The Psychometric Characteristics of the ADHD Rating Scale-Iv.

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UMI
THE PSYCHOMETRIC CHARACTERISTICS
OF THE ADHD RATING SCALE-IV

A Dissertation
Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by

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ABSTRACT

The ADHD Rating Scale-IV is a screening instrument designed to assess attention-deficit/hyperactivity disorder in children. It is comprised of 18 items and has both a home and school version for parents and teachers to complete, respectively. A sample consisting of 178 parent-teacher dyads of children aged 6-12 years of age participated in the study. Psychometric investigation of these scales revealed high internal consistency, adequate test-retest reliability, and appropriate correlations with other measures of ADHD. Principal components factor analysis revealed two factors for both scales: (1) Inattention-hyperactivity and (2) Impulsivity-hyperactivity. Discriminant function analyses and base rate analyses revealed that these scales can correctly separate true ADHD children from normal controls but that it has significant difficulty differentiating other clinical populations. It was concluded that both scales have psychometric properties strong enough to be used as a screening measure.
CHAPTER 1
INTRODUCTION

Attention-Deficit Hyperactivity Disorder (ADHD) is a childhood disorder characterized by significant problems with attention span, impulse control, and motor activity. As one of the most common disorders of childhood, its prevalence has been estimated at three to five percent of school aged children and is diagnosed more often in males than females (Diagnostic and Statistical Manual of Mental Disorders (4th ed.) (DSM-IV); American Psychiatric Association, 1994). ADHD has also been shown to co-exist at high rates with other psychiatric disorders of childhood (Biederman, Newcorn, & Sprich, 1991; Jensen, Martin, and Cantwell, 1997).

However, the very nature of a disorder clearly indicates a categorical or medical approach that assumes a psychiatric disease identifiable by a set of discrete diagnostic criteria. Currently, many investigators support a dimensional or factorial approach to classification which employs the psychometric paradigm (Edelbrock & Costello, 1988; Steingard, Biederman, Doyle, & Sprich-Buckmisster, 1992). ADHD has had and continues to have a historic evolution, both in terms of etiologies and diagnostic criteria. DuPaul (1992) outlined a specific strategy for conducting ADHD assessments whereby the ADHD Rating Scale (DuPaul, 1991) is utilized as a screening instrument. This instrument was based upon the diagnostic criteria for ADHD.

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according to the revised third edition of the DSM (American Psychiatric Association, 1987). This screening instrument has since been updated to resemble the current criteria for ADHD as set forth by the recent fourth edition of the DSM. This scale is now referred to as the ADHD Rating Scale-IV (DuPaul, in preparation). Although this new instrument was expected to have similar psychometric properties to its predecessor, proper investigation of this instrument was warranted. Therefore, the purpose of this study was to psychometrically investigate this new scale.

Exploration of the factor structure of this ADHD Rating Scale-IV was the first goal of this study. Its predecessor, the ADHD Rating Scale yielded two factors for both the home and school versions of the scale: inattention-hyperactivity and impulsiveness-hyperactivity. Likewise, it was hypothesized that this two factor structure would remain for this latest version of the scale.

The next step in this investigation involved assessing the reliability of the scales. The internal consistency was explored by computing coefficient alphas for the total and sub-scale scores. The test-retest reliability, a stability measure over time, was explored by computing coefficient kappas for both the home and school version of the scale.

Evidence for the validity of the scale was then addressed through various methods. Convergent and discriminant validity was assessed through a multtrait
multimethod (MTMM) matrix of correlations. By utilizing measures of the same trait (i.e., attention), the concordance of the ADHD Rating Scale-IV and these other measures were shown. Similarly, by utilizing measures of a different trait (i.e., depression), the discordance of the ADHD-Rating Scale-IV was also shown.

Support for the concurrent validity of this scale was addressed through various discriminant function analyses. These analyses assessed the predictive ability of the ADHD Rating Scale-IV to discriminate between different populations.

While it is assumed that most readers are familiar with traditional psychometric methods of assessing reliability and validity, investigation was also conducted through utilization of base rate information. Examination of the sensitivity, specificity, and the false positive and false negative error rates provides evidence for the validity of any assessment procedure (Bar-Hillel, 1980; Duncan & Snow, 1987; Willis, 1984). The sensitivity of an assessment procedure refers to its ability to correctly detect the problem or disease. The specificity of an assessment procedure refers to its ability to accurately identify individuals without the problem or disease. The sensitivity of a predictor is analogous to its hit rate while the specificity of a predictor is analogous to its correct
rejection. Mathematically, indication that a test possesses validity occurs when the following formula is true:

\[
\frac{\text{Valid Positives}}{\text{False Positives}} > \frac{\text{False Negatives}}{\text{Valid Negatives}}
\]

However, Faust and Nurcombe (1989) proposed that validity is only one test that data must pass; the data must also pass an effectiveness test. Effectiveness addresses whether or not predictions are more accurately made when relying on the presence of the valid sign. (A valid sign is when the test or indicator says the trait is present.) According to these authors, accuracy is increased by the presence of a sign only when the error rate (i.e., false positives plus false negatives) is less than the frequency of the condition to be identified or predicted. Gouvier, Hayes, and Smiroldo (1997) offer mathematical formulas to assess the effectiveness of a sign. For base rates below .50, effectiveness is indicated when the following is true:

\[
\text{Base Rate} > \text{False Positives} + \text{False Negatives}
\]

For base rates above .50, the formula is adjusted such that the following must be true:

\[
1 - \text{Base Rate} > \text{False Positives} + \text{False Negatives}
\]

Therefore, both the validity and effectiveness of a measure can be mathematically computed by utilizing base rates.

The following literature review is offered to historically explore the evolution of current definitions and assessment practices. Additionally, the etiological view points are presented, both in terms of psychopharmacological
and neuroanatomical models. An understanding of the current state of the field will yield the importance of exploring the psychometric characteristics of a rating scale that can be useful in identifying children with Attention-Deficit/Hyperactivity Disorder. Further elaboration on the purpose of the study will appear at the conclusion of this review.
CHAPTER 2
LITERATURE REVIEW

Attention-Deficit/Hyperactivity Disorder appears in the newly published fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV); American Psychiatric Association, 1994). This disorder has been variously labeled "minimal brain dysfunction", "hyperkinesis", and "hyperactive child syndrome". The diagnostic criteria from the DSM-IV integrates into one overarching category what were previously two categories in the revised third edition of this same manual (i.e., Attention-Deficit Hyperactivity Disorder and Undifferentiated Attention-Deficit Disorder (without hyperactivity)). The DSM-IV presents one set of criteria with three subtypes: Predominantly Inattentive Type; Predominantly Hyperactive-Impulsive Type; and a Combined Type. In addition, the DSM-IV criteria mandates that the symptoms be present in at least two settings, as a means to reduce false-positive diagnoses (DSM-IV, pg 775). This distinction of subtypes resembles the criteria set forth by the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III; 1980) in which three diagnostic labels were used: Attention Deficit Disorder with Hyperactivity (ADDH), Attention Deficit Disorder (without hyperactivity, ADD), and Attention Deficit Disorder, Residual Type, (ADD, RT) in which the diagnostic label changed as a result of the presence or absence of
hyperactivity. Although this relabeling appears tiresome and confusing, it seems driven by the vast amount of research that has been devoted to this disorder in an attempt to make the label more meaningful and reliable.

Historical Overview

According to Barkley (1989), the earliest descriptions of this disorder were offered by George Still (1902). Still described a group of clinically referred children as aggressive, defiant, resistant to discipline, highly emotional, and showing little self control. Further, Still (1902) suggested that these behavioral exhibitions were a result of "defects in moral control". He further contended that there were both biological and environmental factors involved but that the severe degree seen in his clinical sample was most often a result of biological factors. Interest in the disorder waned until after World War II when the term "minimal brain damage" was coined. According to Barkley (1989), this label resulted from the influential writings of Strauss and Lehtinen (1947) who posited that restless and inattentive behavior were evidence of brain damage in children because such symptoms are often seen in victims of brain damage. Although this may seem alarming, perhaps more alarming is the fact that this inferential thinking went basically unchallenged for quite some time.

The next major postulated position was offered by Laufer, Denheff, and Solomons (1957) who contended that the
difficulties experienced by hyperactive children had to do with defects in the filtering of stimuli in the central nervous system which caused overstimulation of the cortex. This resulted in a change in terminology from "minimal brain damage" to "minimal brain dysfunction". During the 1960's, there appeared to be growing concern favoring an objective measurement of hyperactivity and attempts were made to make this the focus of the disorder. It was at this time that the various effects of stimulant drugs were studied. As a result of this zeitgeist, neurological impairments were deemphasized and this disorder was referred to as "hyperactive child syndrome" (Chess, 1960) or "Hyperkinetic Reaction of Childhood" (American Psychiatric Association, 1968). The next change in the label occurred when it was noted that hyperactive children had major deficits with sustained attention and impulse control (e.g., Douglas, 1972). This relationship was so salient that the American Psychiatric Association (1980) renamed this disorder "Attention Deficit Disorder (with or without hyperactivity)" in the DSM-III. In the revised edition of the DSM-III (i.e., the DSM-III-R, American Psychiatric Association, 1987) the disorder was referred to as "Attention Deficit-Hyperactivity Disorder", suggesting that hyperactivity is a key feature of the disorder.

As stated earlier, the prevalence of ADHD has been estimated at three to five percent of school aged children.
The importance of prevalence estimates and base rate information merits attention as the final part of this historical overview. The reason is that base rates differ from the epidemiologists' incidence and lifetime prevalence statistics in that they are regarded as current population prevalence (Bar-Hillel, 1980; Gordon, 1977). In other words, the subject or patient comes in with it already in his or her background; it is a priori (Gouvier, Hayes, & Smiroldo, 1997). Base rate information can be used to give a better understanding of the significance of symptoms or diagnostic test findings. Therefore, as the etiologies and assessment practices of ADHD are explored in the following sections, it is important to keep in mind that signs or symptoms can only be regarded as significant to the degree that they exist disproportionately between normal and clinical samples.

**Etiologies.** As stated in the historical overview, brain damage was originally proposed as the cause of ADHD symptoms; however, there was little evidence to support this claim. There is evidence, however, to support a physiological basis to ADHD.

**Psychopharmacological Models**

Lending support to a dopamine hypothesis, Shaywitz, Yager, and Klopper (1976) proposed an animal model of ADHD in which rat brains were chemically lesioned with hydroxydopamine to deplete the brain of dopamine. As a
result, the young rats became hyperactive. In addition, when these rats were given amphetamines (dopamine agonists), hyperactive behavior decreased. Similarly, decreases in hyperactive behavior has been reported in children when given antipsychotic medication (dopamine antagonists) (Winsberg & Yepes, 1978). These results present an inconsistency in that one would pharmacologically expect an antagonist to either have no effect on the hyperactivity or attenuate it. Therefore, it appears that other mechanisms must be involved other than just dopamine receptors.

