoms endorsed by either informant reduced the validity of the diagnosis. The authors further suggested that a valid diagnosis must be based on the separate reports and ratings of each individual respondent. In other words, separate teacher-based and parent-derived disorders should be established. Offord and his colleagues, however, studied only ODD and CD. It is not known if this loss of information will occur when combined teacher and parent data are used to identify AD/HD symptoms.

Objective and Analogue Measures

In an attempt to make valid and reliable assessments of AD/HD symptoms, more objective measures have been employed in schools, clinics, and research protocols. Classroom observations, for example, are conducted to sample typical child behavior in the environment in which problems have been noted. In addition, time sampling procedures where behavior is coded immediately after it is observed have been used in conjunction with observations to validate paper-and-pencil assessments that are commonly used to make AD/HD diagnoses (Barkley, 1991). Observations are generally considered to be more direct measures of student deportment. However, observation, as it has been conducted in research, requires much time and effort to train observers to a high level of

reliability and to continuously check inter-rater consistency to insure that there has been no "criterion drift" or gradual change in the operational definitions of the target behaviors (Kazdin et al., 1983, Sattler, 1992). Furthermore, observations in the typical classroom are rarely done in an unobtrusive manner. Therefore, classroom observations that are conducted in regular education schools may be tainted by reactivity (Sattler, 1992) such that the presence of the observer in the classroom may elicit atypical child or teacher behavior. As a result, the behaviors sampled during the observation period may not be representative of the behavior that is being targeted for intervention (Sattler, 1992).

In addition, direct observation of classroom behavior by naive raters has demonstrated little relationship with teacher ratings of children's behavior (Kazdin et al., 1983; Schachar et al., 1986). Although Barkley and others find observation and time sampling procedures to be more ecologically valid and well suited as criterion measures of child behavior (Barkley, 1998), reactivity, criterion drift, and other problems associated with direct observation methods may invalidate findings based on this method.

Objective measures that do not require the input of various informants and directly measure the constructs of interest may offer another option in the assessment and diagnosis of child disorders (W.W. Tryon, 1985). Although these measures are far from perfect in identifying the presence or absence of specific childhood disorders, the face validity, objectivity, and utility of such measures in the diagnostic process may warrant their use (Barkley, 1998). For example, activity recordings made with the use of mechanical devices are presumed to register higher levels of movement in children who are hyperactive than in those who are not. Similarly, tasks that require the child to attend

to stimuli for a long period of time and delay pre-potent responses may be more objective and quantifiable indications of the child's attentional capabilities and impulse control than behavior ratings or other retrospective reports. However, the ecological validity of these laboratory measures has been questioned (Barkley, 1991). As Barkley (1991) points out, analogue measures may be accurate but sufficient construct validity has not been established for many of these instruments. Few analogue measures have demonstrated unequivocal specificity for the constructs that have been hypothesized as being the primary deficits of AD/HD. As such, some researchers (Gordon & Mettleman, 1988; Halperin et al., 1992) have collected normative data for laboratory measures such as the Continuous Performance Test (CPT) and actigraph. Normative data make it possible to compare the activity levels, reaction times, and CPT errors among disordered and non-disordered children. Unfortunately, many objective instruments have insufficient or no norms.

Aside from the limited availability of normative data, there is much variation among the laboratory measures that have been used to quantify children's activity, attention, and impulsivity. Tasks such as the CPT, cancellation tests, differential reinforcement of low rate behaviors (DRL), and matching-to-sample tasks, while purported to measure inattention and impulsivity (Barkley, 1998), are very different from each other. As such, it is possible that these instruments measure different constructs or different aspects of the same construct. Even among CPTs, there are so many variations in the types of stimuli used (e.g., visual, auditory, numbers, letters), the length of stimulus exposure and the interstimulus interval (ISI) that it is difficult to make generalizations about children's attentional capacities and impulse control across studies. Similarly,

standard administration of these more objective instruments is lacking. For example, some studies have the experimenter remain in the room while the CPT is administered whereas others have the child work on the task alone (see van der Meer, Shalev, Borger, & Gross-Tsur, 1995). The presence or absence of the experimenter during the CPT has been demonstrated to differentially affect the outcome of this measure (van der Meer et al., 1995). Thus, the lack of standardized administration may explain some of the differences in the findings among studies that employ this measure.

This study attempted to closely replicate the administration procedures used in prior studies that employed objective laboratory measures (Halperin et al., 1992, Halperin et al., 1993; Matier-Sharma et al., 1995; Reichenbach, Halperin, Sharma, & Newcorn, 1992). However, these administration procedures were employed in a school rather than a laboratory setting. By using different data analysis techniques and behavioral rating scales that are more consistent with DSM-IV definitions of disorder (Reynolds & Kamphaus, 1998), this study was designed to be comparable to previous research and also provide new data on the issue of objective measures in the assessment of AD/HD symptoms.

Analogue Assessment of Inattention and Impulsivity

The Continuous Performance Test (CPT) has been used in AD/HD research as an objective measure of vigilance (Corkum & Siegel, 1993). Early studies incorporated vigilance tasks to assess the accuracy of radar operators in the military. These studies were done to determine how quickly and accurately military personnel could identify targets that were briefly exposed on a radar screen (Barkley, 1998). Receiver Operated Characteristics (ROC) were employed to explain the results of vigilance studies. ROC

measures take into account the operator's sensitivity to detecting targets (i.e., the limits of his/her sensory system) as well as his or her tendency to report targets that are briefly presented (i.e., the threshold level for making decisions about the presence or absence of a stimulus; Banks, 1970). The signal detection paradigm is typically used in research on attention and memory. Hits (correct identifications), misses (non-identifications), false positives (incorrect identifications), and false negatives (incorrect rejections) are the data yielded by such studies. According to Corkum and Siegel (1993), changes in the subject's ability to discriminate targets and the duration of the response time are related to the operator's level of arousal, expectation of a target, motivational level, and other factors. Parasuramen and Davies (1984) found that decrements in vigilance were a function of time on task. The longer the subject was required to be vigilant, the less accurate and slower were his or her target detections. Age and IQ have also been found to influence vigilance in children (Klee & Garfinkel, 1983).

Early neuropsychological studies employed vigilance paradigms to determine the extent of brain damage in adult patients. For example, impulsive behavior and the inability to sustain attention were recognized as characteristics of individuals with particular types of traumatic brain injury. The CPT was therefore used to measure the extent of brain injury in adult patients (Corkum & Siegel, 1993; Barkley, 1998; Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956). As early conceptions of AD/HD identified the etiology of the disorder as some type of brain damage or dysfunction (i.e., Minimal Brain Disorder/ Dysfunction), the CPT and other vigilance tasks began to be used as measures of attention and impulsivity problems in AD/HD. This practice continues in the more

recent studies of this disorder (Inoue et al., 1998).

Previous studies have found significant differences in CPT performance among children with DSM-III ADD or DSM-III-R AD/HD and normal controls (Halperin et al., 1993; Klee & Garfinkel, 1983). However, the discriminant validity of CPT measures in the identification of AD/HD and other child patient groups is equivocal. Even within a similar group of studies (Halperin et al., 1992, Halperin et al., 1993), the ability of the CPT to distinguish among different groups of disordered children (i.e., patients with and without AD/HD) was inconsistent. Differential findings among studies employing CPT and/or actigraph may be related to the use of different samples of children (pure AD/HD *vs.* comorbid groups), differences in the type of task used (i.e., visual *vs.* auditory target detection), stimulus presentation (i.e., the length of inter-stimulus interval and rate of stimulus presentation), and/or the dependent variable used (i.e., commission and omission scores *vs.* inattention and impulsivity scores). As mentioned previously, such differences hamper one's ability to make generalizations regarding the findings in the CPT and actigraph literature.

Mechanical Assessment of Activity

Similar to the CPT studies of inattention and impulsivity cited above, the use of various acceleration-sensitive devices such as actometers, actigraphs, and stabilometric chairs has been common in the AD/HD literature (Barkley, 1998). One such device, the actigraph, is an automated acceleration-sensitive device that stores the electronic signals produced by the subject's supra-threshold movements in its microprocessor's memory. A computer interface is used to activate the device and download the data for subsequent

analysis. Automated activity monitors have been used for their high degree of objectivity to validate subjective diary self-reports of activity and emotional state in adults (Patterson, Krantz, Montgomery, Deuster, Hedges, & Nebel, 1993) and to assess motor activity in children (Halperin et al., 1992, Halperin et al., 1993; Inoue et al., 1998; Matier-Sharma et al., 1995; Porrino et al., 1983; G.S. Tryon, 1997).

In children, actigraph recordings have been shown to distinguish between those diagnosed with AD/HD and those with no diagnosis (Inoue et al., 1998; Porrino et al., 1983). However, the evidence that actigraph measures distinguish between children with AD/HD and other psychiatric groups has been equivocal. For example, in a series of studies by Halperin and his colleagues (Halperin et al., 1992, Halperin et al., 1993), children with AD/HD were found to be more active than other child patient groups in the earlier but not the latter study. The use of a pure, non-comorbid sample in the more recent investigation (Halperin et al., 1993) may account for these disparate results.

There has also been some evidence that actigraph data may be used to examine the discriminant validity of the DSM-IV subtypes of AD/HD. One Japanese study that compared children with AD/HD and those with no diagnosis found that activity level as assessed by waist-worn actigraphs distinguished among various subgroups of AD/HD when used in combination with CPT and a matching to sample task (Inoue et al., 1998). Using objective measures, these investigators also identified subtypes of AD/HD that were somewhat similar to those that have recently been adopted by the DSM-IV psychiatric classification system (APA, 1994). However, a psychiatric control group was not used in this study. Therefore, the validity of the actigraph as a diagnostic measure that can

differentiate AD/HD from other patient groups (Halperin et al., 1993; Matier-Sharma et al., 1995) or AD/HD subtypes from one another (Dane, Schachar, & Tannock, 2000; Inoue et al., 1998) has limited support.

Inconsistencies in instrumentation, methodology, and data analysis characterize the literature on actigraphy. These differences are similar to those cited in the CPT literature. For example, there are many types of actigraphs available for use in research. It is not known if the companies that produce these devices use the same thresholds levels for recording or produce devices that are similarly sensitive to movement. Moreover, the consistency between actigraphs made by the same manufacturer has not been explored sufficiently. One study of adults (Patterson et al., 1993), however, found that different actigraphs had high inter-trial stability for both individual and group activity data. This same study also indicated that actigraph measures were significantly related to physiological measures of arousal including oxygen uptake and heartrate. How, or if, these findings relate to childhood hyperactivity has not been explored.

The literature on objective measures suffers from a lack of standardized administration and data analysis procedures. For example, CPT administration procedures (i.e., experimenter present/absent, duration of the task, duration of stimulus exposure), placement of the actigraph (i.e., waist or wrist worn; truncal placement at the front, side, or back), and the dependent measures used (i.e., CPT commission/omission errors vs. impulsivity/inattention measures that consider latency to respond in addition to errors) have not been consistently employed. Thus, the ability to generalize the findings of these studies and develop overarching theories or hypotheses is limited. As this is the case, this

study attempted to replicate the work of previous studies (Halperin et al., 1992; Halperin et al., 1993; Inoue et al., 1998; Matier-Sharma et al., 1995) as this series of studies has been most consistent in the procedures used to administer laboratory measures (i.e., actigraph placement, CPT instructions).

It is not known whether the results of previous studies of the objective measurement of AD/HD are due to the differences in the instruments themselves or the ways in which the disorder has been conceived (i.e., unitary *vs.* bidimensional models; see Bauermeister et al., 1992; Lahey, et al., 1994). As the definition of AD/HD has changed with each new edition of the DSM, it is possible that the latest refinements in this diagnostic category (DSM-IV; APA, 1994) — in particular, the addition of AD/HD subtypes — may be more consistently identified by objective measures (Inoue et al., 1998). Therefore, the DSM-IV AD/HD diagnostic criteria will be used to define inattention, hyperactivity, and impulsivity in this study.

Summary and Purpose of the Study

As is apparent from the above review of standardized retrospective, analogue, and mechanical methods of assessment of AD/HD symptoms, there is no single instrument that confirms or disconfirms these diagnoses. Furthermore, a recent study (Matier-Sharma et al., 1995) that attempted to use objective measures in the diagnosis of AD/HD subtypes found that actigraph and CPT measures are not appropriate for making differential diagnoses of the disorder. Rather than examine the diagnostic utility of objective measures, this study sought to determine if parent and teacher ratings and endorsements of AD/HD symptoms could predict more direct and less biased measures (PIM activity, CPT

Impulsivity scores, CPT Inattention scores) of the behavior of school-aged children. As such, objective measures were not employed as a "gold standard." Rather, paper-and-pencil methods that have acceptable psychometric properties were used to predict automated measures of inattention, impulsivity, and hyperactivity.

As discussed previously, both standardized measures and automated laboratory assessments have limitations. Pencil-and-paper measures may be subject to biases, distortions, and forgetting on the part of respondents whereas actigraph and Continuous Performance Test measures have limited construct validity (Barkley, 1991; Conners, 1998). Analogue laboratory measures may provide relatively unbiased results that are less susceptible to human error. Moreover, objective assessments may more accurately identify off-task and inattentive behavior as well as subtle motor excesses (e.g. fidgeting) that may foster inconsistent ratings among respondents (Bidaut-Russell et al., 1995; Swanson et al., 1999; Verhulst & Akkerhuis, 1989). CPT and actigraph measures may be more precise and less intrusive ways of collecting data on inattentiveness, fidgetiness, and impulsivity than ratings or interviews. Additionally, significant differences between objective and subjective measures of children's symptoms may serve to alert researchers and clinicians to possible biases and/or inaccuracies in reporting on standardized paper-and-pencil measures.

The purpose of this study was to validate CPT and actigraph measures against more psychometrically established standard measures of AD/HD such as the Diagnostic Interview Schedule for Children (DISC), the Behavior Assessment System for Children (BASC), and the Diagnostic Rating Scale of DSM-IV Symptoms (DRS). Evidence of

relationships between subjective and analogue data would enhance the construct validity of mechanical assessments and enhance our understanding of how best to employ analogue measures as part of the assessment battery.

This validation study was based on correlational analyses that allow for bidirectional prediction. Typically, the validation of measures with unknown or questionable psychometric properties such as the CPT and actigraph is accomplished by calculating the correlations between these measures and those with established validity (i.e., standardized ratings scales, symptom lists, structured interviews). However, these analyses would entail multiple statistical tests that would inflate Type I error. Because of the correlational nature of the research, this study employed the reverse procedure using the standard subjective scales as predictors of actigraph and CPT data. This procedure was used to reduce Type I error and increase the power of the statistical tests used.

Hypotheses

Based on the research cited above, the following hypotheses are offered:

Overall Activity/Impulsivity Hypotheses

Based on analogue (Porrino et al., 1983) and observational (Sleator & Ullmann, 1981) assessments of activity, it was hypothesized that children would be more active in classroom than individual testing situations. Porrino and her colleagues found significant differences in mean actigraph activity among hyperactive and non-hyperactive boys in highly structured classroom situations. However, they noted that the latter group's activity level increased such that group differences in mean activity during free play were nonsignificant. Similarly, Sleator and Ullman (1981) found that hyperactive children in

individual clinical sessions frequently presented as asymptomatic. Taken together, these findings suggest that PIM activity measures for the entire sample would be lower during the individual testing session and significantly higher during the classroom session.

HO1: Mean activity level as measured in the classroom will be significantly higher than that measured during the individual testing session (T = Mean Class Activity >Mean Individual Activity, at p <.05.).

As suggested by the research on externalizing and other salient symptoms (Briggs-Gowan et al., 1996; Loeber et al., 1991; Mitsis et al., 2000, Sawyer et al., 1992), it was hypothesized that parent and teacher paper-and-pencil ratings and interview reports of children's activity levels would differentially predict mean individual and mean classroom activity levels respectively. As suggested by the Mitsis study (Mitsis et al., 2000), it was presumed that parents are less accurate reporters of child in-school behavior compared to teachers. As hyperactive children display few symptoms during individual clinical sessions (Sleator & Ullmann, 1981) and are likely to receive more individual attention at home than in the classroom, individual clinical testing sessions were assumed to be analogous to the home situation. Oppositely, small group instruction in the classroom was considered to represent the typical classroom setting. It was therefore hypothesized that parent ratings and interview reports of activity would predict individual clinical session mean activity levels and that teacher ratings would best predict children's mean classroom activity level as recorded by actigraph. Thus, the following hypotheses were advanced:

HO2: Combined mean parent ratings of children's activity levels on the BASC-PRS Hyperactivity Scale and the number of hyperactivity symptoms endorsed on the

DISC-IV interview will significantly predict mean actigraph scores attained during the individual test session.

HO3: Combined mean parent ratings on the BASC-PRS Hyperactivity Scale and the mean number of DSM-IV hyperactivity symptoms endorsed on the DISC-IV interview will not be significant predictors of children's mean classroom activity.

HO4: Combined teacher-derived mean BASC Hyperactivity *T* score and the mean number of hyperactivity symptoms rated "Often" or 'Very Often" on the DRS-T symptom checklist will predict mean classroom activity.

HO5: Combined teacher-derived mean BASC Hyperactivity *T* score and the mean number of hyperactivity symptoms rated "Often" or "Very Often" on the DRS-T will not predict children's mean activity in the one-to-one clinical session.

A number of factor-analytic studies have indicated that hyperactivity and impulsivity are highly correlated with each other (APA, 1994; Lahey, Applegate et al., 1994). As such, it was hypothesized that combined parent endorsements of DSM-IV hyperactivity and impulsivity symptoms on the DISC-IV and clinically significant ratings of hyperactivity and impulsivity on the Hyperactivity scale of the BASC-PRS would predict CPT Impulsivity scores obtained during the individual clinical session. In contrast, teacher ratings of hyperactivity and impulsivity on the BASC-TRS and DRS-T would not predict CPT Impulsivity scores obtained during the one-on-one session (Sleator & Ullman, 1981). CPT Impulsivity was operationally defined as a combination of short reaction times to "X" in the absence of "A" plus the number of very long (>1.25 second) reaction times to the "A" not followed by an "X." As stated previously, impulsivity symptoms as

defined in the DSM-IV (APA, 1994) are considered to be part of the hyperactivity construct. Therefore, the following hypotheses regarding impulsivity were advanced:

HO6: Combined mean parent ratings on the BASC-PRS Hyperactivity Scale and parent endorsements of impulsivity symptoms on the DISC-IV interview will significantly predict proband impulsivity scores on the CPT.

HO7: Combined mean teacher ratings on the BASC Hyperactivity Scale and the number of DRS-T impulsivity symptoms rated "Often" or "Very Often" will not predict children's Impulsivity scores on the CPT.

Overall Inattention Hypotheses. Inattentive behavior is less salient and intrusive compared to aggression and excessive motor movement. Studies have indicated that the latter more overt problem behaviors are more likely to be identified and foster greater agreement among adult respondents (Briggs-Gowan et al., 1996; Loeber et al., 1991). Assuming that the home setting requires performance on fewer structured, repetitive tasks, that rewards for appropriate behavior are more immediate (see Douglas & Parry, 1983; Sonuga-Barke et al., 1992), and that children are exposed to more attractive, preferred activities (Landau et al., 1992) compared to the school setting, it was hypothesized that parent ratings of their offspring's ability to remain focused would not predict CPT Inattention scores. Rather, teachers would be more likely to report inattention and their reports would be consistent with CPT inattention scores. CPT inattention was operationally defined as a combination of missed "X" targets and "X-only" (X not preceded by an A) commission errors with reaction times of longer than 1.25 seconds. Inattention hypotheses were as follows:

HO8: Combined mean parent ratings of Attention Problems on the BASC-PRS and parent endorsements of inattention symptoms on the DISC-IV structured interview will not significantly predict CPT Inattention scores

HO9: Combined mean teacher-rated Attention Problems *T* score on the BASC and the number of DRS-T Inattention symptoms rated as occurring "Often" or "Very Often" will be significant predictors of CPT Inattention scores.

