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Assessment of Nonverbal Cognitive Processes in Children with Attention Deficit Hyperactivity Disorder

Jacqueline J. Head

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Assessment of Nonverbal Cognitive Processes in
Children with Attention Deficit Hyperactivity Disorder

by

Jacqueline J. Head

Presented to the Faculty of
George Fox University
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of the requirements for the degree of
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in Clinical Psychology

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Approval

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Attention Deficit Hyperactivity Disorder

by

Jacqueline J. Head

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Date: March 19, 1997

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Academic Affairs

Date: 3-19-97
Assessment of Nonverbal Cognitive Processing in Children with Attention Deficit Hyperactivity Disorder

Jacqueline J. Head
George Fox University
Newberg, Oregon

Abstract

This study reviewed the literature on ADHD/ADD including a survey of the disorder, current clinical interventions and, diagnostic techniques. Data was collected comparing three groups of children (control, ADHD, ADD) on a newly developed nonverbal assessment test, the Leiter-R. The findings show that the Leiter-R resulted in significant differences in scores between the control group and the ADHD and ADD groups on twelve of the twenty subtests. This demonstrates the efficacy of the Leiter-R as an assessment tool for ADHD and ADD.

Based on these findings the following tentative recommendations were proposed to assist children with ADHD and ADD. Children with ADHD and ADD need to have assistance with cognitive deficits as well as with behavioral problems. Children with
ADHD and ADD may learn better when material is presented visually rather than in oral form only. Affected children may need to be taught problem solving skills because they have trouble generalizing from one situation to another. Research with children with Traumatic Brain Injury (TBI) has led to the development of teaching strategies that may be helpful with children with ADHD and ADD.
Acknowledgements

There have been a number of changes in our family since I started at George Fox University five years ago. We have moved three times. One of our children graduated from college, and another one graduated from high school. Our oldest son was married and our daughter is currently engaged. Some family members have died and others have been born. Throughout all of this, my family has been a source of support and encouragement. I especially want to thank my husband, Gene, who has loved me continuously for the last 28 years and who told me that his ministry while I was in school was to take care of me and help me become a psychologist. I also want to thank my daughter Jennifer for her help with word processing.

Special thanks go to my committee, Gale Roid, Dean Longfellow and Kathryn Ecklund. Gale was extremely patient with me as he explained the statistics over and over until I finally began to understand.

Finally, thank you to the night crew at Salem Hospital Psychiatric Medicine Unit (especially Gail, Lucy, Donna, Eleanor, and Joe). They believed in me and cheered me on when I was discouraged and thought this would never be finished.
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Attention Deficit Hyperactivity Disorder (ADHD) is the current name for a behavior disorder first diagnosed in children. The three core areas of dysfunction are attention, impulse control, and excessive activity for the age of the child (American Psychiatric Association, 1994). The disorder is pervasive in that it affects all areas of a child’s life, and is generally a chronic condition, often continuing to some degree into adulthood (Barkley, 1990).

A conservative estimate of the prevalence of ADHD is 3% - 5% of the school age population (APA, 1994). Based on 1980’s school enrollment data, at least 600,000 (Barkley, 1990) to 700,000 (Madsen, 1994) children are affected in the United States. ADHD is the most common reason for referral and treatment of children in mental health clinics and occurs in boys approximately four times more often than in girls. Children with this disorder generally experience difficulties in school, at home, and with peers. People are often impatient with ADHD children because the symptoms are not observable during all tasks and at all times. The symptoms vary with the situation, leading parents and teachers to consider such children lazy and willfully disobedient. This conclusion on the part of authority
figures means that ADHD children are frequently treated punitively rather than therapeutically which exacerbates the problem and compounds the developmental difficulties of children with ADHD.