A noradrenergic hypothesis was proposed by Kornetsky (1970) in which he hypothesized that since amphetamine causes norepinephrine release, which in turn causes hyperkinetic behavior, hyperkinetic behavior may be simply caused by naturally occurring norepinephrine excesses. This hypothesis received further support when greater concentrations of the major metabolite of norepinephrine were reported in ADHD subjects as compared to normals (Shekim, DeKirmenjian, & Chapel, 1977). More recently, noradrenergic mechanisms were shown to differ in ADHD children who also present with reading disabilities (Halperin, Newcorn, Koda, Pick, Mckay, & Knott, 1997; Halperin, Newcorn, Sshwartz, McKay, Bedi, & Sharma, 1993). However, the clinical utility of these findings has yet to be appreciated since specific noradrenergic agonists and antagonists failed to produce
positive behavior changes in ADHD children (e.g., Langer, Rapoport, Ebert, Lake, & Nee, 1983).

A serotonergic hypothesis also emerged when lower levels of platelet serotonin were noted in hyperactive children (Coleman 1971; Wender, 1969). However, Irwin, Benlendink, McCloskay, and Freedman (1981) found elevated levels of serotonin in some groups of ADHD children. Although the relationship between ADHD and serotonin remains unclear, Potter, Scheinin, Golden, Rudorfer, Cowdry, Calil, Ross, and Linnoila (1985) showed that tricyclics previously thought to affect only noradrenergic systems also alter serotonergic systems. More recently, lower central serotonergic functioning was identified in aggressive boys with ADHD (Halperin, Newcorn, Kopstein, McKay, Schwartz, Siever, & Sharma, 1997). Despite this, it appears that multiple neurotransmitter systems play integrated roles in hyperactive behavior and therefore, ADHD effects may not be attributed to just one neurotransmitter.

Along these lines, the inhibitive effects of monoamine oxidase (MAO) has been investigated. MAO affects norepinephrine, serotonin, and dopamine, among others. Lending support to a MAO-ADHD link, Brown, Ebert, Murphy, Langer, Ebert, Post, and Bunney (1984) reported that the normal decrease in MAO activity found in normal controls between the ages of six and twelve, was not observed in his sample of ADHD children. Zametkin, Rapoport, Murphy,
Linnoila, and Ismond (1985) demonstrated improvement in sustained attention when ADHD children were given MAO inhibitors. However, in comparison, treatment with medical stimulants still appear clinically superior.

**Neuroanatomical Models**

As evident by the discussion of psychopharmacological models of ADHD, it has been and continues to be quite difficult to isolate neurochemicals related to ADHD. Similarly, much work has gone into isolating specific brain sites thought to be involved in ADHD. Further complicating this issue is the fact that the neurotransmitters affect the functioning of various neuroanatomical structures. If one were to consider ADHD to be similar to Parkinson’s syndrome, then it would make sense to hypothesize an anatomical specific site for ADHD. As expected, investigations in abundance have been conducted and there have been several areas of the brain implicated as dysfunctional in ADHD children. Naturally, numerous brain sites have been hypothesized as playing a role in the symptomatology of ADHD; however, the ones discussed in this review will be those that continue to have relevance with respect to recent findings.

The diencephalon, which includes the thalamus, hypothalamus, subthalamus, and epithalamus, was first implicated in causing ADHD as a result of the work of Laufer, Denhoff, and Solomons (1957). However, due to the numerous
brain structures in the diencephalon, their investigation failed to identify specific sites responsible for the symptoms of ADHD. Despite this, Laufer et al. (1957) were the first researchers to anatomically investigate this disorder in children, and subsequently, stimulated this area of research. Satterfield and Dawson (1971) proposed that hyperactivity in children resulted from being underaroused, thus implicating the reticular activating system (RAS). This explanation has intuitive value in that a child with ADHD appears to have a short or underaroused attention span. Despite this, the RAS explanation was later refuted in a review by Rosenthal and Allen (1978) due to inconsistent findings among various investigations of autonomic arousal. Various researchers investigated the role of the hypothalamus in ADHD children (e.g., Aarskog, Fevang, & Klove, 1977; Leibowitz, 1984; Wender, 1971), however, no definite conclusions were drawn. According to a review by Zametkin and Rapoport (1986), this hypothesized defect in hypothalamic dysfunction has been tested indirectly and, therefore, inadequately. They recommend the inclusion of normal control groups in future studies.

More recently, the specific frontostriatal structures of the prefrontal cortex and basal ganglia have been implicated in the response inhibition associated with ADHD children (Casey, Castellanos, Giedd, Marsh, Hamburger, Schubert, Vauss, Vaituzis, Dickstein, Sarfatti, & Rapoport, J. (1997).
By using magnetic resonance imaging (MRI) on ADHD children and controls, it appeared that the prefrontal cortex suppressed responses to salient, but otherwise irrelevant events in the experimental group. Furthermore, it appeared that the basal ganglia executed these behavioral responses.

In a study of cerebral blood flow, Lou, Henriksen, and Bruhn (1984) synthesized much of the hypothetical and empirical findings of previous research in regard to the anatomical specificity of ADHD. These researchers implicated dopaminergic neurons that originate in the mesencephalon, pass through the central frontal lobes to the prefrontal cortex. In conclusion, Lou et al. (1984) postulated the interaction between the RAS and the prefrontal lobe in the regulation of attention.

In conclusion, the very complicated task of trying to isolate a specific neuroanatomical site for ADHD becomes readily apparent. Additionally, since much of brain function is still unknown, it could very well be that there is no single site responsible for ADHD and that various sites play key roles in the regulation of ADHD symptoms.

**Genetic Predispositions**

The role of hereditary transmission of ADHD symptoms has been investigated through family, twin, and adoption studies. These studies have shown that there are higher rates of depression, alcoholism, and conduct problems among the biological relatives of children with ADHD. In addition,
evidence exists that between 20% and 32% of the parents and siblings of children with ADHD also have symptoms (Biederman, Minir, Knee, Habelow, Armentano, Autor, Hoge, & Waternaux, 1986). In regard to studies of monozygotic and dizygotic twins, O'Connor, Foch, Sherry, and Plomin (1980) found greater concordance for ADHD in the monozygotics. Goodman and Stevenson (1989) reported a 51% concordance rate for monozygotics and a 33% concordance rate in dizygotics.

At present, however, much is still not known in regard to the genetic transmission of ADHD for no gene has been described or found. However, continued research in this area could directly link with neuroanatomical studies showing phenotypic similarities between ADHD children and their relatives.

Diet

The actual diet of the child has long been proposed as a cause of ADHD. Feingold (1975) suggested that artificial colorings and flavorings in the child's diet played a major role in hyperactivity. In fact, Feingold even developed a special diet which eliminated artificial additives in an attempt to benefit hyperactive children. However, the effectiveness of this diet was only measured by parent report.

In an attempt to empirically assess this Feingold diet, Harley, Ray, and Tomasi (1978) compared the Feingold diet to a control diet in unmedicated hyperactive children. Each
child randomly received each diet for a month in a double blind fashion. Diet effectiveness was measured by parent and teacher questionnaires, neuropsychological testing, and direct observations of the child in the classroom and laboratory. Results showed no consistent diet effect, although there was an unexplainable order effect in those children which received the Feingold diet second. In a review by Mattes and Gittelman (1981), the authors pointed out that previous studies investigating the Feingold diet (e.g., Goyette, Conners, and Petti, 1978; Conners, 1980; Weiss, Williams, and Margens, 1980) also failed to show any dietary effects of artificial additives on hyperactivity. Finally, Mattes and Gittleman (1981) conducted an impressive study which again failed to show any effect of food additives.

Smith (1975) suggested that refined sugar might be a cause of ADHD. However, like the first studies on the Feingold diet, evaluation was heavily based upon anecdotal report. As an empirical investigation of refined sugar, Kaplan, Wamboldt, and Barnhardt (1986) had ADHD children use as much breakfast sweetener as desired (either sucrose or aspartame in a blind fashion). Results showed that there was no distinguishable difference in behavior between the children given sugar as compared to the children given aspartame.
In conclusion, no strong evidence exists to support the hypothesis that dietary influences play a role in the cause or exacerbation of ADHD symptoms. Despite this, there continues to be much media attention and widely held beliefs that diet is a major cause of hyperactivity in children.

**Environmental Toxins**

Some researchers have implicated elevated blood lead levels in relation to ADHD (e.g., Gittelman & Eskenasi, 1983), however, all research thus far has only been correlational in nature. In addition, maternal alcohol consumption and cigarette smoking has also been found to be related to ADHD symptoms (e.g., Streissguth, Martin, Barr, Sandman, Kirchner, & Darby, 1984), but again, all evidence is correlational and cause has yet to be established.

In summary, the etiology of ADHD has been investigated both in terms of biological and environmental causes. However, even though evidence exists for both sides of the nature/nurture controversy, it must be said that the exact etiology is currently unknown. Despite this, it becomes plausible at this juncture to assume that various factors may mediate the onset of ADHD symptoms.

**Current Definitions of ADHD.** According to the DSM-IV criteria for ADHD, the diagnosis includes three subtypes: Inattentive; Hyperactive-Impulsive; and a Combined Type. The first two subtypes have nine symptoms in which the
child must exhibit at least six for the diagnosis. If the child meets both criteria, then the diagnosis is "Combined Type". Additionally, the symptoms must have persisted for at least six months and to a degree that is maladaptive and inconsistent with developmental level. DSM-IV criteria requires that some of these symptoms had to have present before the age of seven and that some impairment from the symptoms is present in two or more settings. Finally, "In Partial Remission" should be specified if an individual no longer meets full criteria.

Twelve of the fourteen ADHD diagnostic criteria from the DSM-III-R appear in the DSM-IV. Two of the criteria were eliminated from the DSM-III-R while six new criteria were added. Interestingly, children who previously met DSM-III-R diagnostic criteria may not meet DSM-IV criteria because of the significant changes. Despite this, it is likely that children who met the criteria for the DSM-III-R would be meet the criteria of the DSM-IV, but now with a subtype. Factor analytic studies from the ADHD symptoms clearly revealed two factors; inattention and hyperactive/impulsive (McBurnett, Lahey, & Pfifner (1993). Therefore, the DSM-IV re-established subtypes of ADHD and the symptoms underwent large field trials to ensure the diagnostic utility of each symptom (Frick, Lahey, Applegate, Kerdyck, Ollendick, Hynd, Garfinkel, Greenhill, Biederman, Barkley, McBurnett, Newcorn, & Walden, 1994).
In a recent study addressing the correspondence between DSM-III-R and DSM-IV ADHD diagnostic criteria, it was found that 93% of the cases met diagnostic criteria according to both (Biederman, Faraone, Weber, Russell, Rater, and Park; 1997). These findings are consistent with previous DSM-IV field trials which supported diagnostic continuity between the two classification systems (Lahey, et al., 1994).