Chapter 4

Method

Participants

Data collection was undertaken in two waves during the Spring of 2001 and the Fall of 2002. A general information letter (see Appendix A) was initially sent to the parents of all children attending a public elementary school located in Westchester County, New York. This suburban school houses all of the second and third grade students in the district. The total population of the school was approximately 550 students including those in regular, collaborative, and special education programs. Training and consultation in behavioral management techniques (i.e., behavior contracts, positive reinforcement) is given to all teachers by the school psychologist. However, not all teachers consistently employ behavioral programs in their classes. The student population is quite diverse consisting of 65% Caucasian, 12% Hispanic, 8% African-American, 4% Asian, and 11% other (i.e., Middle Eastern, West Indian) children. The teaching staff is also diverse, although the majority of teachers are Caucasian. Both male and female classroom teachers were employed in this school.

During 2001 and 2002 recruitment periods, the parents of 28 and 60 volunteers respectively (total $n = 88$ or 16% of the school population) indicated their willingness to participate by returning the bottom portion of the introductory recruitment letter. Upon receipt of these forms, the experimenter reviewed the purpose and procedures of the study with parents over the telephone to ensure their understanding of the study's requirements. All 88 parents were sent a CUNY Graduate Center Institutional Review Board-approved

Consent To Participate form (see Appendix B) for their perusal. Of this group, 17 (61%) of first wave and 34 (56%) of the second wave returned signed consent forms. A total of 51 children (9.3% of the total school population) were, therefore, initially recruited.

It is important to note that not all 51 children participated in every aspect of the study. This occurred as the result of several factors. First, two children were eliminated from the study because they met the exclusionary criteria described below. Secondly, two children refused to give assent and declined participation. Thirdly, several parents could not be reached in order to administer the structured interview. Moreover, a number of target children were missing data for several different measures (i.e., Hollingshead SES and BASC parent ratings). Lastly, the current study is different from the one that was originally proposed. The purpose of the original study was to compare groups of unaffected and children with varying subtypes of AD/HD. The parents of children initially considered to be "normal controls" were not administered the structured psychiatric interview. Due to the insufficient number of volunteers who received research diagnoses of AD/HD, it was necessary to modify the study using available data As a result, analyses involving parent DISC data had substantially smaller sample sizes (n = 22) than those where no parent interview data were collected (n = 25). Further clarification of the different sample sizes is presented below.

The total sample of 51 second and third grade student volunteers were screened for the following exclusionary criteria via an intake interview that was conducted over the telephone with their parents (see Appendix C).

Language. Inclusion in this study was contingent upon parents' ability to speak

English. As the researcher is monolingual, all parent interviews were conducted in English. Of the 51 children whose parents had consented to participation, one child whose parents had difficulty understanding intake interview questions (i.e., "Has your child ever hit his head and lost consciousness?") was excluded. The exclusion of this child brought the total sample to 50 participants. In two cases, however, the information obtained during the intake and psychiatric interviews of non-English speaking parents was included in the study. In these instances, English speaking adolescent siblings served as translators for their parents. In general, however, translators were not employed due to issues of confidentiality.

Other conditions. Questions on the parent intake interview screened for the presence of Pervasive Developmental Disorders (PDD), Mental Retardation (MR), Traumatic Brain Injury (TBI), and Tic Disorders. Participants whose parents endorsed a positive history of any of the above disorders were excluded from the study because these conditions have characteristics such as excessive motor movement (i.e., Tourette Disorder, Autistic Disorder), inattention, and impulsivity (i.e., TBI) that are similar to the symptoms of AD/HD. As this study focused on symptoms specific to AD/HD, it was felt that the overlapping symptoms of these other disorders might obscure the findings. One child who had been previously diagnosed with PDD according to parent intake interview information was excluded from the study, thereby further reducing the total sample to 49 children.

During the intake interview, parents were also asked if their child had been absent on 50% or more of school days during the previous year and if their child had ever

repeated a grade. Positive responses to either of these questions would have resulted in exclusion from the study. These exclusionary criteria were adopted to ensure that participants did not have severe cognitive or academic delays that would spuriously affect performance on the dependent measures — particularly the CPT. None of the volunteers met these exclusionary criteria.

The presence of significant delays in children's cognitive functioning was further ascertained via a brief, standardized measure of cognitive functioning (the Kaufman-Brief Intelligence Test; K-BIT, Kaufman & Kaufman, 1990). Children who attained an overall IQ score less than 70 would have been excluded from the data analysis as it was felt that their ability to perform on the CPT would be severely hindered given their cognitive limitations. No children were excluded based on low IQ.

Summary. As mentioned above, one child volunteer was excluded due a diagnosis of PDD, another was excluded due to the language barrier, and two declined participation (see the Procedure section below). No children were eliminated from the study on the basis of limited cognitive ability as determined by K-BIT or parent-endorsed MR, head trauma, Tourette Syndrome or other Tic Disorder. Thus, of the 51 probands whose parents had given permission to participate, 47 actually participated in this study.

Incomplete Data

As mentioned previously, DISC interview data were not collected for every participant. Several parents could not be contacted for the diagnostic interview ($n = 8$). Additionally, parents of children who had no significant score elevations on any of the BASC clinical scales (T scores > 60) according to teacher and parent report ($n = 14$) were

not given the DISC interview as per the original design of the study. Computer failure resulted in lost DISC data for three cases. As a result, of the 47 children evaluated, only 22 (48%) completed the DISC interview.

Missing data were also due in part to inconsistent compliance among respondents. The number of completed rating scales, questionnaires, and interviews used in this study fluctuated indicating that multiple measures may have been missing for the same child.

Demographic Characteristics of the Sample

The top portion of Table 1 on page 59 indicates that child participants attained a mean composite IQ that fell within the Average range when compared with the normative sample of same-aged children (Kaufman & Kaufman, 1990). This table also indicates that the mean age of the sample was approximately 8 years, 2 months. Parent responses on the Hollingshead questionnaire resulted in a mean raw SES score that fell within the Level IV range (medium business or minor professional; Hollingshead, 1975). The lower portion of Table 1 indicates that the sample contained more males (n = 27) than females (n = 20), and more third (n = 30) than second grade (n = 17) students. Medication status, and the ethnic breakdown of the sample are also listed in the bottom of Table 1.

Family socio-economic status (SES) and proband ethnicity were determined by parent report on the Hollingshead Four Factor Index of Social Status (Hollingshead, 1975) questionnaire. This questionnaire requires parents to indicate their marital status, type of employment, number of years of education, and head of household status. SES information was unavailable for 8 of the 47 participants as these parents did not complete the Hollingshead questionnaire. The following is the distribution of socio-economic levels

Table 1

Sample Descriptive Statistics

Descriptor	*M*	*SD*	*Range*	*n*
IQ	106.96	15.25	77 - 146	47
Age (Mos.)	98.64	8.61	85 - 114	47
SES	46.77	11.10	27 - 66	45

Descriptor	*N*	*Descriptor*	*N*	*Descriptor*	*N*
Gender		*Ethnicity*		*SES*	
Male	27	Caucasian	22	Level I	0
Female	20	African-American	3	Level II	1
Grade		Hispanic	12	Level III	13
2	17	Asian	1	Level IV	11
3	30	West Indian	2	Level V	14
Medication Status		Mixed	2		
Yes	6				
No	41				

Note: IQ = K-BIT Composite IQ, Age = age in months, SES = Hollingshead Socio-

Economic Status (continuous variable), Gender = gender of the participant, Grade = child's grade in school, Medication Status = participant does/does not take stimulant medication for AD/HD, Ethnicity = ethnic group of the participant as per parent interview; SES categories: I = unskilled laborers, II = semi-skilled laborers, III = skilled craftsmen, clerical, IV = medium-sized business, semi professional, V = major business, professional.

---

participants: 26% of the sample (n = 14) was at the highest level (Level V - major business or professional), 20% (n = 11) were at Level IV (medium business, minor professional, technical), and 24% of participants' families (n = 13) were at Level III (skilled craftsmen, clerical, sales worker). Only one family (1.9% of the sample) received a Level II (machine operators, semiskilled workers) classification. None of the participants' families were found to represent the lowest level of economic status (Level I - unskilled laborers, menial service workers). Of those who completed the Hollingshead questionnaire (n = 45), the mean raw SES score fell within the Level IV category indicating that the average respondent's social status was next to the highest possible level.

The ethnic composition of the sample as reported by parents on the Hollingshead questionnaire was as follows: 40.7% (n = 22) Caucasian, 22.2% (n = 12) Hispanic, 5.6% (n = 3) African-American, 3.7% (n = 2) West Indian, 1.9% (n = 1) Asian, and 3.7% (n = 2) of mixed ethnicity. These figures indicate that the sample was fairly representative of the student body of the school as described previously. Of the 47 volunteers, 5 parents did not respond to the items regarding ethnicity (n = 42).

In terms of gender, Table 1 indicates that the sample consisted of 27 males and 20

females. Of these, 17 (31.5%) were in the second grade and 30 (55%) were third graders. Student ages ranged from 7-years, 1- month to 9-years, 6-months. The mean age of the sample was 8-years, 2-months (*SD* = 8.5 months).

Medication Status

Parents were interviewed regarding their child's medication status. Children who were taking psychostimulant medication (i.e., Concerta, Ritalin, Adderall) were asked not to take these medications on the morning of testing so that the results would not be influenced by the effects of the medication. The safety of discontinuing methylphenidate, dexedrine, or other commonly used psychostimulant medications has been demonstrated in several studies (Barkley, 1991; Camp & Kozleski, 1997; Greenhill, Halperin, & March, 1997; Shaywitz & Shaywitz, 1991; Werry, 1994). However, to insure that the appropriate professional was aware that patients would miss one morning dose of medication, parents of medicated volunteers were required to obtain the treating physician's signature on the Temporary Discontinuation of Medication form (see Appendix D). This form was returned to the experimenter as proof that the physician was aware that the child would be unmedicated for a brief period, and that he or she agreed to the safety of this procedure. Physician permission was also sought to encourage parents to speak to a medical professional to allay any potential concerns regarding the discontinuation of medication.

According to parent reports on the intake interview, 5 boys and 1 girl were taking psychostimulant medications for the treatment of AD/HD symptoms at the time of the study. All medicated children received physician permission and did not take medication on the morning of testing. As children are typically not medicated in the evenings due to

medication disruptions in sleep, a 12 hour medication "washout" period was achieved.

Measures

Demographic Measures

Four Factor Index of Social Status. One of the demographic variables considered in this study was family socioeconomic status (SES). SES has been shown to be related to DSM-IV definitions of AD/HD. At least one epidemiologic study of 520 children in Columbia (Pineda et al., 1999), indicated that significantly more boys from low SES families met DSM-IV criterion "A" (the presence of at least 6 inattention and/or hyperactivity/ impulsivity symptoms) as compared to those from higher social classes. Although this relationship was not found in previous studies (Paternite, Loney, & Langhorn, 1976), it was determined that the potential relationship between SES and outcome variables should be examined.

Probands' family social status was ascertained using the Four Factor Index of Social Status (Hollingshead, 1975). As described above, the Hollingshead measure assesses social status by collecting data on parent employment, education, and marital status. According to Hollingshead's research, these variables have the greatest impact on social status. The family's social status is then calculated according to the formula provided. Hollinghead's formula yields five possible levels of social status ranging from the highest (Level V) to the lowest (Level I).

Kaufman Brief Intelligence Test - Revised. As it was determined that delays in cognitive functioning might influence the performance of participants on some of the outcome measures, a brief cognitive assessment (the Kaufman Brief Intelligence Test, K-

BIT-R; Kaufman & Kaufman, 1990) was administered to all participants. IQ data for each participant was based on the Composite Score attained on this individually administered measure of verbal and non-verbal intelligence. Three tasks: picture identification, word definition, and progressive matrices were administered to all children 8 years or older. Children younger than 8 were administered only picture identification and matrices as per standardized administration instructions. In the authors' view, the K-BIT tasks are closely associated with the underlying "g" or general intelligence factor (Kaufman & Kaufman, 1990). The K-BIT was normed on a national sample of over 2,000 individuals ages 4 to 90 years. The standardization sample was selected to represent the data reported by the U.S. Census Bureau in terms of gender, geographic region, and socioeconomic status (Kaufman & Kaufman, 1990). According to the authors, this test is best used as a screening device. The K-BIT was therefore selected for use in the current study to provide a rough estimate of the child's IQ for inclusionary purposes.

Psychometric data on the composite score are reported here as only this score was used to determine the child's eligibility for inclusion in the study. Kaufman and Kaufman (1990) examined the internal consistency and stability of the composite score and found that split-half and test-retest correlations for youngsters ages 5 to 12 years were both .92. In addition, the Standard Error of Measurement for the composite score was found to be 4 to 5 points in a sample of 4- to 19-year-olds. These data suggest that the K-BIT is a reliable measure.

The extent to which the K-BIT is a valid measure of intelligence was assessed by a study of the relationship between the K-BIT and criterion measures of academic

achievement (e.g., the Kaufman Achievement Battery for Children, Kaufman Test of Educational Achievement, the Wide Range Achievement Test-Revised) and IQ (e.g., Test of Non-Verbal Intelligence, Slosson Intelligence Test, Wechsler Intelligence Scale for Children-Revised, Wechsler Adult Intelligence Scale). Correlations among these measures were generally in the moderate to high range. For example, correlations between the composite scores attained on the K-BIT and full scale IQs on the WISC-R and WAIS-R were .80 and .75 respectively. Among 7- to 9-year-olds, the correlation between the K-ABC and the K-BIT was .69 (Kaufman & Kaufman, 1990). Therefore, concurrent and criterion-related evidence indicates that the validity of the K-BIT for the assessment of intellectual functioning in children is satisfactory.

Predictor Measures

The Behavior Assessment System for Children. Teacher and parent forms of the BASC (Reynolds & Kamphaus, 1998) were used to screen children for potential symptoms. These rating scales instructed adult respondents to retrospectively rate the frequency of specific behaviors during the previous 6 months on a 0 (Never), 1 (Sometimes), 2 (Often), and 3 (Always) Likert-type scale. The BASC teacher and parent forms have clinical scales including: Aggression, Anxiety, Attention Problems, Atypicality, Conduct Problems, Depression, Hyperactivity, Somatization, and Withdrawal. These forms also have adaptive scales such as Leadership and Social Skills that assess the child's strengths. The adaptive scales, however, were not used in this study. Broadband dimensions such as Internalizing, Externalizing, School Problems, and Behavior Symptoms indices were also calculated but not used in the data analyses.

The BASC is a relatively new instrument that has several related components including teacher (TRS), parent (PRS), and child self-report (SRP). Observational and child history forms are also part of the system. Together, these scales yield multi-dimensional, multi-informant information that is preferred according to best practices in the assessment of children with AD/HD (Kamphaus & Reynolds, 1998; Landau & Burcham, 1995). Although the BASC has not been studied as extensively as other omnibus rating scale systems such as the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983), it was selected for this study because of its consistency with DSM-IV AD/HD symptoms. Additionally, extant studies have indicated that the CBCL and BASC are very similar in their ability to distinguish children with AD/HD from their non-affected peers (Doyle, Ostrander, Skare, Crosby, & August, 1997; Ostrander, Weinfurt, Yarnold, & August, 1998; Vaughn, Riccio, Hynd, & Hall, 1997).

Criterion-related evidence for the BASC was demonstrated by the moderate to high (.66 to .82) correlations between BASC Aggression, Hyperactivity, Conduct Problems, and Attention Problems Scales and related CBCL scales (Kamphaus & Frick, 1996). Furthermore, one recent study (Vaughn et al., 1997) suggests that when the BASC-PRS and TRS results are used in combination, these effectively discriminate DSM-IV AD/HD subtypes from each other. This same study suggests that a combination of parent and teacher BASC data is useful in the identification of the AD/HD INATT subtype (Vaughn et al., 1997). Although these reports support the utility of the BASC in identiflying subtypes of the disorder, there is some disagreement with these findings. A study that used discriminant classification tree analyses (Ostrander et al., 1998) found that

the CBCL model did a better job of discriminating among children diagnosed with predominantly INATT and COMB subtypes of AD/HD than the BASC model. Moreover, Doyle and his colleagues (1997) suggest that the BASC parent, teacher, and child formats do not discriminate among the AD/HD subtypes regardless of the use of single or multiple informants. Considering the above findings, the ability of the BASC to discriminate among AD/HD subtypes is equivocal. The current study, however, did not employ the BASC to discriminate subtypes of AD/HD but rather as an standardized index of inattention, impulsivity , and hyperactivity in children. Only two of the BASC clinical scales were used in this study: Hyperactivity and Attention Problems. Given the significant relationship between BASC and CBCL measures of these constructs, the use of the BASC in this study is justified.

According to the authors (Reynolds & Kamphaus, 1998), the BASC-TRS and PRS were normed on a school-based sample of over 5,000 individuals whose demographic characteristics were consistent with U.S. Census data. In developing the BASC, three types of reliability were examined for both the parent and teacher forms: internal consistency, interrater consistency, and stability over time. For the teacher form, the average internal consistency of all scales was high (> .80). Items on the Aggression, Hyperactivity, Social Skills, and Study Skills Scales, for example had the highest correlations with other items in that particular domain. The coefficient alpha for the parent rating scale (PRS) composite was also high (.80 - .90) with individual items also showing good consistency (.70s - .80s) within each subscale. Inter-informant reliability assessments revealed moderate correlations among teacher, father, and mother ratings of

the proband's behavior. Median test-retest reliability coefficients ranged from .82 to .91 for teachers and .70 to .85 for parents after a two-week interval. This suggests that assessment of the same child over time was fairly consistent. Overall, the BASC has been shown to be a reliable instrument for assessing children's behavior (Kamphaus & Frick, 1996). However, independent replications of these findings are needed.

The Diagnostic Interview Schedule for Children. The DISC-IV (Shaffer et al., 2000), is the latest version of this structured parent interview. This revision was employed in the field testing of the Disruptive Behavior Disorders (DBD) section of the DSM-IV (Lahey et al., 1994). The DISC was used to make DSM-IV subtype diagnoses and identify comorbid conditions in the original version of this study. In terms of the current study, positive endorsements of DSM-IV hyperactivity, impulsivity, and inattention symptoms by parents were used as a additional variables to validate laboratory measures of these constructs.

The DISC-IV interview format contains closed-ended "stem" questions that are asked of each informant. Stem questions are very general and inquire about the essential aspects of the DSM-IV symptom. Such questions are designed to elicit many "false positive" responses. More specific follow-up items that ask about the level of impairment, frequency, and duration of the symptom serve to refine the diagnostic process. Follow-up or contingent probes were created to increase the diagnostic specificity of the interview (Shaffer et al., 2000). Parents are asked to give a "yes" or "no" answer that is then entered into the computer scoring algorithm by the interviewer. Subsequent questions are based on each response. Specific probes are skipped when a "no" response is given to the

stem item. For example, a "no" response to the general item asking if the child has had problems remaining seated during the past 12 months, results in skipping all items related to the "out of seat" DSM-IV AD/HD criterion. A timeline of personal events marking particular points during the past year (e.g., 1-, 6- or 12-months-ago) is created by the parent and the interviewer. The purpose of the timeline is to improve the accuracy of retrospective reports by enhancing the ability of respondents to recall the temporal sequence of past events. Each section is computer-scored and a print-out of all negative and positive DSM symptoms as well as the diagnosis may be displayed at the completion of the interview.

Early versions of the DISC revealed poor to moderate agreement between diagnoses ascertained by DISC, clinical (Costello et al., 1984), and semi-structured interview (Piacentini et al., 1992). However, studies of more recent versions (DISC 2.3) reveal good (κ =.60 to .80) test-retest reliability for AD/HD and Oppositional Defiant Disorder and fair to moderate stability coefficients for Conduct, Mood, and Anxiety Disorders (Schwab-Stone, Shaffer, Dulcan, Jensen, Fisher et al., 1996). Schwab-Stone and her colleagues (1996) attribute low reliability coefficients to an attenuation of symptoms during the long (1-year) retest interval.