Barkley (1990) had criticized the DSM-III-R ADHD criteria, stating that it was inadequate. Therefore, Barkley set forth his own diagnostic criteria which offered the following: (1) a cut-off score of two standard deviations above the mean on well standardized, reliable and valid child behavior rating scales which measure inattention and hyperactivity; (2) parent and/or teacher complaints of inattention, impulsivity, overactivity and poor rule-governed behavior; (3) onset of symptoms before the age of six with symptoms at least twelve months in duration; and (4) the ruling out of mental retardation, significant language delay, sensory handicaps, and severe psychopathology.

Similarly, it could be said that the impetus of the ADHD Rating Scale stemmed from DSM taxonomy criticisms. DuPaul (1991) added a likert rating to each of the 14 symptoms of ADHD so that information specific to each symptom can be obtained from both the home and school setting.

Interestingly, one would expect high relationships between the actual behavior of hyperactive children and the
rating scales completed in regard to their behavior. However, Barkley (1990) showed low correlations between scores on rating scales and actual behavioral observations. Conversely, various structured interviews have correlated significantly with rating scales (Biederman, Faraone, Doyule, Lehman, Kraus, Perrin, & Tsuang, 1993; Achenbach & Edelbroch, 1983; Hodges, Kline, Stern, Cytryn, & McKnew, 1981.) Despite this, a multi-method assessment is recommended throughout the literature (e.g., Shekim, Cantwell, Kashini, Beck, Martin, & Rosenberg, 1986; Barkley, 1989; DuPaul, 1992).

**Assessment of ADHD.** Gresham (1985) pointed out that assessment procedures are used primarily for two purposes: (1) to make classification/eligibility decisions and/or (2) to make program planning/intervention decisions. The format of the DSM-IV is for classification purposes so that professionals can communicate regarding a "cluster of behaviors". In the following sections, various components that have been used in ADHD assessments will be addressed. These include laboratory measures, direct observations, interviews, and behavioral rating scales.

**Laboratory Measures**

Laboratory measures of sustained attention, impulsivity, and activity level have been investigated and used in research studies. Such measures are often used in
clinical assessments of ADHD because of their freedom from subjective reports.

Some of the more widely used measures include the Continuous Performance Test (CPT; Rosvald, Mirsky, Sarason, Bransome, & Beck, 1956), the Gordon Diagnostic System (Gordon, 1983), and the Matching Familiar Figures Test (MFFT; Kagan, 1966). However, the clinical utility of these measures is quite limited because of poor psychometric properties and little, if any, normative data. In an investigation of these clinic based tests, DuPaul (1992) reported that the CPT and the MFFT were found to share little variance with parent and teacher rating scales. In addition, the clinic test scores of the CPT and MFFT frequently did not lead to the same diagnostic conclusion when compared to behavior rating scales and parent interview data. Finally, Barkley (1990) argued against their utility, stating that these measures fail to take into consideration contextual variables crucial to a functional analysis of ADHD symptoms.

To recapitulate, clinic or laboratory measures have yet to show their usefulness in an ADHD diagnosis. However, DuPaul (1992) concluded that the limited utility of such available tests suggests the need to develop clinic-based measures of sufficient ecological validity that can be used in conjunction with parent and teacher reports in the evaluation of ADHD.

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Direct Observations

The information obtained during direct observations of a child can be invaluable. Foster and Cone (1986) stated that the goal of direct observational assessment is the production of data that are unbiased representations of the behavior of interest. Several observational systems have been developed and validated to identify specific symptoms believed to be of primary concern in ADHD children. Some of these coding systems include the Classroom Observation Code (Abikoff, Gittelman-Klein, & Klein, 1977), the Restricted Academic Coding System (Barkley, 1990), and the Hyperactive Behavior Code (Jacob, O’Leary, & Rosenblad, 1978).

As a viable alternative, the observer can develop and use a less formal observational code to determine the frequency or duration of ADHD related behaviors in a classroom setting. DuPaul (1992) strongly recommends that since normative data are unavailable for direct observation, it is important that the referred child’s behavior be compared to one or two other children who have been identified as typical or average by the teacher. However, as Foster and Cone (1986) warned, the reliability of a code is generally inversely proportional to its complexity. Despite the potential value of direct observations, results from direct observations must be interpreted with caution. Direct observations have many limitations including reactivity, experimenter bias, and observer drift. Barkley (1990), for
example, showed low correlations between data from direct observations and scores on behavior rating scales.

In summary, direct systematic observations of child behavior in the problematic setting can be beneficial in making both classification and treatment decisions. However, one is cautioned in the ADHD literature since studies have failed to show significant correlations between observations and results from other measures.

**Interviews**

As a means of obtaining various types of information, interviews can be conducted with the parents, teachers, and/or the child. Ollendick and Cerny (1981) described four major objectives of the initial child and family interview: (a) to clarify presenting complaints; (b) to obtain a developmental and social history; (c) to assess family interaction patterns that might be related to the target behaviors; and (d) to determine resources within the family that might be utilized in treatment programming. (p.31)

Witt and Elliott (1983) also provided guidelines and objectives for interviews with teachers. Their objectives included problem definition; selection of target behaviors, identification of problem frequency, duration, and intensity, conditions in which the problem behavior occurs, required level of performance, and strengths of the student. The interview can be critical in exploring past medical and developmental history of the child, family and educational
history, current psycho-social stressors and functioning of the child's family. Interviews can be conducted with the parent, the child, and/or the child's teacher. In fact, there exist structured and semi-structured interviews that can be utilized to derive a diagnosis from either the parent or the child.

Some of the more researched structured and semi-structured interviews include the Diagnostic Interview for Children and Adolescents-Revised (DICA-R, Reich & Welner, 1988); the Diagnostic Interview Schedule for Children-Revised (DISC-R, Shaffer, Schwab-Stone, Fisher, Davies, Piacentini, & Gioia (1988); the Child Assessment Schedule (CAS, Hodges & Fitch, 1979); the Interview Schedule for Children (ISC, Kovacs, 1983), and the Schedule for Affective Disorders and Schizophrenia for School Aged Children (K-SADS, Puig-Antich & Chambers, 1978).

In summary, interviews can be valuable assessment tools yielding important information. Further, the interviewing of multiple sources allows for the convergence of the information so that an accurate diagnosis can be reached. However, interviews should never stand alone as the only sources of data gathering. They should be used in conjunction with other assessment devices such as standardized behavior rating scales and direct observations of the child in the problem settings.
Behavior Rating Scales

Behavior rating scales and checklists are indirect assessment strategies that are generally inexpensive, easy to administer and score, and can be used to obtain data from multiple sources. Morris and Kratochwill (1983) point out that data quantification methods and multivariate statistical procedures allow for the identification of clusters of highly intercorrelated behaviors that may be hypothesized to represent a behavioral dimension. Behavior rating scales lend themselves to such analysis. As with interviews, in the assessment of ADHD, rating scales can be completed by the parents and teachers. Barkley (1987) also points out that with adolescents, self-report ratings can be reliable and useful.

Parent Rating Scales. Since parents have observational opportunities of their child that clinicians do not, parental ratings of child behavior can be a useful component of assessment. Perhaps two of the most popular scales which report good reliability and validity are the Child Behavior Checklist (CBCL; Achenbach & Edelbroch, 1983) and the Conners Parent Rating Scale-Revised (CPRS; Goyette, Conners, & Ulrich, 1978). Both of these rating scales present various behaviors and ask the parent to respond as to how often their child engages in that behavior. The results produce, on both scales, cluster scores for various behavioral domains.
Specifically to the assessment of ADHD, the ADHD Rating Scale (DuPaul, 1991) can also be completed by parents and when scored, yields two factors: inattention-hyperactivity and impulsiveness-hyperactivity. The ADHD Rating Scale comes from the 14 criteria set in the DSM-III-R for ADHD and asks parents to respond as to how each item describes their child.

Teacher Rating Scales. As with parent questionnaires, there are various commercially available scales that the child's teacher can complete. Again, as with the parent, the teacher has observational opportunities of the child that parents and clinicians do not. However, teachers also have the observational advantage of access to their own "mini-norm" group (i.e., children previously and currently taught). Therefore, one would expect teachers to be reliable reporters of behavior excesses and deficits.

The most widely used of these rating scales include the teacher version of the Child Behavior Checklist, the Teacher Report Form (TRF; Achenbach & Edelbroch, 1983) and the Conners Teacher Rating Scale-28 (CTRS-28; Goyette, Conners, & Ulrich, 1978). In addition, the ADHD Rating Scale was shown to have good psychometric properties with teacher completion (DuPaul, 1991).

Self-Report Scales. Reiterating what Barkley (1989) pointed out, adolescents themselves can be reliable reporters of their own behavior. The Youth Self-Report (Achenbach & Edelbrock, 1987) possesses similar items as the CBCL and the
TRF and can be completed for youths between the ages of 11 and 16. As a means of guiding treatment, Barkley has found it helpful for these same teens to complete rating scales that rate their parents' behavior on many of these same scales. Use of this information can provide directions for behavioral family therapies.

In summary, various behavior rating scales have been shown to be a reliable and valid technique of measuring behavior problems of children and categorizing the behaviors in clusters. Finally, these rating scales can also be used to document the effectiveness of interventions.

However, it must be reiterated that no single measure or assessment technique should stand on its own to reach any diagnostic decision. Specifically to ADHD, Barkley (1989) has suggested that the assessment be comprehensive:

"such an assessment should rely on several informants, employ multiple settings, and use a variety of assessment methods that focus not only on the primary symptoms of ADHD, but also the child's academic and social functioning, as well as the integrity of his or her family environment."

Further, this "comprehensive" assessment should include interviews with the child, parents, and teachers; rating scales from multiple informants; and direct observation of the child (Barkley, 1989).
In a landmark article, DuPaul (1992) proposed a framework for conducting an ADHD assessment in the school setting. In this framework, he delineated four stages in the assessment of ADHD. Stage One involves screening in which he recommends that the teacher complete the ADHD Rating Scale (DuPaul, 1991), which is based on the fourteen behavioral symptoms of ADHD as set by the DSM-III-R. If eight or more of these symptoms are rated highly (i.e., "pretty much" or "very much" of the time, according to the four point Likert scale), then further assessment of ADHD becomes warranted. Stage Two involves a multi-method assessment of ADHD which includes a review of school records, parent interview, parent and teacher ratings, and direct observation of behavior. Stage Three is the interpretation of results and Stage Four is the development of the treatment plan.

DuPaul's ADHD Rating Scale from Stage One has recently been revised by its original author to compliment the changes in the ADHD diagnostic criteria appearing in the DSM-IV. The new version of the scale has been titled the "ADHD Rating Scale-IV". Since a principal part of this assessment process proposed by DuPaul involves the use of the ADHD Rating Scale, psychometric investigation of the ADHD Rating Scale-IV became warranted. It seemed appropriate to properly assess both the home and school versions of this ADHD Rating Scale-IV. Be as it may, reliability is a necessary component for validity, the reliability of this scale was first investigated. When
the data analyses indicated adequate reliability for both home and school versions, validity investigation began. Finally, the factor structure for both versions of the scale was explored.
Subjects

Subjects included 178 children between the ages of 6-12, with approximately three-fourths of the sample representing a clinical population (see below for definition of clinical). 67% of the participants were male and 33% were female. Finally, all subjects had been enrolled in a Louisiana school.

Materials

Consent Forms. The parents of the children included in the study were given a letter explaining the purpose of the study and requested their permission for their child to participate. The consent form also requested the assent of the child for inclusion in the study. More specifically, the parental consent form requested the parent to complete the CBCL, and the ADHD Rating Scale-IV. Additionally, the form indicated parent and teacher interviews would be conducted. Finally, the form specified that the parent or the child could withdraw from the study at any time without any adverse consequence. (See Appendix A.)

For subjects solicited through the schools, principals and teachers were also provided with a consent form which explained the purpose of the study and requested their participation. More specifically, it indicated the teacher
would complete rating scales and participate in an interview. (See Appendices B and C)

**Child Behavior Checklist.** The Child Behavior Checklist (CBCL; Achenbach, 1991) is a well researched behavioral rating scale that is completed by a parent/guardian. It consists of 118 problem items and generally requires approximately 15 minutes to complete. It yields the following eight clinical subscales: Withdrawn; Somatic Complaints; Anxious/Depressed; Social Problems; Thought Problems; Attention Problems; Delinquent Behavior; and Aggressive Behavior. The scores are reported as T-scores, having a mean of 50 and a standard deviation of 10. T-scores above 70 are considered clinically significant.

Test-retest reliability of this scale was shown to be .89 with a one-week retest (Achenbach & Edelbroch, 1983). Validity of the CBCL is supported with correlations with other empirically derived measures of childhood psychopathology (Achenbach and Edelbroch, 1983). More recently, the CBCL demonstrated convergent validity with psychiatrically diagnosed ADHD children (Biederman, Faraone, Doyle, Lehman, Kraus, Perrin, & Tsuang, 1993).

However, with respect to the CBCL’s use in ADHD assessments, there is substantial agreement that the use of a T-score above 70 on the Hyperactivity scale may not be sufficiently sensitive for an accurate diagnosis (Kazdin & Heidish, 1984; Shekim et al., 1986). Steingard, Biederman,
Doyle, and Sprich-Buckminster (1992) showed that the use of a 60 cutoff score on the Hyperactivity scale increased the sensitivity and predictive value of the rating without decreasing specificity. More recently, Chen, Faraone, Biederman, and Tsuang (1994) recommended a cutoff T-score of 65 on the Attention Problem scale to identify ADHD boys from a community population.

Teacher Report Form. The Teacher Report Form (TRF; Achenbach, 1991) is a behavior rating scale that is completed by the child’s teacher and serves as the CBCL companion measure (Weine, Phillips, & Achenbach, 1995). Like the CBCL, it includes 118 problem items and generates the same eight syndrome profiles. Ninety-three items on this scale have counterparts on the CBCL, although the wording differs slightly. The test-retest reliability of the TRF problem scores over a mean interval of 15 days was found to be .92 (Achenbach, 1991). Inter-rater reliability for the TRF using different teachers was found to be .54 for the problems scores.

The construct validity of the TRF has been investigated by comparing it to the Conners Revised Teacher Rating Scale (Goyette, Conners, & Ulrich, 1978). Achenbach (1991) showed Pearson correlations for the TRF ranging from .80 to .83 with the Conners Conduct Problems, Inattention-Passivity, and total problem scores. Additionally, the TRF Aggressive
Behavior and Externalizing scales correlated .67 and .63 with the Conners Hyperactivity scale.

Criterion related validity was investigated by using referral for services for emotional/behavioral problems as the general criterion to test the discriminative power of the TRF scales. According to Cohen's (1988) criteria for effect sizes, all TRF scales except Somatic Complaints consistently showed medium to large effects (Achenbach, 1991).

In regard to ADHD assessments, this scale was shown to discriminate between ADHD children and other psychiatric disorders (Edelbrock, Costello, & Kessler, 1984).

ADHD Rating Scale-IV (DuPaul, in development). The ADHD Rating Scale-IV is currently under development and is a revision of the ADHD Rating Scale (DuPaul, 1991). The ADHD Rating Scale was based upon DSM-III-R ADHD criteria and likewise, the ADHD Rating Scale-IV is based upon DSM-IV ADHD criteria. Although the psychometric properties of the ADHD Rating Scale-IV are under investigation, it is expected that they will be similar to its predecessor, the ADHD Rating Scale (DuPaul, 1995, personal communication).

The ADHD Rating Scale was shown to be a highly reliable questionnaire. With respect to its internal consistency, the ADHD Rating Scale reported Cronbach alphas for the total score and its two subscales. The following alpha coefficients were reported for the parent ratings: ADHD
total score, .94; impulsivity-hyperactivity, .90, and inattention-hyperactivity, .93 (DuPaul, 1991).

Test-retest reliability for parents was obtained with a four week interval between initial and subsequent rating. The Pearson product moment correlation for the ADHD total score and its two subscales were as follows: ADHD total score, .94; impulsivity-hyperactivity, .90; and inattention-hyperactivity, .94 (DuPaul, 1991). In addition, interrater reliability between parents and teachers was shown to be moderately high, with significant correlations (DuPaul, 1991).

Finally, the ADHD Rating Scale’s validity was shown with statistical correlational significance with various ADHD criterion measures. Parent completed ratings were significantly correlated with the child’s work completion and academic efficiency. In addition, DuPaul (1991) reported teacher ratings on the ADHD Rating Scale to correlate significantly with direct observations of on-task behavior and scores on the Abbreviated Conners Teacher Rating Scale (ACTRS, Goyette, Conners, and Ulrich, 1978). (The parent and teacher versions of the ADHD Rating Scale-IV are presented in Appendices D and E, respectively.)

Schedule for Affective Disorder And Schizophrenia for School-Age Children-Epidemiologic Version (K-SADS-E), (Orvaschel & Puig-Antich, 1987). The K-SADS-E is a semi-structured diagnostic interview designed according to DSM-
III-R criteria. According to the authors, it should be regarded as a tool for the diagnostic evaluation of children and adolescents in the area of psychopathology specified. It can be administered to the parent, the child, or a significant other. With multiple informants, summary ratings can be generated and recorded on the scoring sheet provided.

Each section of the K-SADS-E begins with a brief description of the disorder covered. The interview then consists of screening questions and/or symptom items. Generally, sections will begin with screening questions and if these are coded as negative, the interviewer advances to the next section. For example, the depression module begins with general screening items to assess dysphoric mood, irritability, and anhedonia. However, the ADHD module consists of symptom questions only. The items are generally written with wording appropriate for the youngest children and should be altered (appropriately) when interviewing an adolescent. In addition, the items require alternate wording to the third person when interviewing a parent or significant other.

In utilizing the K-SADS-E, a disorder is considered present as long as active symptoms of the illness and/or functional impairment due to the illness persist. A disorder is considered to be in remission when the symptoms are no longer present even though the person may be seeking treatment. In the ADHD section, there are 14 symptom items...
that can be asked of both the parent and the child. However, there are an additional eight items pertaining to "Other Characteristics" that can be asked of the parents. The authors indicated that these are included because other investigators may wish to apply alternative diagnostic classification systems to their data, since classification systems are still evolving. Despite this, a positive diagnosis is made for ADHD when 8 of the 14 items are coded positive.

Hodges (1993) in a review article concluded that the reliability and validity data relevant to DSM-III-R diagnoses provided support for use of this instrument. More specifically, Ambrosini, Metz, Prabucki, and Lee (1988) reported the internal consistency reliability (Cronbach alpha) for several syndromes of two raters over six scoring time frames. The total internal consistency across these syndromes all had alphas above .91. Cronbach alpha ranged from .83 to .93 for the ADHD syndrome and ranged from .76 to .89 for Major Depression.

For inter-rater reliability, Ambrosini et al. (1989) reported the kappa statistic for all diagnoses combined to be .84. Specifically for ADHD and Major Depression, kappas were reported as .88 and .83 respectively. More recently, an investigation of the ADHD module of the K-SADS yield a kappa of 1.0, with a 95% confidence interval of .8 to 1.0 (Chen, Faraone, Biederman, & Tsuang 1994). Ambrosini et al. (1989)
concluded that the K-SADS is a reliable diagnostic interview and recommended it for research purposes.

The test-retest reliability of the K-SADS has been shown to be acceptable to high for all major diagnostic categories, except for anxiety disorders (Chambers, Puig-Antich, Hirsch, Paez, Ambrosini, Tabrizi, & Davies, 1985). Apter, Orvaschel, Laség, Moses and Tyano (1989) report the test-retest reliability of the depression scale to be .72 with a one week interval when interviewing the child.

More recently, Faraone, Biederman, and Milberger (1995) investigated the test-retest reliability of the K-SADS by comparing childhood diagnoses based on maternal report at baseline and one year later. Reliability and accuracy were reported to be excellent for both ADHD and major depression.

The validity of the K-SADS has been investigated and supported as well. Total diagnostic concordance was shown between the K-SADS and the Child Assessment Schedule (Hodges, McKnew, Burbach, & Roebuck, 1987). In using the kappa statistic, concordance between parent interviews was shown to be .60. In using both the parent and child positive diagnoses from the interviews, kappas were shown to be .65 for an ADHD diagnosis and .75 for Affective Disorders (Hodges et al., 1987).

More recently, the validity of an ADHD diagnosis using the K-SADS was further demonstrated with 133 ADHD and 118 normal control boys (Biederman, Faraone, Doyle, Lehman,
Kraus, Perrin, and Tsuang, 1993). These authors demonstrated the convergence between a positive ADHD diagnosis of the K-SADS with significant elevations on the Attention Problems subscale of the Child Behavior Checklist (CBCL). In order to evaluate the strength of association between the two, the Total Predictive Value (TPV) and the Odds Ratio (OR) were computed whereby a scale is viewed as a good predictor if the TPV is 70 or above and the OR is greater than or equal to three. For non-comorbid ADHD males between the ages of 6-17, the TPV was shown to be .86 and the OR to be 99.4, indicating excellent prediction, according to the authors.