In terms of validity, parent-derived DISC 2.3 diagnoses were generally found to be consistent with clinical diagnoses. Evidence of concurrent validity was demonstrated for the DISC diagnoses of AD/HD (κ = .61-.82) and ODD (κ = .57 -.73). Moderate agreement between clinician and parent-derived structured interview diagnoses were noted for conduct, anxiety, and depressive disorders (Jensen, Watanabe, Richters, Roper, Hibbs

et al., 1996). However, no validity studies of the DISC-IV have thus far been conducted. The acceptable psychometric properties of the Disruptive Behavior Disorder module in the previous version, however, warrant the use of the AD/HD module in the present study.

The Diagnostic Rating Scale -Teacher version. A DSM-IV symptom checklist, the Diagnostic Rating Scale - Teacher version (DRS-T; Weiler et al., 1999), was used to obtain information regarding AD/HD and other symptoms from the index child's classroom teacher (see Appendix E). Teachers were asked to rate the frequency of symptoms observed in the classroom. As the DRS-T is a fairly new scale, there have been few investigations of its psychometric properties. However, two recent studies conducted by its authors (Weiler et al, 1999; Weiler et al., 2000) suggest that this scale has sufficient utility particularly in the identification of AD/HD and other child DBDs. In terms of the validity of the DRS, the symptoms listed on this instrument are quoted directly from the DSM. It may therefore be presumed that the rating scale, as with the DISC, is as diagnostically valid as the DSM-IV criteria. This study used the number of DSM symptoms of hyperactivity, impulsivity, and inattention rated as occurring "Often" or "Very Often" by the teacher as an index of impairment. DRS-T AD/HD items are similar to those on the DISC the DSM-IV-based BASC Hyperactivity, and Attention Problems scales.

As with almost all rating scales, the DRS precludes consideration of other DSM diagnostic criteria such as age at onset of symptoms and the extent of impairment (i.e., social, academic, etc.). However, the DRS may be useful for data collection about the child's school behaviors particularly when a teacher interview is not feasible (Weiler et al.,

1999). In light of evidence that parents cannot replace teachers as informants regarding children's behavior in the classroom (Mitsis et al., 2000), teacher-derived diagnostic rating scales such as the DRS-T, serve an important function in assessing child behavior problems. A checklist of symptoms such as the DRS may be the most expedient means to obtain teacher-derived diagnostic information. When the DRS-T is used in conjunction with additional teacher ratings, observations, and parent-derived information, a more complete picture of the child's overall functioning may be ascertained.

Criterion Measures

Actigraph. The average activity level of each participant was recorded using solid state MicroMini-Motionlogger actigraphs (Ambulatory Monitoring Inc., Ardsley, N.Y.). These devices are approximately the size of a small wristwatch and weigh 1.7 ozs. The actigraph generates a piezo-electric beam each time the wearer makes any supra-threshold movement. The threshold is pre-set by the factory to provide optimal sensitivity. The voltage created by the piezo-electric beam is filtered and amplified. The electronic signals that result from this process are averaged over each one minute epoch and stored in the device's solid state memory. The Proportional Integrating Measure (PIM) is the mode of operation that was chosen for this study. When PIM is used as a dependent measure, it yields an activity level or magnitude of movement per unit time (1 minute epoch).

Studies have indicated that actigraph measures distinguish between normals and children diagnosed with AD/HD (Halperin et al., 1993; Inoue et al., 1998; Porrino et al., 1983). However, the discriminant validity among AD/HD subtypes (Inoue et al, 1998) and between AD/HD and other disorders (Halperin et al., 1993) has not been

unequivocally demonstrated by actigraphic differences alone. For example, in one case-controlled design (Halperin et al., 1993), actigraph measures did not distinguish "pure" or non-comorbid groups of AD/HD, anxiety, and mood-disordered children. However, using a more heterogeneous sample of children, actigraph measures have been found to distinguish between AD/HD subtypes (Inoue et al., 1998) and AD/HD and other childhood disorders (Halperin et al., 1992). These studies suggest that inconsistent results may be related to differences in the nature of the sample (pure AD/HD *vs.* comorbid groups of children). Actigraph measures were not used to discriminate between psychiatric samples or subtypes of AD/HD in this study. As such, the use of the actigraph as a predictor of parent and teacher ratings of hyperactivity is warranted.

Continuous Performance Test. Neuropsychological studies have postulated relationships between the core features of AD/HD and impairments in brain functioning. Specifically, the difficulties in sustained attention, planning, organization, and the inhibition of impulsive responses commonly associated with AD/HD mimic deficits in individuals with frontal lobe injuries. However, some believe that the deficits associated with this disorder are related to almost every area of the brain (Boliek & Obruzut, 1997). If one subscribes to the notion that specific brain regions are implicated in AD/HD, it follows that specific tasks that tap the deficits in planning, organization, and response style may be used to validate this diagnosis. As such, three facets of the CPT have been used to identify attentional and response deficits; latency to respond, errors of commission, and errors of omission. First, a long latency of response to targets has been used as an index of cognitive sluggishness. Oppositely, a brief elapsed time from the onset of the target

stimulus to the subject's response has been used as a measure of impulsive responding. Secondly, impulsive responses have generally been defined as responses to non-target stimuli (e.g., responses to "A" followed by "B" rather than "A" then "X"). Thirdly, non-response to target stimuli has been used as a measure of inattention (Corkum & Siegel, 1993). It should be noted, however, that these dependent measures have not demonstrated unequivocal discriminant evidence for the differential diagnosis of AD/HD (Matier-Sharma et al., 1995).

The CPT used in this study asks participants to respond to a briefly exposed sequence of letters ("A" then "X") and to inhibit responses to other patterns (e.g., "B" followed by "X," "A" followed by "B"). The "A" in this task acts as the "get ready" signal, whereas the "X" is the "go" signal. This CPT, developed by Greenblatt, Sharma, and Halperin (see Halperin et al., 1988), yields three dependent measures: Inattention, Impulsivity, and Dyscontrol. These scores are conceptualized differently than the commonly used Commission and Omission Errors that take into account "false alarms" and "misses" only. The CPT inattention score is calculated as the number of missed targets plus the number of slow (> 1.25 seconds) reaction time "X-only" responses (i.e., responses to "X" not preceded by "A"). This conceptualization accounts for inattention to the "get ready" ("A") as well as "go" ("X") signals. The CPT impulsivity score is defined as the total number of short (<1.25 seconds) reaction time (RT) responses to letters other than "X" following an "A" ("A" not "X") plus the number of long reaction time (>1.25 seconds) responses to "A" not followed by "X". " The dyscontrol score includes all other possible errors and will not be analyzed in this study as the relationship

between this dependent measure and the constructs associated with AD/HD is not clear (Halperin et al., 1993). Previous studies by Halperin and his colleagues have indicated that inattention and impulsivity scores conceptualized in this manner are more stable and valid constructs than commission and omission errors (Halperin et al., 1988; Halperin, Sharma et al., 1991; Halperin, Wolf et al., 1991).

Although several CPT studies have demonstrated that this measure discriminates children with AD/HD from normal control children, fewer CPT studies have been able to distinguish children with AD/HD from other referred children (Barkley, 1991). The use of the CPT in this study was warranted as inattention and impulsivity scores were used to validate the way in which the assessment of inattention and impulsivity is typically conducted, namely, by parent and teacher paper-and-pencil ratings of behavior. Additionally, as inattention may be very difficult to assess via direct observation, the CPT may provide a more direct measure of this construct.

Procedure

Table 2 (page 75) presents a tally of participants who completed the initial screening and follow-up measures. After the initial interview, the 47 parents who had given consent were sent an omnibus rating scale of child behavior (the Behavior Assessment System for Children - Parent Rating Scale; BASC-PRS). In addition, each child's teacher was given the teacher version of this same scale (the BASC-TRS). As per the original study, children who attained scores of at least 1 standard deviation above the mean (T score ≥ 60) on Hyperactivity and/or Attention Problems Scales as reported by teacher, parent, or both were followed-up with structured parent interviews regarding

these symptoms. Additional follow-up data on all children were ascertained from teachers using a DSM-IV symptom checklist (the DRS-T). To illustrate this procedure, a *T* score of 64 on the Hyperactivity Scale of the BASC-PRS or TRS was considered to be a "red flag" for possible hyperactivity problems and was followed by further assessment using a structured parent interview (DISC-IV). For this reason, only 22 of the 47 participating parents completed the DISC. The use of a more lenient cut score than that recommended by the BASC's authors ($T \geq 60$; Reynolds & Kamphaus, 1998) increased the initial sensitivity of the screening measure so that less severe cases would be included in the study.

Teachers were asked to rate participants using the DRS-T. As shown in Appendix E, this rating scale asks teachers to rate the frequency of the symptoms associated with AD/HD and other DSM diagnoses using Likert scoring from 0 (Never) to 3 (Always). Total scores in each domain (Inattention, Hyperactivity, Impulsivity, Anxiety, Mood, ODD, and CD) consisted of the number of symptoms that were rated as occurring "Often (2)" or "Very Often (3)" by the child's teacher. Of the 47 child volunteers, DRS-T data were collected for 44 children. DRS-T data collection was incomplete for three participants due to a lack of teacher response.

Teacher interviews were not used due to the lengthiness of this procedure (Mitsis et al., 2000).

Individual Child Testing Procedure

Once all screening and follow-up diagnostic data were collected, the experimenter contacted parents to inform them about the day and time of in-school individual

Table 2

Diagnostic Instruments and Number of Respondents

Screening Instruments	*n*	*Follow up Instruments*	*n*
BASC-PRS	47	DISC-IV	22
BASC-TRS	46	DRS-T	44

Note: BASC-PRS = Behavioral Assessment System for Children - Parent Rating Scale; BASC-TRS = Behavioral Assessment System for Children - Teacher Rating Scale; DISC-IV = Diagnostic Interview Schedule for Children- Fourth Edition; DRS-T = Diagnostic Rating Scale -Teacher version.

assessment with the K-BIT, CPT, and actigraph. These data were typically collected between 9:00 and 10:30

a.m. to avoid the effects of fatigue and hunger. Assessments were usually administered on the same morning. However, individual and classroom assessments were sometimes given on different days because of scheduling conflicts, child absence from school, or equipment failure.

On the evening before testing, parents were contacted by telephone and asked to inform their child that the experimenter would meet with him or her at school on the following day. This was done to reassure children that parents were acquainted with the

experimenter, thereby easing any fears that the youngsters may have had. Upon meeting each child, the experimenter introduced herself and engaged the child in general conversation (e.g., the student's favorite movie, toy, television show) in order to develop rapport. Once rapport was established, the study was explained in language appropriate for the child's developmental level. A script containing a complete explanation of the child's involvement in the study was printed out and used as the Assent Form (see Appendix F). Once the material on this form was discussed with the student, he or she was given the opportunity to agree or refuse to participate. Children indicated their assent by printing or signing their names on the form.

Once assent was obtained from each child, measures of intellectual functioning, activity, impulsivity, and attention were administered during a 30-40 minute individual clinical assessment session. These sessions were conducted in two separate locations within the school depending on room availability. The 2001 sessions were conducted in the "time out" room located on the first floor of the school building. In 2002, the basement instrumental music room was used. Each of these rooms had ample space and allowed for undisturbed testing.

All equipment was demonstrated to the child, and his or her questions were answered before the start of the testing. The examiner initialized the activity monitor using an IBM-compatible laptop computer (Fujitsu Lifebook 400) that was fitted with an actigraph interface (Ambulatory Monitoring, Ardsley, N.Y.). Once activated, the device was placed in a pouch that was attached to a belt worn around the child's waist. The pouch was positioned towards the back on the child's non-dominant side (i.e., the left side

for right-handed children). This placement allowed for uninhibited movement and was consistent with previous research (Inoue et al., 1998; Halperin et al., 1992; Halperin et al., 1993; Reichenbach et al., 1992).

While student activity level was being recorded, the child was simultaneously administered the Kaufman Brief Intelligence Test (K-BIT) and then a computerized task requiring sustained attention and the inhibition of pre-potent responses (the Continuous Performance Test; CPT). Tasks on the K-BIT included Picture Vocabulary and Matrices for children younger than 8-years-old. For children 8 years and older, an additional verbal task (Word Definitions) was also administered.

After the cognitive screening, the CPT was administered using the laptop computer described above. The CPT employed in this study is modeled on that developed by Rosvold et al. (1956) as a means of identifying traumatic brain injury. This type of CPT has been employed extensively in studies of children diagnosed with AD/HD (Halperin et al., 1992; Halperin et al., 1993; Reichenbach et al., 1992, Matier-Sharma et al., 1995). The version of the CPT used in this study employs 11 different upper case letters presented individually in quasi-random order. Prior to the presentation of the stimuli on the computer screen, participants practiced finding "A then X" targets within a series of random letters listed on a sheet of paper (see Appendix G). To be consistent with the computerized task, letters on the printed page were exposed one-at-a-time. During this practice, the child was asked to say "Got it" each time he or she identified "A then X" targets. Correct identifications were immediately reinforced using positive feedback (i.e., "That's right!'). Incorrect identifications were met with corrective feedback (i.e., "Was

there an A before that X?"). If the child made errors during the practice, the experimenter gave further explanation and continued going through the list until the child correctly identified three consecutive printed targets.

The correct identification of three consecutive "A then X" targets from the printed page resulted in the administration of a computerized practice task. In keeping with previous administration standards (Halperin et al., 1992; Halperin et al., 1993; Reichenbach et al., 1992), the examiner offered explanations and social reinforcement (e.g., praise) during the computerized practice trial. Participants were instructed to press the space bar each time "A then X" targets appeared on the screen. As with the paper version of this task, three consecutive correct responses on the computerized practice trial allowed for the administration of the test trial. Participants who did not meet this criterion repeated the computerized practice task.

Once the practice trials were completed, the test trial commenced. The test stimuli of the CPT were exposed for 200 ms with a 1.5 s interstimulus interval. Targets were presented on 10% of stimulus exposures. Additionally, the test trial contained 400 stimuli and lasted approximately 12 min. Before beginning the test trial, the examiner informed the child that the letters would be presented more quickly and that many more individual letters would be displayed compared to the practice trial. Consistent with the administration of the CPT in previous studies, the examiner looked over the child's shoulder at the beginning of the test trial. Corrections for incorrect and praise for correct responses were given to ensure sufficient motivation for completing the task. After approximately two minutes, the participant was allowed to continue on his or her own.

The examiner remained in the room and busied herself with another activity while the child continued with the test trial. A script containing the instructions for the administration of the CPT may be found in Appendix H.

After the administration of the CPT, the examiner accompanied the student to his or her classroom where further activity monitoring was conducted. Classroom activity monitoring was conducted during a period when the entire class was divided into small reading and mathematics groups of 5 to 7 children. Monitoring of children's activity in both individual and group settings was done to examine potential differences in activity related to the setting. These measures were also taken to enhance the validity of the actigraph measure by increasing the amount of time allotted for activity assessment. Children remained in the classroom wearing the actigraph for a 30- to 40-minute period. After this time, the examiner returned to the child's class and removed the monitor from his or her waist.

The investigator did not remain in the classroom during activity monitoring to avoid potential reactive effects on participant behavior (Sattler, 1992). Class activities were documented by the teacher using the Classroom Activity Form (see Appendix I). This form made it possible for the investigator to ascertain whether the participant had engaged in activities that required excessive movement and whether the amount of structure during small group activities in the classroom was similar to that of the individual testing. Careful examination of teacher responses on the Classroom Activity Form indicated that, in most cases, class activities required a minimal amount of extraneous movement and that the amount of structure imposed on the classroom tasks was

consistent with that of the individualized sessions (i.e., math workbook assignments, spelling tests, small group reading instruction). In the two cases where greater activity was reported or less structure was imposed (e.g., children were taken to a special presentation of a musical show in the auditorium), the data were discounted and new data were subsequently collected. Thus, the amount of extraneous classroom activity and the structure of classroom sessions were controlled to avoid inadvertent influences on the outcome. Data from unstructured tasks (i.e., free play) were not examined in this study as the literature suggests that movement differences between hyperactive and non-hyperactive children are obscured during free play activities (Porrino et al., 1983).

As a reward for participation in the study, each student was given a thank you note from the researcher and a copy of the bar graph of his or her movement during the monitoring period. These color graphs depicted the intensity of their movements (PIM) during each 1 minute epoch. The researcher taught each child how to "read" the graphs to determine the extent of their movement (i.e., "This tall line shows that you made big movements at 9:40 when we were walking back to your classroom."). Participants were also encouraged to remember particular movements (i.e., running or jumping) or activities (i.e., reading, walking to class) and relate these to the graphical representation. For example, while looking at a short bar, the researcher would ask "What do you think you were doing at this time?" If the child indicated that she or he was sedentary then social reinforcement ("Yes!") was given. If the child was unable to respond, the researcher would provide choices of responses (i.e., "Do you think you were sitting still or moving around ?). Children were encouraged to bring the graphs home and show them to their

parents.

Actigraph data were downloaded onto the laptop computer for subsequent data analysis using the Action W-version 2 program (Ambulatory Monitoring Inc., Ardsley, N.Y.). This program automatically calculated mean activity and the duration of activity measurement. The Proportional Integrating Measure (PIM) was selected for use as the dependent measure of activity. It has been suggested that PIM is a measure of movement intensity (W. Tryon, personal communication, May 11, 2001) rather than movement consistency as measured by the Zero Crossing (ZC) measure. Although ZC is the activity measurement most commonly used in prior studies (Inoue et al., 2000; Halperin et al., 1992; Halperin et al., 1993), it is possible that PIM is more consistent with the distinct quality of movements that characterize hyperactive children (Teicher, Ito, Glod, & Barber, 1996). Teicher et al. (1996) found that boys with AD/HD symptoms not only moved more often but also evinced qualitatively different movement patterns than normal controls according to infared motion detectors. Compared to their non-affected peers, hyperactive boys' movement patterns had greater amplitude and less complexity. To date, there have been no studies that have used PIM as an outcome measure. However, as a purported measure of the magnitude of children's movements, PIM may be a better measure of the types of movement noted by Teicher et al. in their study of boys with AD/HD symptoms.

Data Analysis and Design

The data were primarily analyzed using the Statistical Package for the Social Sciences - Version 10 (SPSS, 2001). Three outcome variables; mean activity level, CPT Inattention, and CPT Impulsivity scores were calculated by the computerized programs

for the actigraph and CPT respectively. Individual scores were then entered into the SPSS database and analyzed. Mean PIM and duration were calculated for each participant using the Action W2 (Ambulatory Monitoring Inc., Ardsley, N.Y.) program. Mean activity and duration data were then entered into SPSS database for subsequent analysis.

Relationships between AD/HD symptoms as reported by adults and more objective measures of activity, attention, and impulse control were initially determined via a series of Pearson Product Moment correlations, *T* tests, and univariate Analyses of Variance. The predictive validity of the objective measures was determined by a series of regression analyses using parent endorsement of symptoms on the DISC-IV and BASC-PRS as well as teacher ratings on the BASC-TRS and DRS-T as predictors of mean activity level, CPT Inattention, and CPT Impulsivity scores. Additionally, paired samples *T* tests were used to examine hypothesized differences between classroom and individual testing session activity.

Chapter 5

Results

As described in the previous chapter, children's activity levels, attentional capacities, and response styles were assessed in order to examine the potential relationships between standardized (BASC, DISC-IV, and DRS-T), mechanical (actigraph), and analogue (CPT) measures. Table 3 (page 84) presents the means, quartiles, standard deviations, *n*s, and ranges for all predictor and criteria variables.

The Hyperactivity scale of the BASC included such items as "interrupts others," "has difficulty waiting for his/her turn" and "acts before thinking" covering both hyperactivity and impulsivity constructs related to the diagnosis of AD/HD (Reynolds & Kamphaus, 1998). The reader should therefore note that BASC-PRS and TRS Hyperactivity *T* scores were used to test hypotheses related to *both* hyperactivity and impulsivity (HO2 through HO7). In terms of the DISC-IV interview and DRS-T symptom rating scale, the figures presented in Table 3 reflect the average number of DSM-IV hyperactivity symptoms endorsed by parents and the number of symptoms that occurred "Often" (scored 2) or "Very Often (scored 3) as rated by teachers.

Hyperactivity measures included both mean classroom and individual test session PIM activity. As no standardization data were available for comparison purposes, relative results in the form of ranges and quartiles of the mean activity levels of participants in the individual testing and classroom sessions are given in Table 3.

Table 3 indicates that the average teacher and parent ratings of children's activity levels on the BASC fell within the non-clinical range (*T* scores < 60) compared with the

Table 3

Measures of Central Tendency for the Total Sample

Measure	*M*	*Q*	*SD*	*N*	*Range*
Parent Predictor Measures					
PRS Hyp *T* score	52.32	3	14.02	47	28 - 87
PRS-Attn Prob *T* score	54.94	2	11.48	47	36 - 81
DISC Hyp Sxs.	1.27		1.83	22	0 - 5
DISC Impul Sxs.	.77		1.19	22	0 - 3
DISC Inatt Sxs.	3.00		3.84	22	0 - 9
Teacher Predictor Measures					
TRS Hyp *T* score	51.53	3	10.97	47	37 - 82
TRS- Attn Prob *T* score	54.15	2	12.09	47	34 - 76
. DRS-T Hyp Sxs.	1.32		1.77	47	0 - 6
DRS-T Impul Sxs.	.66		1.05	47	0 - 3
DRS-T Inatt Sxs.	2.79		3.16	47	0 - 9
Criterion Measures					
Indiv. PIM Activity	3709.25	3	1735.34	47	1176.97 - 9244.97
Class PIM Activity	6682.49	2	2705.69	47	1963.08 - 14441.60
CPT Impul	3.20		6.34	46	.00 - 41.00
CPT Inatt	5.76		5.26	46	.00 - 23.00

Note: PRS-Hyp *T* score = Behavioral Assessment System for Children (BASC) -Parent Rating Scale (PRS) Hyperactivity *T* score, PRS Attn Prb *T* score = BASC-Parent Rating Scale Attention Problems *T* score, DISC-Hyp Sxs. = number of parent-endorsed hyperactivity symptoms on the Diagnostic Interview Scale for Children, DISC Impul Sxs. = # of parent-endorsed DSM-IV impulsivity symptoms on the DISC, DISC-Inatt Sxs. = # of parent-endorsed DSM-IV inattention symptoms, TRS Hyp *T* score = BASC-Teacher Rating Scale Hyperactivity *T* score, TRS-Attn Prb *T* score = BASC-Teacher Rating Scale Attention Problems *T*-score, DRS-T Hyp Sxs. = number of teacher-rated hyperactivity symptoms occurring "often" or "very often," DRS-T Impul Sxs. = number of teacher-endorsed DRS-T impulsivity symptoms rated "often" or "very often," DRS-T Inatt Sxs. = number of teacher-endorsed DRS-T inattention symptoms rated "often" or "very often," Indiv PIM Activity = mean Proportional Integrating Measure activity level during individual testing, Class PIM Activity = mean Proportional Integrating Measure activity during the classroom session, CPT Impul = Continuous Performance Test Impulsivity score, CPT Inatt - Continuous Performance Test Inattention score.

---

standardization sample (Reynolds & Kamphaus, 1998). Relatively speaking, mean parent and teacher BASC Hyperactivity ratings fell below the 75th percentile (Q_3). The bottom third of Table 3 indicates that Mean PIM activity fell within the third (Q_3) and second (Q_2) quartiles for individual and class sessions respectively. In other words, mean activity recorded during the individual testing session fell below the 75th percentile whereas mean class activity fell below the 50th percentile within these distributions. In terms of the mean

number of DSM-IV Hyperactivity symptoms endorsed by parents and teachers, these adults endorsed slightly more than one symptom of Hyperactivity on average. As the number of hyperactivity symptoms endorsed by parents and teachers ranged from 0 to 6 in this sample, the average number symptoms identified was relatively low regardless of informant.

In terms of measures of impulsivity, Table 3 indicates that BASC parent and teacher Hyperactivity ratings, which included impulsivity items, fell within the non-clinical range (T score < 60). A range of from 0 to 3 symptoms of impulsivity were endorsed by parents (DISC) and teachers (DRS-T). However, less than 1 symptom of impulsivity was identified on average irrespective of informant. The bottom portion of Table 3 displays the mean outcome CPT Impulsivity score for this sample. A z score transformation of this score (z = -.06) indicated that it was similar to that of the normative sample (M = 3.5, SD = 5.2; Halperin, Sharma et al., 1991). Thus children in this sample performed similarly to those in the standardization sample on the CPT measure of impulse control.

In terms of criterion measures of attention, Table 3 indicates that the mean T scores on the Attention Problems scales of the PRS and TRS fell within the non-clinical range (T < 60) according to Reynolds and Kamphaus (1998). These scores suggest that, on average, parents and teachers rated probands as having few problems with sustained and/or selective attention. Relative to other participants in this sample, these T scores fell within the second quartile (below the 50th percentile) of the distribution. Of a total of 9 DSM-IV inattention symptoms, parents endorsed an average of 3 symptoms on the DISC-IV. Similarly, teachers endorsed an average of 2.8 inattention symptoms on the DRS-T.

Thus, parent and teacher identification of AD/HD inattention symptoms in probands was similar. Taken together, the data presented in Table 3 suggest that parents and teachers were consistent in their endorsement of the number of DSM-IV AD/HD symptoms in this sample.

The mean scores attained by participants on outcome measures of Inattention are displayed in the lower third of Table 3. The mean CPT Inattention score attained in this sample fell within the 3rd quartile of the distribution. In addition, a *z* score transformation revealed that the mean CPT Inattention score attained in this sample ($M = 5.76$, $SD = 5.26$) was 0.92*z* higher than the average CPT Inattention score attained in the standardization sample ($M = 3.1$, $SD = 2.9$; Halperin, Sharma et al., 1991). Thus, the average performance of this sample on the CPT Inattention measure tended to be poorer compared with those in the original standardization sample (see Halperin, Sharma et al., 1991).

The Relationship of Participant Characteristics to Predictor and Criterion Measures

In order to test for the possible effects of subject characteristics (i.e., SES, gender, medication status, age) on measures of hyperactivity, impulsivity, and inattention, a series of Pearson Product-Moment correlations, *T* tests, and one-way Analyses of Variance (ANOVAs) were computed. For the means, standard deviations, and subgroup *n*s of all descriptor variables, please refer to Table 1 (see page 59). As 48 correlations were calculated, a significance level of $p < .001$ was used to reduce experiment-wise Type I error. Statistically significant results at this level would therefore ensure that the findings were not due to chance. Similarly, a more stringent significance level of .01 was used for

Table 4A

Pearson Correlations Between Participant IQ, Age, SES and Mean PIM Activity

Measure	*IQ*	*Age*	*SES*	*Measure*	*IQ*	*Age*	*SES*
TRS-Hyp	.096	.062	-.036	DISC-Hyp	.313	-.023	-.311
	(47)	(47)	(44)		(22)	(22)	(20)
PRS-Hyp	-.008	-.056	-.256	Indiv. Act	.047	-.45*	-.050
	(47)	(47)	(45)		(47)	(47)	(45)
DRS-Hyp	.064	.069	-.205	Class Act	.021	-.274	-.055
	(46)	(46)	(44)		(47)	(47)	(45)

Note: ( ) = *n*; TRS-Hyp = BASC-TRS Hyperactivity *T*-score, PRS-Hyp = BASC-PRS Hyperactivity *T*-score, DRS-Hyp = number of DRS-T hyperactivity symptoms rated as "Often" or "Very Often," DISC-Hyp = number of DSM hyperactivity symptoms endorsed on parent interview, Indiv Act = PIM activity level during individual testing, Class Act = PIM activity level during the classroom session, IQ = KBIT Composite IQ, Age = age in months, SES = Hollingshead socio-economic status scores (continuous variable); *p = .002.

all *t* and *F* tests.

Activity data. Table 4A (above) presents the correlations between continuous

participant descriptor variables (i.e., age, IQ, and SES) and mean PIM activity level as recorded during individual testing and classroom activities. According to this table, a significant inverse correlation was found between the mean age of the participants and mean actigraph activity level in the one-on-one testing sessions. This correlation suggests that younger participants were significantly more active than older children but only during highly structured individual testing. Thus, the age of the child may be a significant predictor of PIM activity measured during one-on-one sessions. Although a correlation between age and classroom movement was in the same direction, this correlation did not reach statistical significance. Similarly, participant IQ and SES were not significantly related to any teacher or parent hyperactivity rating.

Although not presented in Table 4A, the correlation between IQ and SES (r = .551, p= .009) approached statistical significance suggesting that children in the sample who were of higher socio-economic status tended to have higher IQs. A relationship between SES and IQ has been demonstrated elsewhere (see McDermott, 1995).

Table 4B (see page 90) presents the results of statistical tests used to examine potential relationships between dichotomous and categorical participant variables and measures of activity in the one-on-one testing session. Means, standard deviations, T, and p values are listed for gender, grade level, medication status, and ethnic background. As children of six different ethnic backgrounds were involved in this study, a one-way Analysis of Variance (ANOVA) was used to determine if significant differences in activity during individual testing existed among these ethnic subgroups.

Table 4B indicates that there were no significant differences in mean one-on-one

Table 4B

Comparison of Mean Activity During Individual Testing Among Subsamples of Participants

Descriptor	*n*	*M*	*SD*	*t*	*F*	*p*
Gender						
Male	27	3739.91	1845.53	.139		.890
Female	20	3667.87	1620.74			
Grade						
2	17	4283.41	1667.82	1.745		.088
3	30	3383.90	1714.44			
Medication						
No	41	3451.33	1502.24	-2.865		.006*
Yes	6	5471.74	2319.05			
Ethnicity						
Caucasian	22	3680.49	1748.13		.092	.993
Afro-Amer	3	4069.81	978.80			
Hispanic	12	3469.98	1417.35			
Asian	1	3804.77				
West Indian	2	3300.95	1718.97			
Mixed	2	3400.27	3144.20			

Note: Gender = male or female participant, Grade = 2nd or 3rd grade participant, Medication = participant does/does not receive stimulant therapy treatment, Ethnicity = ethnic background of the proband: Caucasian, African-American, Hispanic, Asian, West Indian and Mixed (i.e., biracial). * p = .006.

---

test session activity between males and females, second and third graders, or among the different ethnic groups. However, children who had been receiving stimulant medication treatment for AD/HD were significantly more active compared to unmedicated children. The reader is reminded that, on the day of testing, none of the medicated children were given their usual dose of stimulant medication and a 12-hour "washout" period was achieved.

Table 4C (see page 92) presents the measures of central tendency and results of statistical tests used to compare classroom actigraph activity levels among boys and girls, second and third graders, medicated and unmedicated, as well as children of various ethnic groups. As shown, there were no significant differences in classroom PIM activity among any of these subgroups.

Impulsivity data. A series of Pearson Product Moment Correlations were calculated to explore the potential relationships between continuous participant descriptor variables (i.e., IQ, age, and SES) and measures of impulsivity (i.e., CPT Impulsivity Scores, number of positively endorsed DISC impulsivity symptoms). Differences in mean impulsivity measures among subgroups of children of various ethnic backgrounds, ages, genders, and medication statuses were examined using an ANOVA and T tests

Table 4C

Comparison of Mean Classroom Activity Measures Among Subsamples of Participants

Descriptor	*n*	*M*	*SD*	*t*	*F*	*p*
Gender						
Male	27	6593.77	2620.71	-.259		.797
Female	20	6802.26	2880.84			
Grade						
2	17	7071.10	2170.73	.738		.465
3	30	6462.28	2978.89			
Medication						
No	41	6264.82	2120.28	-1.76		.136
Yes	6	9536.55	4492.31	(unequal variances)		
Ethnicity						
Caucasian	22	6334.23	2042.95		.290	.915
Afro-Amer	3	7459.76	1026.26			
Hispanic	12	6817.22	3501.25			
Asian	1	7997.93				
West Indian	2	7570.89	1222.27			
Mixed	2	5847.84	2069.40			

Note: Gender = male or female participant, Grade = 2nd or 3rd grade participant, Medication = participant did/did not receive stimulant therapy treatment, Ethnicity = ethnic background of the proband: Caucasian, African-American, Hispanic, Asian, West Indian and Mixed (i.e., biracial).

---

respectively. These findings are presented in Tables 5A and B.

Table 5A (see page 94) indicates that the correlation between IQ scores of participants and the number of impulsivity symptoms endorsed by parents on the DISC interview approached statistical significance ($r = .52$, $p = .009$). Table 5A also indicates a negative correlation between participant age and CPT Impulsivity that did not attain statistical significance ($r = -.29$, $p = .051$). As there is a high probability that these results were due to chance fluctuations in the data, these correlations were not considered to be statistically significant.

A series of statistical tests were conducted to determine if performance on the CPT Impulsivity measure was statistically different among children of different genders, grade levels, medication statuses, and ethnic backgrounds. According to Table 5B (page 95), a one-way ANOVA revealed significant group differences in CPT Impulsivity scores among the various ethnic groups. A *post hoc* test of the differences in CPT impulsivity among children of various ethnic backgrounds could not be conducted, however, as one of the groups had only one participant. Additionally, when the F test was rerun without this participant, no significant differences in CPT impulsivity were found among the various ethnic groups. An independent samples T tests reported in Table 5B indicates that male

Table 5A

Pearson Correlations Between Participant Characteristics and Measures of Impulsivity

Measure	*IQ*	*Age*	*SES*
DISC-Impul	.542* (22)	.113 (22)	-.131 (20)
DRS-Impul	.005 (46)	-.130 (46)	-.191 (44)
CPT Impul	-.137 (46)	-.290^ (46)	.099 (44)

Note: ( ) = *n*s for each analysis, DISC-Impul = # of DISC impulsivity symptoms endorsed by parents, DRS-Impul = number of DRS-T impulsivity symptoms rated as "often" or "very often" by teachers, CPT-Impul = CPT Impulsivity score, IQ = Kaufman Brief Intelligence Test Composite IQ score, Age = age in months, SES = Hollingshead Socio-economic Status score.

* $p = .009$; ^ $p = .051$.

participants had higher mean CPT Impulsivity scores compared to female participants. However, this difference did not reach the statistical criterion set for this study and, thus, may have been due to chance. No significant group differences were found among the CPT Impulsivity scores of second *vs.* third grade or medicated *vs.* unmedicated children.

Inattention. Table 6A (see page 97) presents the results of correlational analyses that examined potential relationships between participant characteristics, and measures of

Table 5B

Comparison of Mean CPT Impulsivity Scores Among Subsamples of Participants

Descriptor	*n*	*Mean*	*SD*	*t*	*F*	*p*
Gender						
Male	26	4.69	8.09	2.13		.043
Female	20	1.25	1.41	(unequal variances)		
Grade						
2	17	5.65	9.82	1.62		.125
3	29	1.76	1.92	(unequal variances)		
Medication						
No	41	3.05	6.59	-.446		.658
Yes	5	4.40	3.85			
Ethnicity						
Caucasian	22	2.22	2.50		62.95	.000*
Afro-Amer	3	3.67	3.79	(unequal variances)		
Hispanic	12	1.08	.90			
Asian	1	41.00				
West Indian	2	1.50	2.12			
Mixed	2	.50	.707			

Note: Gender = male or female, Grade = third or fourth grade, Medication = participant did/did not receive medication for AD/HD, Ethnicity = proband ethnic background: Caucasian, African-American, Hispanic, Asian, West Indian and Mixed (i.e., biracial); * = significant *p* level.

---

inattention. Relationships between IQ, age, and SES, ratings and reports of proband inattention, and CPT Inattention scores were low and nonsignificant. The correlation between mean CPT Inattention score ($M = 5.76$, $SD = 5.26$) and mean age of the participants (M= 8 years, 2 months, $SD = 8.5$ months) only approached significance ($r = -.289$, $p = .051$) and did not meet the more stringent alpha level chosen for this study. Thus, this finding was considered to be due to chance.

Table 6B (see page 98) presents the means, standard deviations, and results of the statistical tests used to compare subgroups of children on the CPT Inattention measure. An examination of these data indicates no significant differences in the mean CPT Inattention scores among children of different genders, grade levels, ages, or ethnic backgrounds.

Summary. When continuous participant descriptor variables were examined, correlational analyses revealed a significant inverse relationship between participant age and individual test session PIM activity. A correlation between age and class session PIM was in the same direction but did not attain significance. Similarly, a positive relationship between IQ and SES approached statistical significance. Significant differences in PIM activity were found between medicated and unmedicated children such that mean

Table 6A

Pearson Correlations Between Participant Characteristics and Inattention Measures

Measure	*IQ*	*Age*	*SES*	*Measure*	*IQ*	*Age*	*SES*
TRS-Attn	-.144	.060	-.276	DISC-Inatt	.297	.024	-.165
	(47)	(47)	(45)		(22)	(22)	(20)
PRS-Attn	-.192	-.107	-.274	CPT Inatt	-.165	-.289^	-.083
	(47)	(47)	(45)		(46)	(46)	(44)
DRS-Inatt	-.159	-.099	-.240				
	(46)	(46)	(44)				

Note: ( ) = *n*s for each analysis, TRS-Attn = teacher BASC Attention Problems *T* score, PRS - Attn = parent BASC Attention Problems *T* score, DRS-Inatt = number of teacher-ratings of "often" or "very often" for inattention symptoms on the DRS-T, DISC-Inatt = number of parent-endorsed inattention symptoms on the DISC, CPT-Inatt = Continuous Performance Test Inattention Score, IQ = KBIT Composite IQ, Age = age in months, SES = Socio-economic status scores (continuous variable); ^ = $p = .051$.

actigraph activity levels were significantly higher for children who had been receiving stimulant medication treatment compared to medication-naive participants. Greater magnitude of movement among previously medicated children, however, was found in the

Table 6B

Comparison of Mean CPT Inattention Scores Among Subsamples of Participants

Descriptor	*n*	*Mean*	*SD*	*t*	*F*	*p*
Gender						
Male	26	5.42	6.21	-.492		.625
Female	20	6.20	3.81			
Grade						
2	17	7.29	5.96	1.21		.243
3	29	4.86	4.69	(unequal variances)		
Medication						
No	41	5.39	4.71	-1.38		.174
Yes	5	8.80	8.79			
Ethnicity						
Caucasian	22	5.41	4.81		1.48	.221
Afro-Amer	3	8.33	9.29			
Hispanic	12	4.67	4.60			
Asian	1	14.00				
West Indian	2	10.50	3.54			
Mixed	2	1.50	.71			

Note: Gender = male or female participant, Grade = 2nd or 3rd grade participant, Medication = participant did/did not receive medicine for the treatment of AD/HD, Ethnicity = five categories including Caucasian, African-American, Hispanic, Asian, West Indian and Mixed (i.e., biracial).

---

individual but not classroom sessions. Moreover, previously medicated children did not receive their usual dose of medication on the morning of testing.

In terms of impulsivity, Pearson correlations indicated a trend in the relationship between proband IQ and the number of parent-reported DSM-IV impulsivity symptoms on the DISC interview. Similarly, a trend suggesting an inverse relationship between participant age and CPT Impulsivity was also found. Significant differences in CPT Impulsivity scores were initially found among participants grouped according to their ethnicity. The source of these differences could not be determined due to the presence of a single participant in one of the groups. When this participant was removed from the anlaysis, there were no significant CPT Impulsivity differences among the various ethnic groups.

Regarding the potential relationship between CPT Inattention and participant characteristics, a correlation between this laboratory measure and the mean age of the participants approached statistical significance. However, this relationship did not surpass the statistical criterion set for this study. In addition, no statistically significant differences in CPT Inattention were found among participants grouped by age, gender, ethnicity, grade, SES, or medication status.

Testing the Hypotheses

Individual vs. Classroom Activity

Mean classroom activity level and mean activity as recorded during individual testing are reported in Table 3 (see page 84). As there are no published norms for PIM activity recordings, it is impossible to qualitatively describe these means. However, a paired samples *T* test revealed that children's actigraph activity was significantly higher in the classroom relative to that measured during the individual test sessions (t (46) = 10.4, $p < .001$). This finding confirms the first hypothesis (HO1) and is consistent with the findings of Sleator and Ullman (1981) who indicated that hyperactive children frequently do not present with motor over-activity in the one-on-one clinical setting.