**Diagnostic Procedures.** Participants were assigned to groups based on their scores on the CBCL, the TRF, and the parent administration of the K-SADS-E. Group 1 represented the ADHD group. Participants in this group met the following inclusion criteria: (1) a T-Score rating of 65 or above on the attention problems subscale on the CBCL; (2) a T-Score rating of 65 or above on the attention problems subscale on the TRF; and (3) a minimum of eight out of fourteen items on the parent administered ADHD module of the K-SADS-E. Group 2 represented a Borderline ADHD group. Unlike Group 1, members in this group only had to meet any one or two of the three defined criteria for Group 1.

Group 3 represented a Depression group. Participants assigned to this group met the following inclusion criteria: (1) a T-Score rating of 65 or above on the anxious/depressed
subscale of the CBCL; and (2) a positive diagnosis with 5 out of 9 items from the parent administered Depression module of the K-SADS-E. It was possible for participants in this group to also have elevated parent and teacher ratings of inattention on the rating scales and interviews.

Finally, Group 4 was the control group. Participants in this group met the following inclusion criteria: (1) no significant ratings on the CBCL and TRF; and (2) no positive diagnoses from either modules of the parent and teacher administered K-SADS-E. Pragmatically speaking, this group will represent children and adolescents who fall in the normal range for behavior.

In order to assure the adequacy of group assignment, all rating materials for each subject was reviewed by another mental health practitioner (i.e., a Ph.D psychologist) before final disposition to one of the four groups was given. There was 100% agreement between the investigator and mental health practitioner on the assignment of subjects to the four groups.

**Procedure**

**Recruitment of Subjects.** Subjects were recruited through schools and through public mental health clinics. Participating schools first had their respective principal's signed permission for the project to include their school. Teachers in these respective schools were then asked if they wished to participate in the study. After permission was
received from both the principal and the teacher, then consents for participation were distributed to students for their parents to read and sign. When the signed consents were returned with the parent completed rating scales, the respective teachers were asked to complete rating scales for those children. Finally, the parent and teacher interviews were conducted either by telephone or in person. A sub-sample of parents and teachers were additionally asked to re-complete their respective versions of the ADHD Rating Scale-IV for reliability purposes.

In the mental health clinics, implementation of the project began after approval was received from the appropriate authorities of the mental health clinics. Then, the parent/legal guardian of children currently receiving or seeking treatment were asked to participate in this project. Participants were approached at the time of the clinic orientation or at the time of the initial intake interview. However, a few subjects were recruited during routine visits to the mental health clinics and through a mail-out. The mail-out consisted of sending parental consent forms to certain families who were already receiving services at the public mental health clinics.

Administration of the Rating Scales. The rating scales included the CBCL, the TRF, and the home and school versions of the ADHD Rating Scale-IV. Parent participants from the mental health clinics completed the consent form and parent
rating scales (if they chose to participate) at the time of their first clinic visit. The teacher rating scales were then mailed to the appropriate school. Participants recruited from the schools returned the completed rating scales with the signed consent form.

Follow-up Administrations. In order to assess test-retest reliability, 25% of the parents and teachers were contacted four weeks following the original assessment, to again complete the respective versions of the home and school ADHD Rating Scale-IV.

Administration of the K-SADS-E Modules. For the school recruited subjects, once the rating scales were returned with signed permission, the parent or guardian who completed the rating scales was contacted by phone so that the ADHD and Depression modules of the K-SADS-E interview could be conducted. The parent was briefly reintroduced to the project; thanked for their participation in the project and allowed to ask any questions pertaining to the project.

During this same time frame, the child’s teacher was also interviewed with both modules from the K-SADS-E. Again, each teacher was thanked for their participation in the project and allowed to ask any questions regarding the project.

In the mental health clinics, the ADHD and Depression modules of the K-SADS-E were administered to the parent immediately following their signature on the consent form.

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Subsequently, the child’s teacher was contacted either by phone or personal visit so that the same modules could be completed.
CHAPTER 4
RESULTS

Factor Structure of the ADHD Rating Scale-IV

Prior to the determination of the reliability and validity of both the home and school versions of the ADHD Rating Scale-IV, a principal components factor analysis procedure with a varimax rotation was employed. A varimax orthogonal rotation produces factors that account for as much unique variance as possible, while preserving the original orientation between the factors. Separate principal component analyses were conducted for the parent and teacher ratings.

ADHD Rating Scale-IV Home Version. The procedure indicated a two factor solution for the home version of the scale, which accounted for 71.1% of the variance before rotation. Only factors with eigenvalues greater than one were retained as significant factors. The prerotation eigenvalues were 11.66 and 1.12, respectively. Kinnear and Gray's (1994) recommendation was utilized whereby items were required to have a factor loading of 0.50 or greater to be considered as sharing an appropriate percentage of its variance (i.e., at least 25%) with the factor. Additionally, this was the same criteria used by DuPaul (1991) for the investigation of the original ADHD Rating Scale. As it turned out, the factor structure of this current scale appeared similar to the factor structure of the original ADHD
Rating Scale. Therefore, it seemed appropriate to keep the labels of the two factors as (1) Inattention-hyperactivity and (2) Impulsivity-hyperactivity. The factor loadings are presented in Table 1. Eleven items loaded on the first factor and nine items loaded on the second factor. Three items loaded on both factors and are regarded as complex items. Interestingly, Item 10 did not load on either factor.

Table 1
ADHD Rating Scale-IV Home Version Factor Loadings

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Inattention/ hyperactivity</th>
<th>Impulsivity/ hyperactivity</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>.81</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>.64</td>
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<tr>
<td>3</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.57</td>
<td>.63</td>
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<tr>
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<tr>
<td>15</td>
<td>.81</td>
<td>.80</td>
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</tbody>
</table>

On the school version of the ADHD Rating Scale-IV the factor structure was also determined to also have two factors. This two factor solution accounted for 78% of the variance before rotation. The prerotated eigenvalues were 12.71 and 1.33, respectively. The item loadings were very
similar to those from the home version of the scale and therefore, the same two factor labels of (1) Inattention-hyperactivity and (2) Impulsivity-hyperactivity were used. The factor loadings on this version are presented in Table 2. Twelve items loaded on the first factor and eleven items loaded on the second factor. The loadings revealed four complex items and all of the items loaded on at least one factor.

Table 2
ADHD Rating Scale-IV School Version Factor Loadings

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Factor</th>
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<tbody>
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<td>Inattention/ hyperactivity</td>
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<td>.85</td>
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<td>16</td>
<td>.82</td>
</tr>
</tbody>
</table>

Reliability

The internal consistency of the ADHD-IV Rating scale was explored by determining Cronbach’s alpha for both versions of the scale and their respective subscales. For the home
version, the coefficients alphas were obtained as follows:
ADHD Total Score, .95 (n=160); Inattention-hyperactivity, .96 (n=164); and Impulsivity/hyperactivity, .95 (n=167). For the school version, the following coefficients were obtained:
ADHD Total Score, .96 (n=170); Inattention-hyperactivity, .97 (n=173); and Impulsivity-hyperactivity, .94 (n=172).

Test-retest reliability was explored by re-administering the appropriate version of the scale to parent or a teacher four weeks after its original completion. At least 40 parents and 40 teachers were asked to re-rate a child so that their responses could be correlated with the previous rating. This correlation statistic, frequently regarded as the kappa coefficient, attempts to show stability of the scale over time. The kappa coefficients obtained for the ADHD-IV home version were as follows: ADHD Total Score, .89 (n=28); Inattention-hyperactivity, .80 (n=29); and Impulsivity-hyperactivity, .90 (n=28). The obtained coefficients for the school version were as follows: ADHD Total Score, .96 (n=38); Inattention-hyperactivity, .94 (n=38); and Impulsivity-hyperactivity, .96 (n=38).

Multitrait-Multimethod (MTMM) Matrix

The multitrait-multimethod (MTMM) matrix of correlations for data collected is presented in Table 3. The two traits (i.e., Attention and Depression) were assessed with four methods (i.e., Parent Rating Scale, Teacher Rating Scale, Parent Interview, and Teacher Interview). The measurements
Table 3
Modified Multitrait-Multimethod (MTMM) Matrix

Note:
M1 - Parent Rating Scales
M2 - Teacher Rating Scales
M3 - Parent Interview
M4 - Teacher Interview

T1 - Attention
T2 - Depression

Numbers in parentheses are reliability coefficients; bold faced numbers are validity coefficients; italic numbers represent heterotrait-monomethod coefficients; and normal font numbers represent heterotrait-heteromethod coefficients.

<table>
<thead>
<tr>
<th></th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>.95</td>
<td>.67</td>
<td>.88</td>
<td>.70</td>
</tr>
<tr>
<td>T2</td>
<td>.59</td>
<td>.30</td>
<td>.55</td>
<td>.28</td>
</tr>
</tbody>
</table>

T1 - (.95)

M1
T2 - .59 (.90)

T1 - .67 .30 (.97)

M2
T2 - .37 .40 .54 (.89)

T1 - .88 .55 .70 .39 (.91)

M3
T2 - .64 .71 .40 .34 .69 (.79)

T1 - .70 .28 .89 .42 .70 .42 (.86)

M4
T2 - .56 .42 .64 .62 .57 .48 .61 (.80)

used for the matrix include ADHD-IV Home Version; CBCL-Depression Subscale; ADHD-IV School Version; TRF-Depression Subscale; Parent K-SADS-E ADHD Module; Parent K-SADS-E Depression Module; Teacher K-SADS-E ADHD Module; and Teacher K-SADS-E Depression Module. The numbers in the main diagonal in parentheses are reliability estimates of scores obtaine
for each trait and by each method. Cronbach’s coefficient alpha (Cronbach, 1951) was used to estimate the internal consistency of each measurement. Nunnally (1978) posited a criterion alpha value of .80 for a scale to show adequate homogeneity of content sampling. Inspection of this matrix revealed that all but one measure had adequate to high alpha coefficients.

Campbell and Fiske (1959) outlined general guidelines to assess validity with the MTMM matrix. For convergent validity, validity coefficients should be statistically significant and large. For discriminant validity, three general guidelines were proposed: (1) each validity coefficient should be larger than the heterotrait-heteromethod coefficients in that same column and row; (2) each validity coefficient should be larger than all of the other corresponding heterotrait-monomethod coefficients; and (3) both heterotrait-monomethod and heterotrait-heteromethod coefficients should present with similar patterns of intercorrelations.