In order to test the hypotheses that parent and teacher ratings of children's activity levels predict actigraph measures of activity during clinical and structured class sessions respectively, four linear regression analyses were conducted. Two of these analyses employed combined parent-derived data as predictors of classroom and individual session activity and two regressions used combined teacher data to predict outcome. The means, standard deviations, *n*s, multiple regression coefficients, *F*, beta, and *p* values for these analyses appear in Tables 7 and 8.

Predictors of Activity in the Individual Testing Sessions

Parent ratings and reports as predictors of individual testing activity. The results of a linear regression analysis using parent-derived BASC-PRS Hyperactivity *T* scores and the number of parent-endorsed DSM hyperactivity symptoms on the DISC-IV to predict mean activity recorded during the individual testing session appear in Table 7 (see page

Table 7

Parent and Teacher Ratings/Reports of Children's Activity Level as Predictors of Clinical Session Activity.

Measure	*Mean*	*SD*	*n*	R^2	*F*	*Beta*	*t*	*p*
Parent Measures								
1. PRS Hyp	57.14	13.9	22			.714	1.48	.156
2. DISC Hyp Sxs	1.27	1.8	22			-.767	-1.59	.129
Criterion Measure								
PIM Indiv.Session	3696.57	1517.03	22	.118	1.27			.304
Teacher Measures								
1. TRS Hyp	51.70	11.03	46			-.031	-.04	.965
2. DRS-T Hyp	1.35	1.78	46			.296	1.04	.306
Criterion Measure								
PIM Indiv.Session	3730.37	1748.40	46	.081	1.90			.162

Note: PRS Hyp = BASC-PRS Hyperactivity *T* score, DISC Hyp Sxs. = number of parent endorsed hyperactivity symptoms on the DISC, TRS Hyp = BASC-TRS Hyperactivity *T* Score, DRS-T Hyp = the number of hyperactivity symptoms rated as "often" or "very often" by teachers on the Diagnostic Rating Scale - Teacher version, PIM Indiv Session = PIM activity recorded in the individual testing session.

101). When entered simultaneously into a regression equation, PRS Hyperactivity and the number of positive DISC symptoms were not significant predictors of individual test session activity. Thus, the second hypothesis that parent reports and ratings of children's activity would predict PIM activity during one-on-one testing was not confirmed. It should be noted that because not all parents completed the DISC, this analysis had an *n* of only 22 participants. Thus, the power to detect effects was low for this analysis.

Teacher ratings as predictors of individual session activity. The lower half of Table 7 presents the means and standard deviations for teacher-derived hyperactivity ratings on the TRS and DRS-T. When simultaneously entered into a regression equation, the mean BASC TRS Hyperactivity *T* score and the mean number of DRS-T Hyperactivity symptoms rated "2" or "3" did not significantly predict mean PIM activity during individual testing. This finding was consistent with the expectation that teacher ratings of children's activity would not predict mean PIM activity in the individual testing session (HO5). Thus, hypothesis 5 was confirmed.

In summary, separate regression equations computed for parent- and teacher-derived ratings and endorsements of DSM-IV hyperactivity symptoms indicated that neither of these was a significant predictor of children's recorded movement in the one-on-one testing session.

Predictors of Activity in the Classroom Session

Parent ratings/reports as predictors of classroom actigraph recordings. An examination of the data in the upper half of Table 8 (see page 103) indicates that when the mean PRS Hyperactivity *T* score and average number of parent-endorsed hyperactivity

Table 8

Parent and Teacher Ratings/Reports of Children's Activity Level as Predictors of Classroom Session Activity.

Measure	*Mean*	*SD*	*n*	R^2	*F*	*Beta*	*t*	*p*
Parent Measures								
1. PRS Hyp	57.14	13.9	22			.507	1.03	.318
2. DISC Hyp Sxs	1.27	1.8	22			-.613	-1.24	.231
Criterion Measure								
3. PIM Class.	6815.41	2508.5	22	.076	.784			.471
Teacher Measures								
1. TRS Hyp	51.70	11.03	46			-.233	-.804	.426
2. DRS-T Hyp	1.35	1.78	46			.405	1.035	.169
Criterion Measure								
3. PIM Class.	6785.09	2641.54	46	.056	1.28			.289

Note: PRS Hyp = BASC-PRS Hyperactivity *T* score, DISC Hyp Sxs. = number of parent-endorsed hyperactivity symptoms on the DISC, TRS Hyp = BASC-TRS Hyperactivity *T* score, DRS-T Hyp = number of teacher-endorsed hyperactivity symptoms rated as "often" or "very often" on the DRS - T, PIM Class Session = Mean Activity Level as recorded during classroom sessions.

symptoms on the DISC were entered simultaneously into a regression equation, these variables failed to predict actigraph measures of children's movement during structured classroom activities. This finding was consistent with expectations and, therefore, confirmed the third hypothesis (HO3). The reader is reminded that complete DISC data were available for only 22 participating parents and that these results may have been due, in part, to limited statistical power to detect an effect.

Teacher ratings as predictors of classroom actigraph recordings. Mean TRS Hyperactivity *T* scores and the number of frequently occurring DRS-T hyperactivity symptoms were entered simultaneously into a regression equation to predict classroom actigraph activity. The lower half of Table 8 shows that statistical significance was not attained. Thus, combined teacher ratings and symptom endorsements did not significantly predict classroom actigraph activity levels in this sample. This finding was contrary to the hypothesis (HO4) that the combination of TRS Hyperactivity and the number of frequently occurring parent-endorsed hyperactivity symptoms on the DRS-T would be significant predictors of children's classroom activity levels as recorded by actigraph. The fourth hypothesis, therefore, was not confirmed.

Predictors of CPT Impulsivity Data

In order to test the hypotheses that parent (HO6) but not teacher (HO7) assessments of proband impulsivity and hyperactivity would predict CPT Impulsivity scores, two regression equations were constructed. Measures of central tendency and the results of these statistical analyses may be found in Table 9 (see page 105).

Parent ratings and reports as predictors of CPT impulsivity. As reported in the

Table 9

Parent and Teacher Ratings/Reports of Children's Hyperactivity and Impulsivity as Predictors of Mean CPT Impulsivity Scores.

Measure	Mean	SD	n	R^2	F	Beta	t	p
Parent Measures								
1. PRS Hyp	56.76	14.16	21			.264	.632	.535
2. DISC Impul Sxs.	.67	1.11	21			-.300	-.718	.482
Criterion Measure								
3. CPT Impulsivity	3.48	8.79	21	.028	.26			.774
Teacher Measures								
1. TRS Hyp	51.78	11.14	45			.057	.287	.776
2. DRS-T Impul	.67	1.07	45			-.094	-.472	.639
Criterion Measure								
3. CPT Impulsivity	3.24	6.40	45	.005	.11			.895

Note: PRS Hyp = BASC-PRS Hyperactivity *T* score, DISC Impul Sxs. = number of parent endorsed DISC impulsivity symptoms, TRS Hyp = BASC-TRS Hyperactivity *T* score, DRS-T Impul = number of teacher-endorsed impulsivity symptoms rated "often" or "very often" on the DRS -T, CPT Impulsivity = Continuous Performance Test Impulsivity Score.

top half of Table 9, the simultaneous entry of the mean BASC-PRS Hyperactivity Scale *T* score and the mean number of positive impulsivity symptoms endorsed on the DISC interview into a regression equation resulted in a nonsignificant R^2 of .028. The nonsignificant beta weights for these two predictors are also given in Table 9. These figures indicate that, contrary to the sixth hypothesis, combined parent ratings of children's hyperactivity and their responses regarding the frequency of DSM-IV impulsivity symptoms did not predict mean CPT Impulsivity. This analysis had limited power to detect effects as only 21 participants completed DISC interviews.

Teacher ratings and reports as predictors of CPT impulsivity. The mean TRS Hyperactivity *T* score that included items related to impulse control and mean number of frequently occurring impulsivity symptoms endorsed on the DRS-T were simultaneously entered into a regression equation to determine if these were significant predictors of CPT Impulsivity. Table 9 (page 105) indicates that the R^2 and beta weights of these predictor variables did not significantly predict the criterion measure. This result was consistent with the expected relationship and thus confirms hypothesis 7.

Predictors of Inattention

In order to test the hypotheses that teacher (HO9) but not parent (HO8) combined endorsements of DSM-IV inattention symptoms and ratings of inattentive behavior would predict CPT Inattention scores, two linear regression equations were computed. One of these used parent-derived data (mean BASC-PRS Attention Problems *T* score and mean number of DISC Inattention symptoms). The other analysis used teacher-derived inattention data (i.e., mean BASC-TRS Attention Problems *T* score and mean number of

DRS-T inattention symptoms that occurred "Often" or "Very Often) to predict the criterion. The data from these analyses including means and standard deviations of each measure appear in Table 10 (see page 108).

Parent data as predictors of CPT Inattention scores. The figures in the upper half of Table 10 indicate that, when the mean parent-rated Attention Problem *T* score (BASC-PRS) and the number of Inattention symptoms endorsed on the DISC were simultaneously entered into a regression equation, the R^2 of .276 had an *F* value that approached significance. This trend in the prediction of CPT Inattention scores may have fallen short of significance due to the small sample size ($n = 21$) resulting from changes in the study's protocol.

Teacher data as predictors of CPT Inattention scores. The bottom half of Table 10 provides the results of a second linear regression analysis that used teacher ratings and endorsements of probands' DSM-IV inattention symptoms as predictors of CPT Inattention. When the mean TRS Attention Problem *T* score and number of DRS-T inattention symptoms rated "Often" or "Very Often" were simultaneously entered into a regression equation, statistical significance was not attained. Thus, teacher ratings of children's inattentive behavior did not significantly predict CPT inattention scores in this sample. These findings are inconsistent with the hypothesis that teacher ratings and endorsements of inattention symptoms (HO9) would predict performance on the CPT Inattention measure. Thus, HO9 was not confirmed.

A summary of the results of hypothesis-testing appears in Table 11 (see page 109).

Table 10

Parent and Teacher Ratings/Reports of Attention Problems as Predictors of Mean CPT Inattention Scores.

Measure	Mean	SD	n	R^2	F	Beta	t	p
Parent Measures								
1. PRS Attn Prob	60.14	11.97	21			.333	1.05	.309
2. DISC Inatt Sxs.	2.71	3.69	21			.224	.71	.490
Criterion Measure								
CPT Inattention	6.52	6.39	21	.276	3.43			.055
Teacher Measures								
1. TRS Attn Prob	54.00	12.30	45			.008	.04	.972
2. DRS-T Inatt	2.80	3.19	45			.275	1.21	.232
Criterion Measure								
CPT Inattention	5.87	5.27	45	.079	1.80			.178

Note: PRS Attn Prob = BASC-PRS Attention Problems *T* score, DISC Inatt Sxs = mean number of inattention symptoms endorsed on the DISC-IV parent interview, TRS Attn Prob = BASC-TRS Attention Problems *T* score, DRS-T Inatt = mean number of inattention symptoms rated "2" or "3" teachers on the Diagnostic Rating Scale, CPT Inattention = Continuous Performance Test Inattention Score.

Table 11

Results of Tests of the Hypotheses

Hypothesis	*Results*
Activity	
HO 1: Classroom Actvity > Individual Activity	Confirmed
HO 2: Parent reports and ratings will predict proband individual test session PIM activity.	Not confirmed
HO 3: Parent reports and ratings will not predict classroom PIM activity.	Confirmed
HO 4: Teacher reports and ratings will predict class PIM activity	Not confirmed
HO 5: Teacher reports and ratings will not predict individual test test session PIM activity.	Confirmed
Impulsivity	
HO 6: Parent reports and ratings will predict CPT Impulsivity scores	Not confirmed
HO 7: Teacher reports and ratings will not predict CPT Impulsivity scores	Confirmed
Inattention	
HO 8: Parent reports and ratings will not predict CPT Inattention	Not definitive
HO 9: Teacher reports and ratings will predict CPT Inattention	Not confirmed

Additional Analyses

BASC Parent Ratings as Predictors of Actigraph and CPT Measures

As mentioned previously, the use of multiple predictors of PIM activity and CPT impulsivity and inattention reduced the power to detect potential relationships in all of the analyses involving the DISC parent interview data. The limited number of DISC respondents ($n = 22$) was due to changes in the original conception of the study as explained previously. *T*-tests were therefore conducted to determine if there were significant differences between the mean parent BASC ratings of children who were included ($n = 22$) and those who were not included ($n = 25$) in the analyses described above. In terms of BASC-PRS Hyperactivity, the mean *T* score of those included in the analysis ($M = 57.14$, $SD = 13.93$) and that of participants who were not included due to a lack of DISC interview data ($M = 48.08$, $SD = 12.93$) yielded a *T* value of 2.3 that approached significance ($p = .025$) with 45 degrees of freedom. Moreover, the mean BASC-PRS Attention Problems *T* score for those included ($M = 60.05$, $SD = 11.69$) and those excluded ($M = 50.44$, $SD = 9.39$) from the analyses, revealed significant differences between these two groups ($t(45) = 3.12$, $p < .003$). These results were not surprising since the original procedure for the study was to administer the interview only to parents of children who received significant ratings (*T* scores ≥ 60) of hyperactivity/impulsivity and/or attention problems on the BASC. Differences in the PRS ratings of hyperactivity and inattention among participants who completed all facets of the study and those who did not suggest that completers and non-completers represented two distinct populations; a more impaired and less impaired group of participants. Thus, analyses based on parent

data examined a more impaired group of children than those based on teacher data.

In order to offset the problem of low power as a result of having only 22 completed DISC interviews, a series of regression equations were calculated using parent BASC data as the sole predictor of PIM activity, CPT Impulsivity, and CPT Inattention. When entered into separate regression equations, the mean BASC-PRS Hyperactivity *T* score was not a significant predictor of either PIM activity during the individual testing (R^2 = .012, $F(1,45)$ = .53, p = .47) or classroom PIM activity (R^2 = .02, $F(1, 45)$ = .934, p = .339). Similarly, mean parent hyperactivity ratings on the BASC (M = 52.04, SD = 14.5) did not predict CPT Impulsivity (R^2 = .008, F (1, 44) = .374, p = .544).

In contrast, a regression equation calculated to determine the ability of parent Attention Problems ratings (M = 54.87, SD = 11.60, n = 46) to predict CPT Inattention scores (M = 5.76, SD = 5.26), attained statistical significance (R^2 = .171, $F(1, 44)$ = 9.04, p = .004). This result suggests that the mean BASC parent rating of probands' inattentive behavior in this sample predicted inattention scores attained on the CPT. This finding is consistent with that of a trend in predicting CPT Inattention from a combination of parent-derived measures of inattention in probands.

Additional analyses were conducted in order to examine the possibility that combined parent and teacher BASC ratings might predict PIM activity, CPT Impulsivity, and/or CPT Inattention scores. Linear regressions revealed that when the mean BASC-PRS and TRS Hyperactivity *T* scores were entered simultaneously, they did not significantly predict classroom (R^2 = .03, $F(2, 44)$ = .674, p = .515) or individual session (R^2 = .06, $F(2, 44)$ = 1.47, p = .242) PIM activity. The simultaneous entry of BASC

parent and teacher Hyperactivity means also did not predict mean CPT Impulsivity (R^2 = .009, $F(2, 43) = .201$, $p = .819$) in this sample. However, when mean parent and teacher BASC ratings of children's Attention Problems were simultaneously entered into a regression equation, there was a trend in the prediction of mean CPT Inattention (R^2 = .18, $F(2, 43) = 4.68$, $p = .014$). Importantly, of the two predictor variables, only the mean parent BASC Attention Problems *T* score approached significance (Beta = .226, $t(44) = 2.63$, $p = .012$). This trend in prediction is consistent with that found in the prediction of CPT Inattention using combined parent ratings and interview endorsements of symptoms. These results also support the finding that the mean BASC-PRS Inattention Problems *T* score was a significant single predictor of CPT Inattention.

Chapter 6

Discussion

This chapter presents a brief summary of the results of this study. The results are then discussed in relation to AD/HD symptomotology including excessive motor activity, poor impulse control, and inattention. The study's strengths and limitations are also presented. Implications of these findings for psychologists and suggestions for future research are presented throughout the chapter.

This study was an attempt to validate objective measures of the constructs associated with Attention Deficit/Hyperactivity Disorder. These constructs include excessive and inappropriate motor activity, poor impulse control, and deficits in sustained and/or selective attention. Standardized structured interviews, behavioral rating scales, and DSM-IV symptom checklists were used as the criteria to validate mechanical measures of the magnitude of activity (actigraphs) and an analogue measure of impulsivity and inattention (the Continuous Performance Test). Participants consisted of a self-selected group of 2nd and 3rd grade students from a public elementary school in Westchester County, N.Y. The range of impairment in the total sample varied considerably including "supernormals" who were asymptomatic, children with mild impairments, and those who were being treated for AD/HD. Importantly, more than half of the participating children (n = 25) who were less impaired according to parent ratings were not employed in the analyses of parent data. This was due to changes in the study protocol. As a result, the findings based on parent data may be indicative of a more impaired group of children.

Discriminant evidence for the PIM activity measure was found in this sample. The

intensity or magnitude of children's movement as recorded by solid-state actigraphs demonstrated discriminant validity in terms of setting (i.e., individual testing *vs.* classroom) and medication status (medicated *vs.* unmedicated) of the participants. The latter finding was evident only in the individual test session. Separate parent and teacher assessments of activity using standardized measures that included rating scales, structured interviews, and symptom checklists did not predict PIM actigraph activity in either setting. Similarly, there was no evidence that an analogue measure of response inhibition (the Continuous Performance Test, CPT) could be predicted by parent or teacher ratings and/or endorsements of children's impulsivity symptoms. Contrary to expectations, teacher responses on standardized measures of inattention did not predict CPT Inattention scores. However, parent-derived attention data from ratings and interviews indicated a trend toward predicting this criterion despite limited statistical power of the parent interviews. Moreover, a follow-up analysis that was conducted to offset the effects of the small number of interview responses ($n = 22$) revealed that, when used as the sole predictor, parent ratings of children's attention significantly predicted scores on the CPT Inattention measure. Similarly, a trend in the prediction of CPT Inattention was found when the data from parent and teacher assessments was combined to predict the analogue measure of inattention. This trend, however, was attributed solely to parent ratings of attention problems in children. Thus, of the parent and teacher ratings of children's attentional capacities, only parent-derived ratings were found to significantly predict CPT Inattention scores in this sample.

Activity

Children who participated in this study were, on average, more active in the classroom than in the one-on-one testing session. Inter-situational differences in PIM activity were significant and could not have been the result of confounds such as the extent of session structure and/or the amount of motor activity required in each setting. Classroom sessions were typically small reading or math groups with a ratio of 5 to 7 students per teacher or teacher-assistant. The structure of these classroom sessions was comparable to that of one-on-one sessions where children were asked to identify pictured objects, solve word puzzles, complete visual matrices, and identify briefly presented visual targets on a computer screen. Classroom and testing tasks were similar in that both were highly structured andrequired close attention to detail, sustained effort, and concentration.

The finding of significant setting differences in activity was compelling considering the findings of several studies indicating that AD/HD symptoms may be attenuated by close adult supervision (Barkley, 1998; Sleator & Ullman, 1981). Although small group size and relatively close proximity of the teacher in the classroom setting may have attenuated activity somewhat, these factors did not reduce classroom activity to levels similar to those recorded in the individual test session. An examination of children's activity levels during whole-class activities such as teacher-directed lessons might further clarify the nature of the differences in children's activity during specific classroom activities (i.e., seatwork, teacher lecture, test-taking). When compared to carefully kept diaries of classroom activities, it is possible that the lowest activity levels would be attained during one-on-one sessions involving teacher-student dyads. In contrast, the

results of this study suggest that the highest levels of activity would occur during class participation and teacher-directed lessons. One might further hypothesize that small group lessons such as those recorded in this study may be associated with a moderate magnitude of PIM activity. The need for normative PIM actigraph data, particularly data collected in various situations and settings, is essential to further examine the discriminant validity of PIM actigraph measures.

Additional discriminant evidence for the PIM actigraph measure was suggested by the finding of activity differences between children previously diagnosed with and treated for AD/HD and those without this condition. After a 12- hour medication "washout" period, participants who had been treated with stimulant medication evinced higher levels of PIM activity compared to medication-naive children. One may further assume that this result was an indication that PIM activity discriminated diagnosed from non-diagnosed children. This assumption, however, is tenuous because of the possibility that at least some unmedicated children were undiagnosed but symptomatic. As children were not diagnosed as part of the protocol of this study, it is impossible to know the exact nature of the undiagnosed group. Thus, distinct groups of AD/HD, non-AD/HD, psychiatric, and normal controls should be studied to determine if subgroup differences in PIM activity exist.

Higher levels of activity among medicated *vs.* unmedicated children were evident only during individual testing sessions where the child-investigator interaction would be expected to attenuate hyperactivity in affected children (Sleator & Ullman, 1981). In this study, the one-on-one nature of the testing session did not reduce the magnitude of

movement in previously medicated children to the same levels as their unmedicated peers. As such, PIM may distinguish impaired from unimpaired children just as did the Zero Crossing (ZC) activity measure employed in previous studies (Inoue et al., 1998; Porrino et al., 1983). Zero Crossing, a measure of movement frequency, has been found to discriminate among some subgroups of AD/HD (Inoue et al., 2000) and to differentiate among children diagnosed with AD/HD, psychiatric controls, and normal/subclinical children (Halperin et al., 1992). The current study extends these findings by indicating that PIM, a measure of the magnitude of movement, has the potential to discriminate children with AD/HD from non-affected children within a particular (i.e., one-on-one instructional) setting. However, the utility of PIM as a means of differentiating AD/HD from other clinical groups requires further investigation. Children's classroom activity patterns must also be examined in order to understand the finding of a lack of discriminant validity among groups of children within this setting. It is possible that behavioral management or other classroom techniques were in force during activity assessment. These classroom contingencies may have ameliorated excess activity resulting in the finding of no differences in PIM between medicated and unmedicated participants. However, this would not explain the overall finding of higher levels of activity in the classroom where such interventions were in place *vs.* individual testing sessions where no intervention existed. If classroom contingencies attenuated activity, then it would follow that there would be no significant differences in activity level between classroom and individual sessions. This was not the case here. Furthermore, a group of 22 participants examined in this study were found to be more impaired than those who did not complete

the study. Thus, it is un likely that behavioral techniques significantly reduced classroom activity to levels attained during the individual sessions.

The finding of differences in the magnitude of movement between classroom and individual activities suggests that PIM actigraph data may be useful in distinguishing differences in movement that accompany changes in the learning environment. If this hypothesis is correct, then PIM may be a more accurate measure of subtle changes in activity (i.e., activity during individual tutoring *vs.* small and large group instruction). Replication of these results is necessary in order to further establish the presence of context-related discriminant validity of PIM activity data.

The impact of setting upon mechanical recordings of activity found in this study is consistent with previous research. For example, Porrino et al. (1983) concluded that, although hyperactive children are generally more active in all situations, ZC differences between affected and non-affected children were greater in specific situations (i.e., during classroom reading and mathematics). During relatively unstructured tasks such as free-play, these investigators found that the frequency of movement in children who were not hyperactive increased. As a result, there were no differences in ZC activity between children who were identified as being hyperactive and those who were not in this relatively unstructured situation. Like the Porrino study, Dane et al. (2000) found that situational and temporal (i.e., time of day) conditions influenced activity levels. As time of day was held constant in this study, responses to temporal changes could not be examined. However, the current study replicated Dane et al.'s findings of situation-specific differences in movement among diagnosed and undiagnosed children.

In contrast to the Porrino et al. study, actigraph activity differences among medicated and unmedicated children in this study were more pronounced in highly structured individual settings but not in during small group reading and math activities in the classroom. As Porrino et al. did not specify the nature (i.e., amount of structure, group size, teacher-student ratio) of reading and mathematics instruction in their study, it is possible that environmental differences resulted in discrepancies between this and previous findings regarding classroom activity.

Another possible explanation for the differing activity findings between this and previous studies is that the relationship between ZC and PIM is not known. If these measures are unrelated, then disparate findings would certainly be expected. If related, then the nature of this relationship would require clarification so that the data could be interpreted unambiguously. Further exploration of this potential relationship is necessary so that overarching theories of activity can be developed.

Regarding possible relationships among demographic and outcome measures of activity, this study found that PIM activity decreased with the age of the participant. A similar relationship was noted by Hart, Lahey, Loeber, Applegate, and Frick (1995). In their 4-year longitudinal study of school-aged boys who were diagnosed with DSM-III-R ADHD, these investigators found that hyperactivity symptoms declined over time. Further, these declines were not attributed to treatment or the effects of repeated assessment. In addition, Hart et al. found that attention difficulties persisted as children aged. The current study partially replicated these findings using a cross-sectional design. Here, young children's activity was inversely correlated with age but only in the individual

testing setting. This finding provides support for the hypothesis that there is a developmental trajectory in AD/HD such that hyperactivity symptoms are associated with younger children and they attenuate as the child ages (also see Lahey et al., 1994).

In terms of individual session and classroom activity, neither single nor combined parent or teacher ratings, symptom checklists, or interview data predicted PIM actigraph levels. The lack of relationships between parent reports and PIM classroom data as well as teacher reports and PIM one-on-one testing data were expected based on evidence that parent reports of school behavior are consistent with reports of at-home behavior but not with teacher reports of school behavior (Mitsis et al., 2000). These results, however, are inconsistent with those of other investigators (Biederman et al., 1990, Biederman et al., 1993; Zeiner, 1997) who suggest that parent-based diagnoses of AD/HD predict teacher ratings and symptom endorsements. The contradictory results of these studies may be attributed to differences in the diagnostic criteria employed. For example, this study and that of Mitsis et al. (2000) used DSM-IV AD/HD criteria whereas, the Biederman et al. and Zeiner studies used older criteria from DSM-III and DSM-III-R. Moreover, the current study suggests that parent ratings and symptom endorsements do not predict activity in a situation that was presumed to be analogous to the home setting (i.e., individual testing). It is therefore possible that the individual testing session did not reflect the home situation and thus hypothesized relationships were flawed. In terms of classroom activity, teacher ratings of hyperactivity symptoms did not predict small group class activity. This result suggests that small reading and math groups were not analogous to typical classroom activities and that hypothesized relationships were

incorrect.

Differences in inter-situational activity (i.e., individual testing *vs.* small group activities) were demonstrated in this study. However, it is plausible that intra-situational fluctuations in activity also impacted on these results. A study by Zentall (1993), for example, found that the symptoms of AD/HD are context-dependent. Zentall had parents rate proband behavior according to specific contexts. For example, parents were asked specific questions regarding their offspring's tendency to fidget during meals, while watching television, while doing homework, and in other specific contexts within the home setting. Zentall found that, compared to children who were not hyperactive, parents reported more context-dependent symptoms in children who were identified as hyperactive but only in the afternoon during homework and play sessions. These results suggest that context and temporal factors may both impact assessment. Similarly, Porrino and her colleagues (1983) found particularly large differences in ZC activity among hyperactive and non-affected children during classroom math and reading sessions. These findings suggest the need to examine the potential relationship of PIM to specific contexts and to the time of day.

As specific contexts were not part of the rating scale or interview protocols in this study, it is possible that intra-situational context was a confounding variable that resulted in a lack of relationship between parent-and teacher-derived standardized measures of hyperactivity and actigraph activity measures in children. Although Porrino et al. (1983) suggested that children who are identified as being hyperactive are generally more active than their unaffected peers, they also found that actigraph differences among these

subgroups were more pronounced in particular circumstances (i.e., classroom math and reading). Regarding the current study, the requirement for greater self-control during individual tasks within the classroom (i.e., seatwork, test-taking) may have been masked because the level of structure and the nature of the tasks were held constant across the two settings. As a log of specific activities was not kept for classroom activities, it was not possible to analyze these data accordingly. The use of context-specific items on rating scales and interviews may promote increased accuracy and validity of the respondents' reports. Using context as a reference in assessment may also improve clinical understanding of the syndrome and a recognition of the specific activities that require intervention. The development of standardized measures that employ context-dependent items should be considered for future examinations of these questions.

Impulsivity

Data analysis revealed a lack of predictive evidence for the CPT Impulsivity measure. Parent-endorsed impulsivity items on the DISC interview and hyperactivity ratings did not predict CPT Impulsivity as hypothesized. As expected, combined teacher-endorsed impulsivity symptoms and hyperactivity ratings were unrelated to CPT Impulsivity scores. Although the former finding was contrary to expectations, analysis of the impulsivity data was consistent with the activity findings discussed above. If, as suggested by previous investigations, activity and impulsive responding are different aspects of a unitary construct (APA, 1994; Bauermeister et al., 1992; Lahey et al., 1994), then the analyses of impulsivity data should lead to similar conclusions as those of activity data. This was certainly the case in this study where standard assessments of activity and

impulsivity did not predict mechanical or analogue measures of these constructs.

In their study of groups children with non-comorbid psychiatric disorders and normal controls, Halperin et al. (1993) found that participants diagnosed with AD/HD received higher scores on the CPT Impulsivity and Inattention measures compared to those in other patient groups. Discriminant evidence of this nature was not observed in the current study. When medicated and unmedicated children were compared, there were no differences in their CPT Impulsivity or Inattention scores. The reader should note, however, that careful diagnostic subgrouping of children with non-comorbid AD/HD and other psychiatric conditions was not attempted in this study. Thus, these results were likely based on a completely different sample than that used in the Halperin et al. study. Similar discrepant findings due to sample differences were also found in a set of studies by Halperin and his colleagues (Halperin et al, 1992, Halperin, et al., 1993).

Inattention

This study found some evidence that children's ability to attend to briefly presented visual stimuli during a computerized target detection task (the CPT) was related to parent, but not teacher, measures of inattention. A trend in the prediction of CPT Inattention by combined parent ratings of attention problems and identification of inattention symptoms suggests that, despite the low power to detect effects, there may be a relationship between parent-derived standardized and analogue measures of this construct. It is important, however, that this finding be replicated in a larger sample in order to determine if this relationship is statistically robust. It is likely that increases in statistical power will uncover a significant relationship between standardized parent

measures and CPT Inattention scores. This conclusion is supported by the finding that, when used as the sole predictor, parent ratings of children's ability to attend predicted CPT outcome. Moreover, the lack of significant relationships between inattention measures and participant characteristics (i.e., age, medication status, IQ) suggests that these factors can be ruled out as potential confounds.

Strengths and Limitations of the Study

A strength of this study was the procedure used to collect data that allowed for the control of environmental variables that may have spuriously influenced the results. For example, the magnitude of movement during the classroom activity monitoring sessions was greater compared to that of individual test sessions. This finding was robust despite the fact that classroom activities consisted of participation in small reading or math groups that may have spuriously reduced activity levels due to the close proximity of the teacher and/or more individualized adult attention (Sleator & Ullman, 1981). Teacher reports of class activities during the monitoring period avoided the possibility that extraneous classroom activity and changes in the amount of classroom structure may have operated as confounding variables in this study.

As the potential confounds of structure and nature of the task were controlled, it is possible that differences in individual and group session activity levels resulted from differences in proband medication status. Previous studies have indicated that children who display excessive and inappropriate activity levels evince reduced levels of activity when administered stimulant medication (Greenhill et al., 1997; Jacobvitz, Sroufe, Stewart, & Leffert, 1990; Shaywitz & Shaywitz, 1991). In this study, initial interviews

with parents revealed that six participants were being treated with stimulant medication. Thus, actigraph activity levels may have been spuriously reduced in these children. However, a 12-hour "medication washout" period was included in the study protocol to account for this possibility. On the day of testing, none of the six children had taken any stimulant medication since the previous day. As such, it is unlikely that medication would have influenced activity measures taken on the day of testing.

Although the short-term influence of medication on outcome was controlled by the design of the study, it is less clear that long-term effects of medication and rater biases were controlled. Parents of medicated children reported "normalized" behavior on the DISC structured interview. These responses cast doubt on the validity of parent reports. The medication regimen for children taking stimulants typically does not require that they be medicated for a 24-hour period due to the deleterious effects of stimulants on sleep, appetite, and growth (Barkley, 1998). Likewise, many physicians recommend "medication holidays" to offset these iatrogenic effects. Thus, it seems plausible that parents have at least some opportunities to observe their children when the medication has lost its effectiveness (i.e., before bedtime, on weekends, during school vacations). It is surprising that parents of medicated children in this study frequently reported sub-clinical behavioral problems despite indications that their children had previously been diagnosed with AD/HD. It is possible that parents generalized behavioral improvements that occurred as the result of medication thereby creating "halo effects." As a result of biased reporting, participants appeared unimpaired according to DISC interviews and parent BASC ratings.

When questioned about diagnosing medicated children using structured psychiatric

interviews, one of the authors of the DISC-IV (Prudence Fisher, personal communication, October, 20, 2002) indicated that the interview responses of the parents of medicated children resulted in a similar lack of definitive diagnoses in her studies. The lack of significant parent-derived predictors of individual testing activity and impulsivity may therefore be due, in part, to symptom reduction brought about by the effects of long-term medication treatment and the resulting parent biases regarding proband behavior.

Findings of limited predictive evidence for mechanical and analogue measures of AD/HD symptoms may be explained in several ways. First, as explained regarding medicated children, it is possible that response biases may have obscured the relationship between parent ratings and reports and the outcome measures of AD/HD constructs. While this possibility was not specifically examined in this study, several investigators have demonstrated biased reporting of children's behavioral problems among teachers (Kazdin et al., 1983; Schachar et al., 1986). In addition, at least one investigator who was instrumental in the development of the DISC (Prudence Fisher, personal communication, October 20, 2002) suggested that parents tended to normalize the behavior of their medicated children. This finding may be related to the effect that has been called "symptom attenuation" in the literature. Symptom attenuation is operationalized as the tendency of informants to initially endorse a symptom and then deny the presence of the symptom during subsequent diagnostic interviews. This effect has been attributed to aspects of the structured interview. For example, the high sensitivity of general "stem" questions, the length, and/ or complexity of interview items, and placement of the question in the latter half of the interview were related to parent denial of symptoms after an initial

endorsement (see Lucas, Fisher, Piacentini, Zhang, Jensen et al., 1999). In addition, certain parent characteristics such as parent age (younger parents) and parents whose children were older and /or less impaired were found to report fewer symptoms upon subsequent interviews (Piacentini et al., 1999). Piacentini and his co-investigators (1999) concluded that, overall, parents tend to endorse fewer externalizing symptoms such as those associated with AD/HD upon re-testing with the DISC. Symptom attenuation may explain, in part, the lack of parent endorsements of hyperactivity and impulsivity among children previously labeled as AD/HD in the current study. Further examination of the validity of parent responses on interview and ratings of children's behavior is needed to understand the nature of symptom attenuation in diagnosed children.

Another limitation that may have resulted in the lack of significant predictions from parent-derived data in this study is the homogeneity of the sample. As previously stated, 25 subjects were not included in parent data analyses due to the reconfiguration of the study. Parent-rated Attention Problems and Hyperactivity indicated that these subjects were significantly less impaired than those whose data were used in the regression analyses. Thus, the remaining participants were more impaired and formed a more homogeneous group. Statistically speaking, this resulted in a restriction of range. The restricted range of scores in this sample may have spuriously reduced the correlations among subject characteristics, predictor, and criterion measures (Glass & Hopkins, 1996). It is therefore recommended that replication of this study involve complete data from all participants. Additionally, future replication of this study should be done with an unmedicated sample to avoid parent and teacher endorsements of more "normalized"

behavior of medicated participants.

The findings presented here represent a sample of suburban middle- and upper-class children from the lower elementary school grades. It is important to note that these findings may not generalize to urban, rural, lower SES children who are older or younger. Additionally, due to the restriction of range imposed by the design of the original study, these results may not generalize tc less impaired samples of children.

Implications For School Psychologists

The above discussion calls into question the reliance of psychologists and other mental health professionals on standardized procedures in the assessment of child behavioral disorders. It is well known that there is no "gold standard" in determining the presence or absence of social-emotional problems in children. However, the need for more reliable, less biased assessment instruments is apparent. Although, as this study suggests, there is no definitive relationship between standardized and mechanical or analogue measures of the constructs of attention, activity level, and response inhibition, there is no doubt that objective methods are less susceptible to bias and error. As such, a continuation of this line of research may result in new assessment procedures that will improve the validity and reliability of objective/analogue and standardized measures. As discussed previously, efforts to improve paper-and-pencil assessments may include the use of context-based items to improve the accuracy of adult reports of children's behavior. The inclusion of validity scales in structured interviews may also be helpful in identifying inconsistent responses in parent reports.

One reason for the limited predictive validity of laboratory measures is that the

analogue measures used in this study do not assess the constructs that they purport to measure. As reported previously, actigraph and CPT measures have not been found to unequivocally represent the constructs of interest in this study (see Halperin et al., 1992; Halperin et al., 1993). Until more studies are done to define the constructs actually assessed by these instruments, it will be difficult to utilize these technologies as part of the assessment process in schools and clinics.

Limited predictive evidence for actigraph and CPT measures may be the result of informant bias as discussed above. It is possible that parents and teachers do not identify symptoms unless they are quite impairing and therefore rating scales and symptom checklists may not be sensitive to milder cases of disorder. If this is true, then the use of such measures in the identification of children in general education classes may be unwarranted.

The findings of this study underscore the notion that the results of standardized rating scales, interviews, and symptom checklists should be viewed with caution when determining classification and/or special educational placement for a child. In particular, the psychologist must be vigilant regarding potential respondent biases and inaccurate recall that can taint informants' reports. As such, the data presented here support the continued use of multi-modal assessment in order to circumvent these pitfalls in assessment.

Studies indicating that parent reports of AD/HD do not predict teacher information (Mitsis et al., 2000) further support the utility of multi-informant diagnostic procedures in identifying the disorder. Multi-informant assessments have been touted as "best practice"

in the assessment of AD/HD and other childhood disorders (Landau & Burcham, 1995; McConaughy & Ritter, 1995; Young et al., 1995). However, several studies indicate that parent-based diagnostic data predicted teacher data (Biederman et al., 1990, Biederman et al., 1993). These suggest that a single informant is sufficient for making a diagnosis. These discrepancies in the literature require further exploration.

Future research must include the establishment of normative data for the PIM activity measure so that the results will be more meaningful. Specifically, "high," "moderate," and "low" levels of activity must be quantified to improve data interpretation. Similarly, the relationship between activity and context must be further explored. If subtle changes in movement can be detected by PIM actigraph measures, then an objectively established continuum of impairment may be determined and the effects of context may be further clarified using actigraphy.

While objective and analogue measures such as the actigraph and CPT are not "gold standard" measures of activity, impulsivity, and inattention, these may serve a useful purpose in the assessment of overactive and inattentive children. Still, further research is needed so that these instruments can be appropriately employed in the assessment of children with behavior disorders.

Appendix A - Parent Letter

Dear Parent/Guardian:

My name is Ilene Kopstein. I am a doctoral candidate at the CUNY Graduate Center. In order to complete the requirements for a Ph.D. in school psychology, I am required to conduct a study on a topic related to children and schools. I have chosen to study Attention Deficit/
Hyperactivity Disorder (AD/HD). Specifically, I am trying to find the best method(s) for identifying children who are hyperactive, have trouble paying attention, and/or tend to act before thinking.

Purpose of the study: This study is being conducted to determine if mechanical assessments such as computerized attention tasks and activity monitors provide more accurate information regarding the presence of AD/HD symptoms compared to commonly used parent and teacher rating forms.

Parent Involvement:

- You will be interviewed either in-person or by telephone for about 30 - 45 minutes regarding family information (i.e., socioeconomic status) and your child's developmental and medical history.

- You and your child's teacher will be asked to complete a behavior rating form (the Behavioral Assessment Scale for Children) indicating how often particular behaviors or feelings occur (i.e., has difficulty sitting still, worries about things).