Examination of the validity coefficients of the ADHD Rating Scale-IV suggests strong convergent validity for both the home and school versions. With regard to discriminant validity, it was noted that the validity coefficients obtained were all larger than their corresponding heterotrait-monomethod and heterotrait-heteromethod coefficients, suggesting that the method of data collection
is not accounting for significant variance. Finally, the heterotrait-monomethod and heterotrait-heteromethod coefficients did exhibit a similar pattern of correlations with each other.

**Discriminant Function Analyses**

Support for concurrent validity is shown when a measure can successfully discriminate between populations differing in some dimension. Various discriminant function analyses were used to assess the predictive ability of the ADHD Rating Scale-IV and its subscales for the home and school version. Stepwise discriminant function analyses based on the overall minimization of Wilk’s Lambda were used. All discriminant function analyses employed two steps. The first step assessed whether or not the scale could significantly discriminate between the different groups. The second step used the scale scores to classify subjects into their respective groups.

**ADHD Rating Scale-IV Home and School Total Score and Teacher K-SADS-E ADHD Module Predictions to the Four Groups.**

In the first analysis, the Total Scores from both the home and school versions were used with the teacher administration of the K-SADS-E ADHD module. This served as an appropriate comparison measure because the teacher modules of the K-SADS-E was not used for group assignments. The four group assignments served as the grouping variable. In other words, the measurements or predictors are regarded as the
independent variables and the four different groups are regarded as the dependent variables.

The analysis produced two significant canonical functions and the K-SADS-E was not retained in the solution. Wilk’s Lambda for Total Score-Home Version was .33 (d.f. 3, 145), F = 96.7, p<.0000 and Wilk’s Lambda for Total Score-School Version was .26 (d.f. 3, 145), F = 45.9, p<.0000. The first function obtained an eigenvalue of 2.34 with a canonical correlation of .84, indicating that this function accounted for 71% of the variance (Chi Squared = 194.71; p<.0000). The second function obtained an eigenvalue of .15 with a canonical correlation of .36, indicating that this second function accounted for the 13% of the variance (Chi Squared = 20.04; p<.0000).

In step two of this analysis, subjects were classified to one of four respective groups. Because the teacher administered K-SADS-E ADHD module was not included as part of either discriminant functions, the classificatory analysis was completed with the ADHD Rating Scale-IV home and school versions. The classification results are presented in Table 4. This procedure correctly classified 60.4% of the total subjects. Interestingly, 93% of Group 4 and 62.2% of Group 1 were correctly classified. However, class accuracy was lower for Groups 2 and 3.
Table 4
Classification of Subjects based on the ADHD-IV Rating Scale
Home and School Versions (Total Scores)
Percent of grouped cases correctly classified: 60.4%

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37</td>
<td>62.2%</td>
<td>13.5%</td>
<td>24.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>22.9%</td>
<td>31.4%</td>
<td>22.9%</td>
<td>22.9%</td>
</tr>
<tr>
<td>3</td>
<td>34</td>
<td>35.3%</td>
<td>35.3%</td>
<td>17.6%</td>
<td>47.1%</td>
</tr>
<tr>
<td>4</td>
<td>43</td>
<td>0.0%</td>
<td>7.0%</td>
<td>0.0%</td>
<td>93.0%</td>
</tr>
</tbody>
</table>

ADHD Rating Scale-IV Home and School Subscale Scores and Teacher K-SADS-E ADHD Module Predictions to the Four Groups.
In this analysis, the two subscale scores from the home and school versions were used with the teacher administration of the K-SADS-E ADHD module. These measures served as the predictors or independent variables. The four group assignments served as the grouping or dependent variable. The analysis again produced two significant canonical functions with only the Inattentive-hyperactive subscales from both the home and school version included in the equation. The Impulsivity-hyperactive subscales from both versions and the teacher administered K-SADS-E ADHD module were not retained in the analysis. Wilk's Lambda for the Inattentive-hyperactivity Subscale-Home Version was .32 (d.f. 3, 145), F = 100.57, p<.0000 and Wilk's Lambda for the
Inattentive-hyperactivity-School Version was .24 (d.f. 3, 145), \( F = 45.57, p < .0000 \). The first function obtained an eigenvalue of 2.54 with a canonical correlation of .85, indicating that this function accounted for 72\% of the variance (Chi Squared = 205.72; \( p < .0000 \)). The second function obtained an eigenvalue of .17 with a canonical correlation of .38, indicating that it accounted for 14\% of the variance (Chi Squared = 22.5; \( p < .0000 \)).

In step two of this analysis, subjects were again classified into one of four groups. This classificatory analysis was completed with the Inattentive-hyperactive subscales from both versions of the ADHD Rating Scale-IV since the other measures had not been retained in the canonical discriminant functions. The classification results are presented in Table 5. This procedure correctly classified 64.5\% of the total subjects. Interestingly, 95.3\% of Group 4 and 80.6\% of Group 1 were correctly classified. However, it again appeared that the functions had difficulty with correctly classifying subjects from Groups 2 and 3.

ADHD Rating Scale-IV Home Version and Subscale Individualized Predictions to the Four Groups. As a means of assessing the discriminating ability of the ADHD Rating Scale-IV Home Version and its subscales, separate discriminant function analyses were conducted each for its total score and its two subscales.
Table 5
Classification of Subjects based on the ADHD-IV Rating Scale
Home and School Versions (Inattentive-hyperactive Subscale Scores)
Percent of grouped cases correctly classified: 64.5%

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>n</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>36</td>
<td>80.6%</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
<td>18.4%</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
<td>36.8%</td>
</tr>
<tr>
<td>4</td>
<td>43</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

In this analysis, Wilk's Lambda for the Inattentive-hyperactivity Subscale-Home Version was .35 (d.f. 3, 155), F = 97.54, p<.0000. The canonical function obtained reported an eigen value of 1.88 with a canonical correlation of .81, indicating that this function accounted for 66% of the variance (Chi Squared = 164.92; p<.0000).

In step two of this analysis, subjects were again classified to one of four respective groups. This classificatory analysis was completed with only the Inattentive-hyperactive subscale of the ADHD Rating Scale-IV. The classification results are presented in Table 6. This procedure correctly classified 52.2% of the total subjects. Interestingly, 95.3% of Group 4 and 61.5% of Group 3 were correctly classified. However, this subscale appeared to
Table 6
Classification of Subjects based on the ADHD-IV Rating Scale
Home Inattentive-hyperactive Subscale Scores
Percent of grouped cases correctly classified: 52.2%

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39</td>
<td>15.4%</td>
<td>28.2%</td>
<td>51.3%</td>
<td>5.1%</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
<td>18.4%</td>
<td>31.6%</td>
<td>28.9%</td>
<td>21.1%</td>
</tr>
<tr>
<td>3</td>
<td>39</td>
<td>12.8%</td>
<td>23.1%</td>
<td>61.5%</td>
<td>2.6%</td>
</tr>
<tr>
<td>4</td>
<td>43</td>
<td>0.0%</td>
<td>4.7%</td>
<td>0.0%</td>
<td>95.3%</td>
</tr>
</tbody>
</table>

have the most difficulty with correctly classifying subjects from Groups 1 and 2.

Wilk's Lambda for the Impulsivity-hyperactivity Subscale-Home Version was .41 (d.f. 3, 158), $F = 74.66$, $p < .0000$. The canonical function obtained reported an eigen value of 1.42 with a canonical correlation of .77, indicating that this function accounted for 59% of the variance ($\chi^2 = 139.92; p < .0000$).

The classificatory analysis was completed with the Impulsivity-hyperactive subscale of the ADHD Rating Scale-IV. These results are presented in Table 7. This procedure correctly classified 51.2% of the total subjects. 90.9% of Group 4 were correctly classified, but the procedure did not do well in classifying subjects from the remaining three groups.
Table 7
Classification of Subjects based on the ADHD-IV Rating Scale
Home Impulsivity-hyperactive Subscale Scores
Percent of grouped cases correctly classified: 51.2%

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>n</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>41</td>
<td>19.5%</td>
</tr>
<tr>
<td>2</td>
<td>39</td>
<td>12.8%</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
<td>13.2%</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

Finally, Wilk’s Lambda for the Total Score-Home Version was .34 (d.f. 3, 152), F = 98.05, p<.0000. The canonical function obtained reported an eigen value of 1.94 with a canonical correlation of .81, indicating that this function accounted for 66% of the variance (Chi Squared = 164.21; p<.0000).

The classificatory analysis for the ADHD Rating Scale-IV total score are presented in Table 8. This procedure correctly classified 57.1% of the total subjects. Group 4 had 95.3 correctly classified and Group 3 had 63.2 correctly classified. However, this procedure appeared to have difficulty with Groups 1 and 2.

ADHD Rating Scale-IV School Version and Subscale Individualized Predictions to the Four Groups. In assessing...
Table 8
Classification of Subjects based on the ADHD-IV Rating Scale Home Total Scores
Percent of grouped cases correctly classified: 57.1%

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38</td>
<td>18.4%</td>
<td>28.9%</td>
<td>50.0%</td>
<td>2.6%</td>
</tr>
<tr>
<td>2</td>
<td>37</td>
<td>2.7%</td>
<td>45.9%</td>
<td>27.0%</td>
<td>24.3%</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
<td>10.5%</td>
<td>26.3%</td>
<td>63.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>4</td>
<td>43</td>
<td>0.0%</td>
<td>4.7%</td>
<td>0.0%</td>
<td>95.3%</td>
</tr>
</tbody>
</table>

the discriminating ability of the ADHD Rating Scale-IV School Version and its subscales, similar analyses were conducted. Separate discriminant function analyses were conducted each for its total score and its two subscales.

For the Inattentive-hyperactivity Subscale, Wilks's Lambda was .44 (d.f. 3, 164), F = 68.27, p<.0000. The canonical function obtained reported an eigen value of 1.25 with a canonical correlation of .75, indicating that this function accounted for 56% of the variance (Chi Squared = 133.32; p<.0000).

In step two of this analysis, subjects again were classified to one of four diagnostic groups by use of only the Inattentive-hyperactive subscale of the ADHD Rating Scale-IV School Version. The classification results are presented in Table 9. This procedure correctly classified
Table 9  
**Classification of Subjects based on the ADHD-IV Rating Scale School Inattentive-hyperactive Subscale Scores**
Percent of grouped cases correctly classified: 52.98%

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>n</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>41</td>
<td>78.0%</td>
</tr>
<tr>
<td>2</td>
<td>42</td>
<td>33.3%</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>41.5%</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

52.98% of the total subjects. This measure did best with Group 4 by correctly predicting 95.3% of the group. Additionally, 78% of Group 1 was also correctly predicted. Similar to its home version counterpart, this subscale appeared to have the most difficulty with correctly classifying subjects from Groups 1 and 2.

Wilk's Lambda for the Impulsivity-hyperactivity Subscale-School Version was .58 (d.f. 3, 162), \( F = 38.85 \), \( p<.0000 \). The canonical function obtained reported an eigen value of .72 with a canonical correlation of .65, indicating that this function accounted for 42% of the variance (Chi Squared = 88.07; \( p<.0000 \)).