- If your child has some symptoms of AD/HD according to the above ratings, you will be interviewed further to see if your child meets the criteria for this diagnosis. The interview takes between 30 and 60 minutes depending on the number of symptoms in question. Interviews will be conducted at your convenience. Your child's teacher will also be asked to indicate the frequency of specific classroom problems (i.e., shyness, hyperactivity).

Child Involvement:

- 2nd and 3rd grade volunteers will be taken out of their classes for approximately 45 minutes. During this time, a brief intelligence screening test and a computer activity which requires the child to pay attention and avoid unnecessary responses will be administered. A battery operated "actigraph" that is approximately the size of a small wristwatch will be placed in the pouch of a belt worn around his/her waist. This actigraph will be used to measure and record the intensity of the movements made by the child during the individual testing session.

- After individual testing, your child will be returned to his/her classroom where

his/her activity will be further measured using the actigraph. After 45 minutes of participation in regular classroom activities, the actigraph will be removed.

- Children who have been taking medication for the symptoms of AD/HD will be asked to remain unmedicated on the morning of testing. Special permission from the child's physician will be needed. A special form will be provided for this.

Confidentiality of all data is assured. Information including names, telephone numbers, addresses, and test results will remain private and will be stored in a locked cabinet to be used only by myself and my advisor, Dr. Georgiana Tryon (Professor of Educational Psychology; GSUC-CUNY) for the purposes of this dissertation. Names, addresses, and phone numbers of students will be used only to contact parents for interviews and for feedback sessions where parents/caretakers will be informed as to the results of the assessment. Personal information (i.e., names) will be removed from the files after all information has been collected. Information will then be identified by code number only. School personnel **will not** be informed of the results of this assessment. However, parents may choose to have the data from this study released to other professionals. A release form will be provided if you would like the information to be shared.

Participation is entirely voluntary and you may withdraw your child from the study at any time without penalty. In addition, participation or refusal to participate will have **no effect** on your child's status at school.

Please complete the bottom of this letter indicating **whether or not** you wish your child to participate. Send this back to me using the enclosed envelope. If you would like your child to participate, you must **also sign and date** the bottom of the enclosed CUNY Graduate Center consent form.

If you have any questions or concerns, do not hesitate to call me at (516) 398-8996 (8 am to 8 pm) or (516) 481-9238 after 8 pm. You may also contact my advisor, Dr. Georgiana Tryon at (212) 817-8293.

Thank you for your interest.

Ilene Kopstein, M.S. Ed

Please check one:

___ I agree to allow my child _____ (name) participate in the study described above. My phone number is _____.

___ I do not give my consent to have my child _____ (name) participate in the study described above.

Appendix B
Parental Consent to Participate in a Research Study

I understand that the New York City Board of Education is cooperating with Ms. Ilene Kopstein, Principal Investigator, and her dissertation supervisor, Dr. Georgiana Tryon, Professor of Educational Psychology, City University of New York (CUNY) Graduate Center (365 5th Avenue, N.Y., N.Y. 10016) in a study designed to identify the differences in activity level, attention, and impulsive responding among 2nd, and 3rd grade children with subtypes of Attention-Deficit/Hyperactivity Disorder (AD/HD) and those without this condition. This study is being conducted in order to fulfill the requirements of the School Psychology doctoral program at the CUNY Graduate Center.

If I wish my child to participate in this study, I will give written consent by signing this form. As has been explained to me, my involvement includes 2 sessions. At the first session, I will be asked to complete a social status questionnaire and a rating scale of my child's behavior and feelings. I will then be interviewed concerning my child's medical and educational history. This initial informational interview will take approximately 30-45 minutes. After this, I will arrange a convenient time to meet with Ms. Kopstein for a second, more in-depth structured interview about my child's behavior and feelings. This second interview will take between 30 and 60 minutes. All interviews will be arranged at my convenience and will take place at the school or over the telephone.

If my child is currently taking medication to control the symptoms of AD/HD, I give my permission to have him/her miss one dose on the morning of testing as this treatment may affect the results of the study. Although I have been informed that no side effects have been associated with discontinuing this type of medication, I have consulted with my child's doctor who has signed the Temporary Discontinuation of Medication form indicating that this procedure is safe.

If my child is selected for the study, I am aware that he/she will be administered a brief assessment of intellectual functioning and a computerized test of attention and impulsivity. During this assessment session, my child's activity level will be monitored using a lightweight device that records movement. This device will be used to monitor activity during individual testing and typical classroom activities. Additionally, I have been informed that my child's teacher will complete two questionnaires regarding his/her behavior.

I am aware that as a participant in this study, my child will be asked to wear a waist-worn activity monitor that resembles a small wristwatch. This device will record his/her movements during a typical classroom instructional period and during the individual assessment period. My child may wear longer clothing to cover this device to allow for unobtrusive measurement during activity assessment. It is possible that my child may experience some discomfort with the apparatus such as a fear of breaking or embarrassment about wearing the device. **If my child experiences any of these, he or**

she may immediately terminate participation without penalty. Participation or withdrawal from this study will in no way affect my child's status at school.

I understand that the results of these assessments and interviews will not become part of my child's school records. They will be used solely for the purposes of this study and will be kept confidential by Ms. Kopstein and Dr. Tryon. School officials will only know that my child is participating in the study. **My son/daughter's status (ADHD or non-ADHD) will not be revealed to school personnel**. In addition, my child's participation or decision not to participate in this study will in no way affect his or her standing in school. I have also been informed that I am free to withdraw my child from this study at any time without penalty.

The data from all measures will be examined by Ms. Kopstein and Dr. Tryon who will compare different groups of AD/HD children with each other as well as with age- and gender-matched non-AD/HD children. The results of activity monitoring, the computerized attention task, interviews, intelligence testing, and parent/teacher ratings of my child's behavior and affect will **not be shared with school personnel.** If I wish, the results of the study (the diagnostic group in which my child was placed) will be revealed to me. I realize, however, that **this is a research study and therefore is not a comprehensive assessment of my child's strengths and weaknesses. If I feel that my child requires further assessment, I may request a referral from Ms. Kopstein or the school psychologist.**

The CPT, actigraph and other assessment instruments used in this study pose no risks to the child participants. However, this study may benefit professionals in the field by providing information regarding the accuracy of parent and teacher reports of children's behavioral difficulties. It may also directly aid the participants by identifying children who may be at risk for behavior and/or emotional disorders.

I understand that participation in this study is **completely voluntary** and that **refusal to participate or withdrawal from the study will involve no penalty to me or my child. Withdrawal from the study or non-participation will not affect my child's status as a student in any way.**

If I have any questions during the course of the study, I will contact Ms. Kopstein (516-398-8996 or 516- 481-9238) or Dr. Tryon (212-817-8293; gtryon@gc.cuny.edu). If I have any questions concerning my rights as a participant, I will call Ms. Hilry Fisher, the Graduate Center, CUNY (212-817-7523; Hfisher@gc.cuny.edu).

_____ _____

Child's Name Parent/Guardian

Appendix C - Intake Interview
Participant Information Sheet

Date_____

Child's Name:_____
ID:_____

DOB:_____ **Place of Birth:**
_____

Parent/Guardian's Name: _____

Address_____

Daytime telephone: _____ **Evening Telephone:**
_____

Marital Status (circle one): Married / Single / Divorced/Separated / Widowed

Classroom Teacher_____**Grade**_____ **Room**
_____

Does the parent speak English?_____

What language is spoken at home?

Is your child in special education?_____

Has he/she ever been retained/left back?_____

Is your child considered to have learning problems?_____ **What type?**_____

Is child on any medication?_____**If so, which?**_____

Are you willing to allow your child to miss one morning dose of medicine for testing?
_____

Has your child be absent from school 50% or more of the time this year, last year?_____

Has the child ever suffered a traumatic brain injury or lost consciousness?____

Appendix D-Temporary Discontinuation of Medication

Date:_____

Dear Dr._____:

I wish to have my child _____participate in a research study on Attention-Deficit/Hyperactivity Disorder. This study is an attempt to validate the assessment methods typically used to determine the diagnosis of AD/HD (i.e., rating scales, interviews) with more objective measures (i.e., activity monitors, attention tasks).

In order to qualify for the study, he/she must not take stimulant or other medications which are used to reduce the symptoms of AD/HD on the morning of testing as these may affect the results..

Please complete and sign the form below which will document the safety of temporarily discontinuing medication.

Thank you for your cooperation.

_____
Parent name (print)

_____
Parent signature

Dear Parent:

As your son/daughter's physician, I feel that it is safe for your child to miss a single dose of his/her medication in order to participate in the research study.

_____
Name of physician (print)

_____
Physician's signature Date

Appendix E- Diagnostic Ratings Scale - Teacher (DRS-T)
Weiler, Bellinger, Marmor, Rancier, & Waber (1999)

Student's Name: _____ Age:_ ___ Date:____

Teacher: _____ Grade: _____ How long have you known this child?_____

Directions: Please indicate how frequently each of these behaviors has occurred over the **past 6 months or since the beginning of the school year.** Each rating should be considered in the context of what is appropriate for the age of the child you are rating.

Frequency Code: 0 = Never, 1 = Occasionally, 2 = Often, 3 = Very Often.

	0	1	2	3
1. Leaves seat in classroom or in other situations in which remaining seated is expected.				
2. Is afraid to try new things for fear of making mistakes.				
3. Loses things necessary for tasks or activities (school assignments, pencils or books).				
4. Has difficulty sustaining attention to tasks or activities.				
5. Talks excessively.				
6. Has difficulty organizing tasks and activities.				
7. Is truant from school.				
8. Bullies, threatens, or intimidates others.				
9. Is forgetful in daily activities.				
10. Is sad, unhappy, or depressed.				
11. Lies to obtain goods or favors or to avoid obligations (i.e. "cons" others).				
12. Feels worthless or inferior.				
13. Does not follows through on instructions and fails to finish schoolwork (Not due to oppositional behavior or failure to understand).				
14. Has difficulty awaiting turn.				
15. Actively defies or refuses to comply with adults' requests or rules.				
16. Fidgets with hands or feet or squirms in seat.				
17. Has difficulty playing or engaging in leisure activities quietly.				

18. Is easily distracted by extraneous stimuli.				
19. Blurts out answers before questions have been completed.				
20. Is angry and resentful.				
21. Loses temper.				
22. Blames self for problems; feels guilty.				
23. Is fearful, anxious, or worried.				
24. Fails to give attention to details or makes careless mistakes in schoolwork.				
25. Deliberately annoys people.				
26. Is "on the go" or acts as if "driven by a motor."				
27. Does not seem to listen when spoken to directly.				
28. Blames others for his or her mistakes or behaviors.				
29. Deliberately destroys others' property.				
30. Feels lonely, unwanted, or unloved; complains that no one loves him/her.				
31. Interrupts or intrudes on others (e.g., butts into conversations or games)				
32. Avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort.				
33. Is self-conscious or easily embarrassed.				
34. Is spiteful or vindictive.				
35. Argues with adults.				
36. Has stolen items of a nontrivial value.				
37. Initiates physical fights.				
38. Runs about or climbs excessively in situations in which it is inappropriate to do so.				
39. Is touchy or easily annoyed by others.				
40. Is physically cruel to people.				

Appendix F - Assent Form for Child Participants
(to be read to potential participants by the experimenter)

Hi _____ (name of child). My name is Mrs. Kopstein. Did your mom or dad tell you that I spoke to him/her? Well, he/she told me I could talk to you today to ask if you would like to help me with a project that I am doing. My project is to study the differences between children in things that are important in school like paying attention and sitting still in class.

First, I will show you how you can help me with my study. Some children move around a lot in class. Others stay pretty still. I want to learn about these differences by recording children's movements using this machine (Show it to the child). This looks like a watch that you might wear on your wrist. This is worn on a belt towards the back so you can move around without it getting in the way. This machine records how much you move around. You can wear it out or under your shirt so that no one can see it. Would you like to try it on? (If the child agrees place it on him/her). Some students will get to wear two of these and some only one. The second one is to make sure that the first one is doing a good job of recording.

Now, while the machine is recording, I am going to ask you guess some words and solve some picture puzzles. Just do the best that you can with these questions because some of these things are for children much older than you are. You won't be graded on this and what you do here won't count towards your grades in school.

Next I am going to ask you to play a computer game. This is a very simple game, nothing fancy like the games you have at home. Letters will flash on the screen and then you will press the spacebar on the keyboard (indicate) whenever the letter "A" is followed by an "X."

After we are done with the computer, I am going to ask you to wear the little recording machine in your class. You don't have to do anything special. Just do what you usually do in class. After the period is over, I will come and take it off and you may go back to your work. Try to forget about the machine and just behave the way you usually do in class

If you are bothered by the machine or if other kids tease you about it, you can tell me and I will take it off. Just tell your teacher that you need to see me. You do not have to be in this study if you don't want to. Do you have any questions that you would like to ask me?

If you understand everything that I've told you and you want to help me, I'd like to you write your name in this space (indicate).

_____ _____

Participant Experimenter Date

Appendix G - Practice Test for the CPT

C	X	F
D	K	A
R	C	B
A	R	X
X	A	A
P	X	X
Z	T	S
X	L	R
T	V	A
R	X	V
A	A	P
X	S	L
G	R	A
D	B	X
A	C	W
B	A	A
T	X	D
F	A	M
A	C	A

Appendix H - Instructions for the administration of the CPT

Read: I am now going to teach you how to play a game using the computer. This is not like a video game or computer game that you might have at home. For this game, I am going to ask you to press the space bar (indicate) on the computer whenever you see the letter "A" followed by the letter "X." Let's practice by looking at some columns of letters. These letters go down the page. I will show them to you one at a time. I want you to say "yes" each time you see an "A" and the an "X." Let's try it.

(Go down the first column of letters exposing one letter at a time. Make corrections, explain the task again if necessary. Once the child has correctly identified three consecutive targets, go on to the next part of the task.)

Computer Practice Session. **Read:** That was good. Now you will do the same thing but this time the letters will come one at a time on the computer screen. One letter will flash on the screen for a short time and then go away. Then the next letter will flash on the screen and also go away. Again, I want you to find all the "As" followed by "Xs." Every time you see and A and then an X, press the space bar here (indicate). This is a practice so you can do it again if you want to. O.K., now the letters will come on the screen. Keep watching.

Help the child and correct any mistakes during the practice trial. If mistakes are made tell the child to do the practice again. If the child gets 3 consecutive correct, go on.

Test Trial: **Read:** You did a great job in practice. This part is the real game. This time the letters will come and go away more quickly than during the practice. Also, there will be many more letters so this part of the game will take longer than the practice. Just do your best finding the 'As' followed by 'Xs.' Ready?

Remain near the child for the first several minutes of the test trial. Make corrections for the first **two** targets (i.e.: "You got it" or "You missed that one." Then walk away and busy yourself with another task.

When the child has finished thank him. Praise his effort ("I like that you tried your best.").

Appendix I - Classroom Activity Assessment- Teacher Report

Directions: Please complete this brief questionnaire to assess the type of activities in which the student participated during the activity monitoring period of the research protocol.

1. When the student returned to class for activity monitoring, what activity was the class engaged in?

_____.

2. Was this an activity that required the child to move around? Y/ N

3. Did the child get up to go to the bathroom, chalkboard, etc. during this time? Y / N

4. If so, approximately how many times did he/she get out of his/her seat? _____.

5. Did the class activity change before the experimenter returned to remove the actigraph? Y/ N

6. What was the second class activity?_____.

7. Did this second activity require the student to move around? Y / N

8. Approximately what time did the second activity begin?_____.

Thank you for your cooperation! -

Appendix J

Waiver of Confidentiality

As the parent/guardian of _____, I hereby waive my right to confidentiality and give permission to Ms. Kopstein, Principal Investigator of the research study, to release the results of the following assessment measures_____

_____

to the following person(s)_____

_____

_____.

I understand that information collected by Ms. Kopstein is for research purposes and should not be used to make classification or placement decisions. However, I would like these data to be made available to the party or parties that are named above.

_____

Parent/guardian (print)

_____

Signature

_____

Date

References

Achenbach, T.M., & Edelbrock, C. (1983). *Manual for the child behavior checklist and revised child behavior profile*. Burlington: University of Vermont.

Achenbach, T.M., & Edelbrock, C. (1986). *Manual for the teacher's report form and teacher version of the child behavior profile*. Burlington: University of Vermont, Department of Psychiatry.

Achenbach, T.M., & Edelbrock, C. (1991). *Manual for the youth self-report and profile*. Burlington: University of Vermont, Department of Psychiatry.

American Psychiatric Association (1968). *Diagnostic and statistical manual of mental disorders* (2nd ed.)., Washington, D.C.: Author.

American Psychiatric Association (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, D.C.: Author.

American Psychiatric Association (1987). *Diagnostic and statistical manual of mental disorders* (3rd ed., rev.). Washington, D.C.: Author.

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

Arnold, L.E., & Jensen, P.E. (1995). Attention-deficit disordeSrs. In H.I. Kaplan & H. Saddock, (Eds.), *Comprehensive textbook of psychiatry: Vol 2*. (6th ed., pp. 2295-2310). Baltimore, MD: Williams and Wilkins.

Banks, W.P. (1970). Signal detection theory and human memory. *Psychological Bulletin, 74*, 81-98.

Barkley, R.A. (1991). The ecological validity of laboratory and analogue assessment methods of ADHD symptoms. *Journal of Abnormal Child Psychology, 19*, 149-178.

Barkley, R.A. (1998). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (2nd ed.). New York: Guilford.

Barkley, R.A., Fischer, M., Edelbrock. C.S., & Smallish, L. (1990). The adolescent outcome of hyperactive children diagnosed by research criteria: I. An 8-year prospective followup study. *Journal of the American Academy of Child and Adoleescent Psychiatry, 29*, 546-557.

Bauermeister, J.J., Alegria, M., Bird, H.R., Rubio-Stipec, M., & Canino, G. (1992). Are attentional-hyperactivity deficits unidimensional or multidimensional syndromes? Empirical findings from a community survey. *Journal of the American Academy of Child and Adoleescent Psychiatry, 31*, 423-431.

Bidaut-Russell, M., Reich, W., Cottler, L.B., Robins, L.N., Compton, W.M., & Mattison, R.E. (1995). The diagnostic interview schedule for children (PC-DISC v. 3.0): Parents and adolescents suggest reasons for expecting discrepant answers. *Journal of Abnormal Child Psychology, 23*, 641-659.

Biederman, J., Faraone, S., Mick, E., Moore, P., & Lelon, E. (1996). Child Behavior Checklist findings further support comorbidity between ADHD and major depression in a referred sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 734-742.

Biederman, J., Faraone, S.V., Milberger, S., Doyle, A. (1993). Diagnoses of attention-deficit hyperactivity disorder from parent reports predict diagnoses based on teacher reports. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 315-317.

Biederman, J., Keenan, K., & Faraone, S. (1990). Parent-based diagnosis of attention deficit disorder predicts a diagnosis based on teacher report. *Journal of the American Academy of Child and Adolescent Psychiatry, 29*, 698-701.

Boliek, C.A.& Obrzut, J.E. (1997). Neuropsychological aspects of attention deficit/hyperactivity disorder. In C.R. Reynolds, & E. Fletcher-Jantzen, (Eds.), *Handbook of clinical child neuropsychology* (2nd ed., pp. 619-633). New York: Plenum Press.

Briggs-Gowan, M.J., Carter, A.S., & Schwab-Stone M. (1996). Discrepancies among mother, child, and teacher reports: Examining the contributions of maternal depression and anxiety. *Journal of Abnormal Child Psychology, 24*, 749-765.

Cantwell, D.P., & Baker, L. (1991). Association between attention-deficit hyperactivity disorder and learning disorders. *Journal of Learning Disabilities, 24*, 81-95.

Camp B.W., & Kozleski E.B. (1997). Developmental Disorders. In W. Hay, J. Groothuis, A Haywood, & M. Levin (Eds.), *Current pediatric diagnosis and treatment*, (13th ed., pp. 86-110) Stamford, CT: Appleton & Lange.