The classificatory analysis completed with this Impulsivity-hyperactive subscale are presented in Table 10. This procedure correctly classified 48.2% of the total...
Table 10
Classification of Subjects based on the ADHD-IV Rating Scale
School Impulsivity-hyperactive Subscale Scores
Percent of grouped cases correctly classified: 48.19%

<table>
<thead>
<tr>
<th>Actual Group n</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1 42</td>
<td>66.7%</td>
</tr>
<tr>
<td>2 41</td>
<td>36.6%</td>
</tr>
<tr>
<td>3 39</td>
<td>38.5%</td>
</tr>
<tr>
<td>4 44</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

subjects. This procedure correctly classified 90.9% of Group
4 and 66.7% of Group 1, but did not do well in classifying
subjects in Groups 2 and 3.

Finally, Wilk's Lambda for the Total Score-School
Version was .49 (d.f. 3, 161), F = 56.73, p<.0000. The
canonical function obtained reported an eigen value of 1.06
with a canonical correlation of .72, indicating that this
function accounted for 52% of the variance (Chi Squared =
116.49; p<.0000).

The classificatory analysis for the ADHD Rating Scale-IV
total score are presented in Table 11. This procedure
correctly classified 52.7% of the total subjects. Group 4 had
93.2 correctly classified and Group 1 had 74.4% correctly
classified. However, like some previous functions, this
Table 11
Classification of Subjects based on the ADHD-IV Rating Scale
School Total Scores
Percent of grouped cases correctly classified: 52.73%

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>n</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>43</td>
<td>74.4%</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>35.0%</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
<td>39.5%</td>
</tr>
<tr>
<td>4</td>
<td>44</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

procedure appeared to have greater difficulty in classifying subjects to Groups 2 and 3.

Baserate Analyses

As stated in the introduction, baserate information can also be used to assess validity. Additionally, the effectiveness of the instruments was also assessed since it is known that valid signs may not increase the accuracy of prediction.

For the purpose of these analyses, the sign of the ADHD Rating Scale-IV was coded positive (i.e., condition present) based on DSM-IV diagnostic criteria. More specifically, items on the scale were divided into their respective inattentive and hyperactivity-impulsivity diagnostic types. Then, a subject was coded positive on the scale when either sub-type had a score of 12 or above. This score was chosen
arbitrarily because it represented an average endorsement of six or more symptoms occurring often or very often.

In assessing the validity of the ADHD Rating Scale-IV Home Version, the appropriate numbers were placed in the validity formula presented in Chapter 1. Accordingly, the following equation had to be true for validity to be indicated:

\[
\frac{41}{71} > \frac{2}{51}
\]

\[
.58 > .04
\]

Since the equation proved true, validity for this measure has been indicated.

Likewise, this same formula was applied to the ADHD Rating Scale-IV School version for a validity indicator. The respective equation turned out as follows:

\[
\frac{43}{44} > \frac{1}{82}
\]

\[
.98 > .01
\]

With this equation also being proved true, validity for the school version of the ADHD Rating Scale-IV is also indicated.

In similar mathematical fashion, the effectiveness of both versions of the ADHD Rating Scale-IV was also assessed in using the other formula outlined in Chapter 1. The base rate for this study’s population was computed to be .26. In using the appropriate formula, the following equation had to be proved true for effectiveness to be indicated:
This equation was not proven true and therefore this measure can not be deemed effective.

Likewise, this formula was applied to the ADHD Rating Scale-IV School version for an effectiveness indicator. The respective equation turned out as follows:

\[ 0.26 > 0.26 + 0.005 \]
\[ 0.26 > 0.265 \]

Again, this equation was not proven true and therefore effectiveness has not been indicated for this measure either.
CHAPTER 5
DISCUSSION

The purpose of the present study was to psychometrically investigate both the home and school versions of the ADHD Rating Scale-IV. These rating scales were found to have high internal consistency, adequate test-retest reliability, and appropriate correlations with other measures of ADHD. Additionally, these results lend additional support to the reliability and criterion related validity of the ADHD diagnostic criteria set forth by the DSM-IV. Finally, both scales were found to have psychometric properties strong enough to be used as a screening measure.

The results of a principal components factor analysis revealed two factors for both scales. Since these factors were similar to the two factors extracted from the original ADHD Rating Scale, the same factor labels were used, namely (1) Inattention-hyperactivity and (2) Impulsivity-hyperactivity. The first factor from both scales accounted for a majority of the variance and was comprised of items associated with inattention and motor restlessness. The second factor was comprised of items related to impulsivity and motor activity. DuPaul’s (1991) surprise that no hyperactivity factor emerged from the original ADHD Rating Scale is also applicable here as is his explanation. DuPaul (1991) contended that hyperactivity may be expressed in the context of problems with inattention or impulsivity and does
not occur in their absence. Additionally, this two-factor model supports the current DSM-IV classification types for ADHD.

The total and factor scores for both versions of the ADHD Rating Scale-IV were all found to be internally consistent, stable across time, and significantly related to other predictors of inattention and hyperactivity. The total scores and subscale scores for both scales had similar correlation coefficients with the other obtained measures of ADHD. As expected, measures from the same informant had stronger correlations than across informants.

Results from the MTMM analysis provided evidence for the validity for both versions of the ADHD Rating Scale-IV. The validity coefficients suggested strong convergent validity for both parent and teacher ratings. MTMM results also indicated discriminant validity for the scales with validity coefficients being larger than their corresponding heterotrait-monomethod and heterotrait-heteromethod coefficients. Therefore, this analysis concluded that method variance was not indicated between parent and teacher reports since there were substantially lower correlations between rating scale measures of ADHD and Depression.

In assessing the concurrent validity of the ADHD Rating Scale-IV, various stepwise discriminant function analyses were used to assess the predictive ability of the total and subscale scores obtained from both versions of the scale.
Stepwise procedures allowed for the variables to be entered into the analysis according to the amount of variance accounted for by that variable.

In the first discriminant function analysis, the total score from both ADHD Rating Scale-IV versions was used with the teacher administered K-SADS-E ADHD module. Because it did not account for a significant portion of the variance, the K-SADS-E was not retained in the analysis. In using the total scores from both the home and school versions in the discriminant functions, 60.4% of the subjects were correctly classified by group.

In the second discriminant function analysis, the subscale scores from both versions of the ADHD Rating Scale-IV was used with the teacher administered K-SADS-E ADHD module. The analysis only retained two of the five variables entered into the analysis. Interestingly, the variables retained were the Inattentive-hyperactivity subscales from the parent and teacher rating. Through utilization of these subscale scores, 64.5% of the subjects were correctly classified.

In the remaining discriminant function analyses, the total and subscale scores from both versions of the ADHD Rating Scale-IV were analyzed by themselves so as to individually assess the predictive ability of each subscale and total score. For the home version of the scale the correct classification rates for the Inattentive-hyperactive
subscale score, the Impulsivity-hyperactivity subscale score, and Total score were 52.2%, 51.2%, and 57.1, respectively. The school version of the scale reported classification rates for the Inattentive-hyperactive subscale score, the Impulsivity-hyperactivity subscale score, and Total score were 53.0%, 48.2%, and 57.7, respectively.

For the majority of these discriminant function analyses, classification difficulty was greatest for Group 2 and Group 3. Group 2 represented a borderline ADHD group and Group 3 represented a depressed group of subjects. However, this was not true for the home version of the ADHD Rating Scale-IV. For some reason, the Total and Inattentive-hyperactive subscale score did better predicting for subjects belonging to Group 3 and Group 4, the control group. Ironically, the Impulsivity-hyperactivity subscale score did not do well in predicting membership in any of the clinical groups. Despite this, the diagnostic implications are clear that this ADHD Rating Scale-IV does an adequate job in ruling out diagnostic concerns but has significant difficulty discriminating between clinical groups. Therefore, it is appropriate that this measure be considered for screening purposes; if the screen is positive, further assessment should take place.

Additional analyses could have been conducted in which only the ironclad ADHD group (i.e., Group 1) and the control group (i.e., Group 4) were used for classificatory purposes.
However, such analyses really do not add to our investigation because elimination of the other two clinical groups would artificially inflate the predictive ability of these rating scales. In fact, this phenomena was partially shown by the greater predictive rates for Groups 1 and 4.

The difficulty for these rating scales to discriminate between these clinical groups is cause for concern but is consistent with other literature. Bird and Staghezza (1993) estimated that the rate of ADHD comorbidity with depressive episodes at 26.8%. Additionally, ADHD has been shown to exist comorbidly with conduct disorder, oppositional defiant disorder, and anxious disorders (Cohen, Cohen, & Kasen, 1993). Inspection of the data indeed showed that many of the subjects identified as depressed had similar elevations on ADHD measures. Conversely, there were few subjects in the depressed group who did not show any ADHD characteristics. In light of this, it would seem difficult for any measure to effectively discriminate between these two clinical populations since they share similar features.

Baserate analyses were used to also indicate the validity of the ADHD Rating Scale home and school versions. The sensitivity of these instruments (i.e., the ability to correctly detect the condition) was superlative. However, the specificity (i.e., accurately identifying those without the condition) was weak. The specificity of these scales played into the effectiveness equation and therefore,
effectiveness for these scales was not indicated. The inability for these baserate analyses to show effectiveness is best explained by the comorbidity argument outlined earlier. Despite this, Gouvier, Hayes, and Smiroldo (1997) contend that overdiagnosing brings less risks than underdiagnosing.

Limitations of the Study and Future Directions

There are several factors that limit the conclusions drawn from the results. First, although both versions of the ADHD Rating Scale-IV demonstrated strong psychometric characteristics, conclusions are tempered by the limitations of rating scales. Reports by others may include a response bias which compromises the concordance between the rating and the actual behavior. Further indications of validity for these scales would be substantiated with strong correlations with direct observations of on-task behavior.

Secondly, in order to truly assess the ability of the ADHD Rating Scale-IV to discriminate between clinical populations, effort must be made to ensure that the populations are indeed distinct. Although it has been argued that comorbidity rates are high with ADHD children, such a clinical group presents with a "grab-bag" of clinical symptomatology. Future studies should further operationalize the diagnostic groups and exclude subjects with overlapping symptoms.
Additionally, other variables which were not investigated here could be related to ADHD symptomatology. Social skills, substance abuse, poor family relationships, and deviant peer groups are only a few examples of extraneous factors that may contribute to a positive diagnosis of ADHD. Proper investigation of this is necessary to further clarify the role the environment has in the life of a child identified as ADHD.

The exclusion of adolescents in this present study was done for methodological reasons. However, investigation of the ADHD Rating Scale-IV with adolescents is warranted since many children with ADHD many go undiagnosed until adolescence. Additionally, although it has been a common practice to exclude adolescents in ADHD research studies, such a practice perpetuates the uncertainty of adolescent ADHD (Biederman, Faraone, Taylor, Sienna, Williamson, & Fine, 1998). Finally, inclusion of adolescent ADHD subjects is essential for thorough investigation of ADHD comorbidity.

In regard to another methodological issue, the classification procedure utilized by these discriminant function analyses had an inherent bias since the cases classified were the same ones used to create the discriminant functions. A procedure known as the jack-knife eliminates this bias by generating discriminant functions without the specific case being classified. In this way, a case is classified based on information from every other case.
all cases are classified in this way, the procedure is regarded as being more conservative.

Finally, the present study utilized only Louisiana children from the southeast part of the state. Thus, it is unknown how representative this sample population is for other geographical regions. Additionally, the diagnostic utility of the ADHD Rating Scale-IV in documenting treatment effectiveness for different populations may prove to be useful.

Conclusion

In sum, this preliminary investigation of the ADHD-IV Rating Scale-IV suggests that this instrument has high internal consistency, adequate stability across time, and significant correlations with other ADHD criterion measures. Factor analysis revealed two similar factors for both the parent and teacher scales, namely (1) Inattention-hyperactivity and (2) Impulsivity-hyperactivity. Both versions did an adequate job of discriminating ADHD subjects with normal controls; less of an adequate job for discriminating different clinical populations. Like its predecessor, the original ADHD Rating Scale, it should be useful in the initial screening of ADHD, as DuPaul (1992) proposed as Stage One of an ADHD assessment. However, additional research is needed to determine the applicability of this rating scale in terms of its diagnostic and treatment utility with diverse populations.
REFERENCES


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73


metabolite levels in ADHD boys with and without reading disabilities.


attention deficit disorder. Archives of Neurology, 41, 825-829.


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APPENDIX A. CONSENT FORM

Louisiana State University - Baton Rouge Campus

Consent Form

1. **Study Title:** The Psychometric Characteristics of the ADHD-IV Rating Scale

2. **Performance Sites:**
   - Jefferson Parish Mental Health Clinics
   - Louisiana Public and Private Schools

3. **Investigators:**
   The following investigator will be able to answer questions regarding the study:
   - **Name:** George Hebert
   - **Telephone Number:** (504) 443-3979

4. **Purpose of the Study:**
   The purpose of the study is to investigate the utility of a rating scale that is completed by both parents and teachers to help identify children with Attention-Deficit Hyperactivity Disorder. By participation in the study, volunteers may help to discover better ways to assess Attention-Deficit Hyperactivity Disorder in children.

5. **Subject Inclusion:**
   The study will include parents and teachers of children between 6-11 years of age.

6. **Subject Exclusions:**
   The study will exclude parents and teachers of children younger than 6 and older than 11.

7. **Description of the Study:**
   Rating scales will be completed by the parent and teacher of children. In addition, the parent and teacher will participate in a brief interview. Some of the participants will also be asked to complete a follow-up rating scale. About 160 parent-teacher dyads will be used for the study. The parent and teacher rating scales will each take approximately 15 minutes to complete. The interviews will each take about 7 minutes. The follow-up rating scale will take approximately 5 minutes.

8. **Benefits:**
   The study will not benefit the participants directly, but may benefit others by finding better ways of assessing Attention-Deficit Hyperactivity Disorder.

9. **Risks:**
   There are no risks.

10. **Alternatives:**
    The study does not evaluate a different treatment, therefore it is not an alternative.

11. **Removal:**
    Participants who agree to complete the rating scales and interviews have fulfilled all of the study requirements after all rating scales and interviews are completed.
12. **Right to Refuse:** Participants may choose NOT to participate or withdraw from the study at any time with no penalty and will not jeopardize their treatment at the present time nor in the future.

13. **Privacy:** The results of the study may be published. The privacy of participating subjects will be protected and the identity of participants will not be revealed.

14. **Release of Information:** The mental health records of the children from the Jefferson Parish Mental Health clinics may be reviewed by the investigators, but subject identity will be kept secret.

15. **Financial Information:** The costs of the project will not be billed to participants.

16. **Signatures:**

The study has been discussed with me and all of my questions have been answered. I understand that additional questions regarding the study should be directed to the investigator listed above. In agreeing to participate in this study, I am authorizing my child's teacher to complete questionnaires and participate in an interview about my child.

I understand that if I have questions about subject rights or other concerns, I can contact the Vice Chancellor of the LSU Office of Research and Economic Development at 388-5833. I have also discussed this with my child and my child's signature below indicates that it is okay with he/she that we participate in the study. I agree with the terms above and acknowledge I have been given a copy of the consent form.

____________________________
Child's Signature            Date
____________________________
Parent/Guardian Signature    Date
____________________________
Phone Number(s)
____________________________
Investigator(s)             Date

The person has indicated to me that the subject has difficulty with reading. I certify that I have read this consent form to the person and explained that by completing the signature line above the person has agreed to participate.

____________________________
Signature of Reader          Date

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APPENDIX B. PRINCIPAL PERMISSION FORM

Principal Permission Form

Dear Principal:

This is a request to allow students and teachers in your school to participate in a research project. The purpose of this study is to investigate current techniques of the assessment of Attention-Deficit Hyperactivity Disorder (ADHD) for children between the ages of six and eleven. If you choose to allow your teachers and students to participate, you will be allowing us to visit classrooms for the distribution of parental consent forms and other rating materials for the students to bring home and return to the school. (Naturally, classrooms will be not be bothered if the teacher chooses not to be involved with the project). Once the materials are returned with signed parental consent, the teacher will also participate in a brief interview, regarding the child’s school behavior. As an incentive, I am offering to fund a pizza party for the class bringing in the most completed questionnaires for each grade. Finally, in being sensitive to teacher’s time, the teacher can limit how many ratings she/he chooses to complete.

In order to protect everyone’s privacy, the data will only be identifiable by a number once it is collected. Further, all data will be treated confidentially and will be secured under lock and key when stored. Finally, any additional investigators assisting in the project will be only those who have received training on the issue of confidentiality.

Thank You

George W. Hebert, M.A.
School Psychology Graduate Student
Louisiana State University

(Please complete below.)

____ Yes, I give permission for my school to participate in the project.

____ No, I do not wish for my school to participate in the project.

School’s Name _________________________

Principal’s Signature _____________________
Teacher Permission Form

Dear Teacher:

This is a request for you and your students to participate in a research project. The purpose of this study is to investigate current techniques of the assessment of Attention-Deficit Hyperactivity Disorder (ADHD) for children between the ages of six and eleven. Your principal has already signed consent for the school to voluntarily participate. If you choose to participate, you will be allowing us to visit your classroom for the distribution of parental consent forms and other rating materials for the students to bring home and return to the school. Once the materials are returned with signed parental consent, you will be asked to participate in a brief interview regarding the child’s school behavior. (In being sensitive to your time, you may limit how many ratings you choose to do. The rating scales take approximately 15 minutes per student to complete and the interview takes approximately 7 minutes per student.) As an incentive, however, I am offering to fund a pizza party for the class bringing in the most completed questionnaires for each grade. (Naturally, the pizza party will be scheduled at a time convenient for you.)

In order to protect everyone’s privacy, the data will only be identifiable by a number once it is collected. Further, all data will be treated confidentially and will be secured under lock and key when stored. Finally, any additional investigators assisting in the project will be only those who have received training on the issue of confidentiality.

Thank You

George W. Hebert, M.A.
School Psychology Graduate Student
Louisiana State University

(Please complete below.)

___ Yes, I agree to participate in the project.
___ No, I do not wish to participate in the project.

School’s Name ____________________ Classroom # ___
Teacher’s Signature ____________________________
## APPENDIX D. ADHD RATING SCALE–HOME VERSION

### ADHD RATING SCALE–IV: HOME VERSION

Child's name ____________________  Age _______  Grade ______

Completed by: ____________________

Circle the number that best describes your child's home behavior over the past 6 months.

<table>
<thead>
<tr>
<th>Item</th>
<th>Never or rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fails to give close attention or makes careless mistakes in schoolwork.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Fidgets with hands or feet or squirms in seat.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Has difficulty sustaining attention in tasks or play activities.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Leaves seat in classroom or in other situations in which remaining seated is expected.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Does not seem to listen when spoken to directly.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Runs about or climbs excessively in situations in which it is inappropriate.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Does not follow through on instructions and fails to finish work.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Has difficulty playing or engaging in leisure activities quietly.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Has difficulty organizing tasks and activities.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Is &quot;on the go&quot; or acts as if &quot;driven by a motor.&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11. Avoids tasks (e.g., schoolwork, homework) that require sustained mental effort.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12. Talks excessively</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13. Loses things necessary for tasks or activities.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. Blurs out answers before questions have been completed.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15. Is easily distracted.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16. Has difficulty awaiting turn.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17. Is forgetful in daily activities.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18. Interrupts or intrudes on others.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

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### ADHD Rating Scale—IV: School Version

Child's name ________________________  Age ______ Grade ______

**Complied by:**

Circle the number that best describes this student's school behavior over the past 5 months (or since the beginning of the school year).

<table>
<thead>
<tr>
<th>Behavior</th>
<th>never or rarely</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fails to give close attention to details or makes careless mistakes in schoolwork</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
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<td>1</td>
<td>2</td>
<td>3</td>
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<td>2</td>
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<tr>
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<td>3</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Runs about or climbs excessively in situations in which it is inappropriate</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Does not follow through on instructions and fails to finish work</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Has difficulty playing or engaging in leisure activities quietly</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Avoids tasks (e.g., schoolwork, homework) that require sustained mental effort</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Talks excessively</td>
<td>0</td>
<td>1</td>
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<td>2</td>
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<td>3</td>
</tr>
</tbody>
</table>
VITA

George Walter Hebert was born on November 14, 1964, in New Orleans, Louisiana. He received a bachelor of science degree in Psychology from the University of New Orleans in 1986 and entered graduate school at Louisiana State University the following year in School Psychology. He elected to conduct his thesis research in biological psychology and earned his master of arts degree in 1989. He then served as a school psychology intern for the Livingston Parish School Board and continued there for two additional years as a school psychologist. The degree of Doctor of Philosophy will be awarded in December, 1998. Currently, Dr. Hebert is serving as the clinical director of the West Jefferson Child and Adolescent Clinic of the Jefferson Parish Human Services Authority.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: George Walter Hebert

Major Field: Psychology

Title of Dissertation: The Psychometric Characteristics of the ADHD Rating Scale-IV

Approved:

[Signatures]

Major Professor and Chairman
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

[Signatures]

Date of Examination:

July 28, 1998