Conners, C.K. (1998). Rating scales in attention-deficit/hyperactivity disorder: Use in assessment and treatment monitoring. *Journal of Clinical Psychiatry, 59, Suppl 7*, 24- 30.

Corkum, P.V., & Siegel, L.S. (1993). Is the continuous performance task a valuable research tool for use with children with attention-deficit-hyperactivity disorder? *Journal of Child Psychology and Psychiatry, 34* 1217-1239.

Costello, A.J., Edelbrock, C.S., Dulcan, M., Kalas, R., & Klaric, S. (1984). *Report of the NIMH diagnostic interview schedule for children (DISC)*. Washington, D.C.: National Institute of Mental Health.

Crocker, L. & Algina, J. (1986). *Introduction to classical and modern test theory* (pp.5-7, 66-86. Orlando, FL: Harcourt, Brace, Jovanovich, Inc.

Dane, A.V., Schachar, R.J., & Tannock, R. (2000). Does actigraphy differentiate ADHD subtypes in a clinical research setting? *Journal of the American Academy of Child and Adoleescent Psychiatry, 39*, 752-760.

Davison, G.C. & Neal, J.M. (1994). *Abnormal psychology* (6th ed., pp.10-23). New York: Wiley & Sons, Inc.

Douglas, V.I., & Parry, P.B. (1983). Effects of rewards on delayed reaction time task performance of hyperactive children. *Journal of Abnormal Child Psychology, 11*, 313-326.

Douglas, V.I., & Parry, P.B. (1994). Effects of reward and non-reward on frustration and attention in attention deficit disorder. *Journal of Abnormal Child Psychology, 22*, 281-302.

Doyle, A., Ostrander, R., Skare, S., Crosby, R.D., & August, G.J. (1997). Convergent and criterion-related validity of the behavior assessment system for children-parent rating scale. *Journal of Clinical Child Psychology, 26*, 276-284.

DuPaul, G.J. (1992). How to assess attention-deficit hyperactivity disorder within school settings. *School Psychology Quarterly, 7*, 61-74.

Edelbrock, C., Costello, A.J., Dulcan, M.K., Kalas, R. & Conover, N.C. (1985). Age differences in the reliability of the psychiatric interview of the child. *Child Development, 56*, 265-275.

Fischer, M., Barkley, R.A., Fletcher, K., & Smallish, L. (1993). The adolescent outcome of hyperactive children diagnosed by research criteria: V. Predictors of outcome. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 324-332.

Frick, P.J., Lahey, B.B., Applegate, B., Kerdyk, L., Ollendick, T., Hynd, G.W., Garfinkel, B., Greenhill, L., Biederman, J., Barkley, R.A., McBurnett, K., Newcorn, J.H., Waldman, I. (1994). DSM-IV field trials for the disruptive and attention deficit disorders: Diagnostic utility of symptoms. *Journal of the American Academy of Child and Adolescent Psychiatry, 33*, 529-539.

Glass, G.V.& Hopkins, K.D. (1996). *Statistical methods in education and psychology* (3rd ed.., pp. 121-123), Needham Heights, MA: Simon and Schuster.

Gomez, R., Harvey, J., Quick, C., Scharer, I., & Harris G. (1999). DSM-IV AD/HD: Confirmatory factor models, prevalence , and gender and age differences based on parent and teacher ratings of Australian primary school children. *Journal of Child Psychology and Psychiatry, 40*, 265-274.

Gordon, M. & Mettleman, B.B. (1988). The assessment of attention: I. Standardization and reliability of a behavior-based measure. *Journal of Clinical Psychology, 44*, 682-690.

Greenhill L.L., Halperin J.M.., & March J.S. (1997). The psychostimulants. In A. Tasman, J. Kay & J.A. Lieberman (Eds.), *Psychiatry* (pp. 1659-1684). Philadelphia: W.B. Saunders Company.

Halperin, J.M., Matier, K., Bedi, G., Sharma, V, & Newcorn, J.H. (1992). Specificity of inattention, impulsivity, and hyperactivity to the diagnosis of attention-deficit hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*, 190-196.

Halperin, J.M., Newcorn, J.H., Matier, K., Sharma, V., McKay, K., & Schwartz, S. (1993). Discriminant validity of attention-deficit hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 1038-1043.

Halperin, J.M., Sharma, V., Greenblatt, E., & Schwartz, S. T. (1991). Assessment of the continuous performance test: Reliability and validity in a non-referred sample. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 3*, 603-608.

Halperin, J.M., Wolf, L.E., Greenblatt, E., & Young, J.G. (1991). Subtype analysis of commission errors on the continuous performance test in children. *Developmental Neuropsychology*, 207-217.

Halperin, J.M., Wolf, L.E., Pascualvaca, D.M., Newcorn, J.H., Healy, J.M., O'Brien, J.D., Morganstein, A., & Young, G. (1988). Differential assessment of attention and impulsivity in children. *Journal of the American Academy of Child and Adolescent Psychiatry, 27*, 326-329.

Hart, E.L., Lahey, B.B., Loeber, R., Applegate, B., & Frick, P.J. (1995). Developmental change in attention-deficit hyperactivity disorder in boys: A four-year longitudinal study. *Journal of Abnormal Child Psychology, 23*, 729-749.

Hollingshead, A.B. (1975). *The Four Factor Index of Social Status.* New Haven, CT: Yale University Department of Sociology.

Inoue, K., Nadaoka, T., Oiji, A., Morioka, Y., Totsuka, S., Kanbayashi, Y., & Hukui, T. (1998). Clinical evaluation of attention-deficit/hyperactivity disorder by objective quantitative measures. *Child Psychiatry and Human Development, 28*, 179-188.

Jacob-Timm, S. & Hartshorne, T.S. (1994). *Ethics and law for school psychologists* (2nd Ed., pp. 95-137, 144-162). New York: Wiley & Sons, Inc.

Jacobvitz, D., Sroufe, L.A., Stewart, M., & Leffert, N. (1990). Treatment of attentional and hyperactivity problems in children with sympathomimetic drugs: A comprehensive review. *Journal of the American Academy of Child and Adolescent Psychiatry, 29*, 677-688.

Jensen, P.S., Shervette, R.E., Xenakis, S.N., & Richters, J. (1993). Anxiety and depressive disorders in attention deficit disorder with hyperactivity: New findings. *American Journal of Psychiatry, 150*, 1203-1209.

Jensen, P.S., Watanabe, H.K., Richters, J.E., Roper, M, Hibbs, E.D., Saltzberg, A.D., & Liu, S. (1996). Scales, diagnoses, and child psychopathology: II. Comparing CBCL and the DISC against external validators. *Journal of Abnormal Child Psychology, 24*, 151-168.

Kamphaus, R.W., & Frick, P.J. (1996). *Clinical assessment of child and adolescent personality and behavior.* Needham Heights, MA: Allyn & Bacon.

Kaufman, A.S., & Kaufman, N.L. (1990). *Manual for the Kaufman Brief Intelligence Test.* Circle Pines, MN: American Guidance Service.

Kazdin, A.E., Esveldt-Dawson, K., & Loar, L.L. (1983). Correspondence of teacher ratings and direct observations of classroom behavior of psychiatric inpatient children. *Journal of Abnormal Child Psychology. 11*, 549-564.

Klee, S.H., & Garfinkel, B.D. (1983). A computerized continuous performance task: A new measure of inattention. *Journal of Abnormal Child Psychology, 11*, 487-496.

Klein, R., & Manuzza, S. (1991). Long-term outcome of hyperactive children: A review. *Journal of the American Academy of Child and Adolescent Psychiatry, 30*, 383-387.

Kovacs, M. (1996). Presentation and course of major depressive disorder during childhood and later years of the life span. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 705-715.

Kuhne, M., Schachar, R., & Tannock, R. (1997). Impact of comorbid oppositional or conduct problems on attention-deficit hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 1715-1725.

Lahey, B.B., Applegate. B., McBurnett, K., Biederman, J., Greenhill, L., Hynd, G.W., Barkley, R.A., Newcorn, J., Jensen, P., Richters, J., Garfinkel, B., Kerdyk, L., Frick, P.J., Ollendick, T., Peres, D., Hart, E.L., Waldman, I., & Shaffer, D. (1994). DSM-IV field trials for attention deficit hyperactivity disorder in children and adolescents. *American Journal of Psychiatry, 151*, 1673-1685.

Landau, S., & Burcham, B.G. (1995). Best practices in the assessment of children with attention disorders. In A. Thomas, & J. Grimes, (Eds.), *Best Practices in school psychology-III* (pp. 817-829). Washington, DC: The National Association of School Psychologists.

Landau, S., Lorch, E.P., & Milich, R. (1992). Visual attention and comprehension of television in attention-deficit hyperactivity disordered and normal boys. *Child Development., 63*, 928-937.

Loeber, R., Green, SM., Lahey, BB, & Stouthamer-Loeber, M. (1991). Differences and similarities between children, mothers, and teachers as informants on disruptive child behavior. *Journal of Abnormal Child Psychology, 19*, 75-95.

Lucas, C.P., Fisher, P., Piacentini, J., Zhang, H., Jensen P.S., Shaffer, D., Dulcan, M., Schwab-Stone, M., Regier, D., & Canino, G. (1999). Features of interview questions associated with attenuation of symptom reports. *Journal of Abnormal Child Psychology, 27*, 429-437.

MacLeod, R.J., McNamee, J.E., Boyle, M.H., Offord, D.R., & Friedrich, M. (1999). Identification of childhood psychiatric disorder by informant: Comparisons of clinic and community samples. *Canadian Journal of Psychiatry, 44*, 144-150.

Matier-Sharma, K., Perachio, N., Newcorn, J.H., Sharma, V., & Halperin, J.M. (1995). Differential diagnosis of ADHD: Are objective measures of attention, impulsivity, and activity level helpful? *Child Neuropsychology, 1*, 118-127.

McConaughy, S.H., & Ritter, D.R. (1995). Best practices in multidimensional assessment of emotional or behavioral disorders, In: A. Thomas, & J Grimes (Eds.), *Best Practices in School Psychology-III* (pp. 865-877). Washington, DC: The National Association of School Psychologists.

McClellan, J.M., & Werry, J.S. (2000). Introduction: Research psychiatric diagnostic interviews for children and adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 19-27.

McDermott, P.A. (1995). Sex, race, class, and other demographics as explanations for children's ability and adjustment: A national appraisal. *Journal of School Psychology, 33,* 75-91.

Mitsis, E.M., McKay, KE, Schulz, K.P., Newcorn, J.H., & Halperin, J.M. (2000). Parent-teacher concordance for DSM-IV attention-deficit/hyperactivity disorder in a clinic referred sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 308-313.

Offord, D.R., Boyle, M.H., Racine, Y., Szatmari, P., Fleming, J.E., Sanford, M., & Lipman, E.L. (1996). Integrating assessment data from multiple informants. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 1078-1085.

Ostrander, R., Weinfurt, K.P., Yarnold, P.R., & August, G.J. (1998). Diagnosing attention deficit disorders with the behavioral assessment system for children and the child behavior checklist: Test and construct validity analyses using optimal discriminant classification trees. *Journal of Consulting and Clinical Psychology.*, *66*, 660-672.

Parasuraman, R., & Davies, D.R. (1984). *Varieties of attention*. Toronto: Academic Press.

Paternite, CE, Loney, J., & Langhorn, J.E. (1976). Relationships between symptomatology and SES-related factors in hyperkinetic/MDB boys. *Journal of Orthopsychiatry, 46*, 291-301.

Patterson, S.M., Krantz, D.S., Montgomery, L.C., Deuster, P.A., Hedges, S.M., & Negel, L.E. (1993). Automated psychical activity monitoring: Validation and comparison with physiological and self-report measures. *Psychophysiology, 30*, 296-305.

Pelham, W.E., Gnagy, E.M., Greenslade, K.E., & Milich, R. (1992). Teacher ratings of DSM-III-R symptoms for the disruptive behavior disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*, 210-218.

Piacentini, J.C., Cohen, P., & Cohen, J. (1992). Combining discrepant diagnostic information from multiple sources: Are complex algorithms better than simple ones? *Journal of Abnormal Child Psychology, 20*, 51-62.

Piacentini, J., Roper, M., Jensen, P., Lucas, C., Fisher, P., Bird, H., Bourdon, K., Schwab-Stone, M., Rubio-Stipec, M., Davies, M., & Dulcan, M. (1999). Informant-based determinants of symptom attenuation in structured child psychiatric interviews. *Journal of Abnormal Child Psychology, 27*, 417-428.

Pineda, D., Ardila, A., Rosselli, M., Arias, B.E., Henao, G.C., Gomez, L.F., Mejia, S.E., & Miranda, M.L. (1999). Prevalence of attention-deficit/hyperactivity disorder symptoms in 4- to 17-year-old children in the general population. *Journal of Abnormal Child Psychology, 27*, 455-462.

Plizka, S.R. (1992). Comorbidity of attention-deficit hyperactivity disorder and overanxious disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*, 197-203.

Plizka, S.R. (1998). Comorbidity of attention-deficit/hyperactivity disorder with psychiatric disorder: An overview. *Journal of Clinical Psychiatry, 59 (suppl 7)*, 50 -58.

Porrino, L.J., Rapoport, J.L., Behar, D., Sceery, W., Ismond, D.R., & Bunney, W.E. (1983). A naturalistic assessment of the motor activity of hyperactive boys. *Archives of General Psychiatry, 40*, 681-687.

Radosh, A., & Gittleman, R. (1981). The effect of appealing distractors on the performance of hyperactive children. *Journal of Abnormal Child Psychology, 9*, 179-189.

Reichenbach, L.C., Halperin, J.M., Sharma, V., & Newcorn, J.H. (1992). Children's motor activity: Reliability and relationship to attention and behavior. *Developmental Neuropsychology, 8*, 87-97.

Reynolds, C.R, & Kamphaus, R.W. (1998). *Behavior assessment system for children manual*. Circle Pines, MN: American Guidance Service.

Rosvold, H.E., Mirsky, A.F., Sarason, I., Bransome, J., & Beck, LH. (1956). A continuous performance test of brain damage. *Journal of Consulting Psychology, 20*, 343-350.

Sattler, J. (1992). *Assessment of children* (3rd ed.). San Diego, CA: Author.

Sawyer, M.G., Baghurst, P., & Mathias, J. (1992). Differences between informants' reports describing emotional and behavioural problems in community and clinic-referred children: A research note. *Journal of Child Psychology and Psychiatry, 33*, 441- 449.

Schachar, R., Sandberg, S., & Rutter, M. (1986). Agreement between teachers' ratings and observations of hyperactivity, inattentiveness, and defiance. *Journal of Abnormal Child Psychology, 14*, 331-345.

Schwab-Stone, M., Fallon, T., Briggs, M., & Crowther, B. (1994). Reliability of diagnostic reporting for children aged 6-11 years: A test-retest study of the diagnostic interview schedule for children - revised. *American Journal of Psychiatry, 151*, 1048-1054.

Schwab-Stone, M.E., Shaffer, S., Dulcan, M.K., Jensen, P.S., Fisher, P., Bird, H.R., Goodman, S., Lahey, B.B., Lichtman, J.H., Canino, G., Rubio-Stipec, M., & Rae, D.S. (1996). Criterion validity of the NIMH diagnostic interview schedule for children version 2.3 (DISC 2.3). *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 878-888.

Shaffer, D., Fisher, P., Lucas, C.P , Dulcan, M.K., & Schwab-Stone, M.E. (2000). NIMH diagnostic interview schedule for children version IV (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 28-38.

Shaffer, D., Schwab-Stone, M., Fisher, P., Cohen, P., Piacentini, J., Davies, M., Conners, C.K., & Regier, D. (1993). The diagnostic interview schedule for children-revised version (DISC-R): I. Preparation, field testing, interrater reliability, and acceptability. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 651-657.

Shaywitz, S.E., & Shaywitz, B.A. (1991). Attention deficit disorder: Diagnosis and role of ritalin in management. In L.L. Geenhill, & B.B. Osman (Eds.), *Ritalin: Theory and patient management* (pp. 45-68). New York: Liebert.

Sleator, E.K., & Ullmann, R.K. (1981). Can the physician diagnose hyperactivity in the office? *Pediatrics, 67*, 13-17.

Sonuga-Barke, E.J.S., Taylor, E., Sembi, S., & Smith, S. (1992). Hyperactivity and delay aversion: I. The effect of delay on choice. *Journal of Child Psychology and Psychiatry, 33*, 387-398.

Still, G.F. (1902). Some abnormal psychical conditions in children. *Lancet, i*, 1008-1012, 1077-1082, 1163-1168.

Swanson, J.M., Lerner, M., March, J., & Gresham F.M. (1999). Assessment and intervention for attention-deficit/hyperacitivity disorder in the schools: Lessons from the MTA study. *Pediatric Clinics of North America, 46,* 993-1009.

Teicher, M.H., Ito, Y, Glod, C., & Barber, N.I. (1996). Objective measurement of hyperactivity and attentional problems in ADHD. *Journal of the American Academy of Child and Adolescent Psychiatry, 35,* 334-342.

Tryon, G.S. (1997; Winter). The use of activity monitors in the assessment of attention deficit hyperactivity disorder. *The School Psychologist, 51*, 1, 15-16, 30.

Tryon, W.W. (1985). The measurement of human activity. In W.W. Tryon (Ed.), *Behavioral assessment in behavioral medicine* (pp. 200-256). New York: Springer.

van der Meer, J., Shalev, R., Borger, N., & Gross-Tsur, V. (1995). Sustained attention, activation, and MPH in ADHD: A research note. *Journal of Child Psychology and Psychiatry, 36*, 697-703.

Vaughn, M.L., Riccio, C.A., Hynd, G.W., & Hall, J. (1997). Diagnosing ADHD (predominantly inattentive and combined type subtypes): Discriminant validity of the behavior assessment system for children and the Achenbach parent and teacher rating scales. *Journal of Clinical Child Psychology, 26*, 349-357.

Verhulst, F.C., & Akkerhuis, G.W. (1989). Agreement between parents' and teachers' ratings of behavioral/emotional problems of children aged 4-12. *Journal of Child Psychology and Psychiatry, 30*, 123-136.

Verhulst, F.C., Koot, H.M., & van der Ende, J. (1994). Differential predictive value of parents' and teachers' reports of children's problem behaviors: A longitudinal study. *Journal of Abnormal Child Psychology, 22*, 531-546.

Weiler, M.D., Bellinger, D., Marmor, J., Rancier, S., & Waber, D. (1999). Mother and teacher reports of ADHD symptoms: DSM-IV questionnaire data. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*, 1139-1147.

Weiler, M.D., Bellinger, D. K., Simmons, E.K., Rappaport, L.K., Urion, D.K., Mitchell, W.J., Bassett, N.J., Burke, P.J., Marmor, J., & Waber, D. (2000). Reliability and validity of a DSM-IV based ADHD screener. *Neuropsychological Development of Cognition - Section C of Child Neuropsychology, 6*, 3-23.

Weiss, G., & Hechtman, L.T. (1993). *Hyperactive children grown up: ADHD in children, adolescents, and adults* (2nd ed.). New York, N.Y: Guilford.

Werry J.S.. (1994). Pharmacotherapy of disruptive behavior disorders. *Child and Adolescent Psychiatric Clinics of North America 3*, 321-341.

World Health Organization (1968). *The international statistical classification of diseases, injuries, and causes of death* (6th ed.). Geneva: Author.

Young, J.G., Kaplan, D., Pascualvaca, D., & Brasic, J.R. (1995). Psychiatric examination of the infant, child and adolescent. In H.I. Kaplan & H. Saddock, (Eds.), *Comprehensive textbook of psychiatry: Vol 2* (6th ed., pp. 3211-3221). Baltimore, MD: Williams and Wilkins.

Zeiner, P. (1997). Parent-reported symptoms of hyperactivity and attention deficits predict teacher-reported symptoms. *Acta Paediatrica Scandinavica, 86*, 172-182.

Zentall, S.S. (1993). Research on the educational implications of attention deficit hyperactivity disorder. *Exceptional Children, 60*, 143-153.