Current diagnostic tools are inadequate and based mainly on behavioral ratings. There are some existing objective tests that are used to identify children with ADHD, but these are not error free and serve most usefully as an affirmation of clinical diagnosis. An example of such a test is the WISC-III, which allows the clinician to identify patterns of subtest functioning that distinguish ADHD groups from normals. These patterns tend to provide both false positives and false negatives (Prifitera & Dersh, 1992). Therefore, they serve as indicators but are not conclusive. Given the importance of ADHD in our society, the need for valid assessment devices to identify ADHD in children is clear. There is also a need for a tool to measure the results of clinical interventions. The present study presents data regarding the non-verbal cognitive differences between ADHD children and a comparison group of normative children. Specific consideration is given to attention processes and memory in an identified ADHD group and a comparison group selected from typical children of the same age range.
History of Disorder

ADHD has a long and controversial history. It is important for the reader to be familiar with this history because our present understanding of ADHD is built on the work of previous researchers. Over the years, the disorder has been known by as many as 13 different names (Walters & Barrett, 1993; see Table 1). Each of the names was chosen to reflect either the major symptoms of the disorder or the belief about the etiology of the disorder which was in vogue at the current time. Another factor in determining the names historically was the main symptoms that were considered to define the disorder at that specific period in time. As the database of information informed new researchers and clinicians, the name was changed to reflect their current thinking about the disorder. Currently, ADHD is the accepted name for this symptom constellation.

The first reference to hyperactive behavior was apparently made in 1854 by the German physician Hoffman (Conners & Wells, 1986). The next reference occurred in 1902 when Still (Still, 1902) lectured to the Royal College of Physicians regarding 20 children in his practice that he described as aggressive, defiant, resistant to discipline, excessively emotional, and exhibiting little self control in inhibiting behavior. Still believed that the symptoms were secondary to the occurrence of a brain disease and, therefore, the disorder was called Brian
Table 1

Listing of Diagnostic Labels for Attention Deficit Hyperactivity Disorder

<table>
<thead>
<tr>
<th>Taxonomic Groupings and Diagnosis</th>
<th>Reference</th>
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<tr>
<td>Brain damage syndrome</td>
<td>Still, 1902</td>
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<tr>
<td>Organic drivenness</td>
<td>Kahn &amp; Cohen, 1934</td>
</tr>
<tr>
<td>Organic brain syndrome</td>
<td>Bradley, 1937</td>
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<tr>
<td>Organic behavior syndrome</td>
<td>Bradley &amp; Bowen, 1941</td>
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<tr>
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<td>Hyperkinetic impulse disorder</td>
<td>Laufer &amp; Denhoff, 1957</td>
</tr>
<tr>
<td>Minimal brain dysfunction</td>
<td>Clements &amp; Peters, 1962</td>
</tr>
<tr>
<td>Hyperactivity</td>
<td>Werry, 1968</td>
</tr>
<tr>
<td>Hyperkinetic syndrome</td>
<td>Rutter, et al., 1970</td>
</tr>
<tr>
<td>Hyperactive child syndrome</td>
<td>Cantwell, 1975</td>
</tr>
<tr>
<td>Minimal brain dysfunction syndrome</td>
<td>Laufer, 1979</td>
</tr>
<tr>
<td>Attention Deficit Disorder</td>
<td>APA, 1980</td>
</tr>
<tr>
<td>Attention Deficit-Hyperactivity Disorder</td>
<td>APA, 1987, 1994</td>
</tr>
</tbody>
</table>
ADHD

Damage Syndrome. In patients where Brain Damage Syndrome continued into adulthood, Still found that they engaged in a higher incidence of adult criminal behavior.

In 1934, Kahn and Cohen (Walters & Barrett, 1993) renamed the syndrome Organic Drivenness based on their theory of etiology. Their belief was that the disorder was due to brain stem damage obtained as a result of prenatal injury, birth injury, or occurring as the result of a genetic predisposition. Their conclusion that the problem was located in the brain stem was inferred from reports of similar behavior in individuals with known brain stem damage. Much support for this theory was provided by a national flu epidemic which took place between 1917-1918.

By the late 1940’s researchers began to address the neurological mechanisms underlying the behavioral symptoms of ADHD. Laufer and Denhoff (1957) believed the site of the central nervous system (CNS) deficit in ADHD was located in the thalamus. They further believed the problem was due to poor filtering of incoming sensory stimuli allowing excessive material to reach the brain. They called the disorder Hyperkinetic Impulse Disorder.

In the 1950’s and 1960’s, the disorder was called Minimal Brain Dysfunction (MBD). Researchers began to question the logical fallacy inherent in the assumption that since brain damage was evident in some children with the
symptoms of what we now call ADHD, it could therefore be assumed that it was present in all children with the same behavioral constellations. The term, MBD, allowed for the likelihood that the area of dysfunction was located somewhere in the central nervous system but did not depend on proving that organic brain damage existed.

The official document listing mental disorders in 1968 was the Diagnostic and Statistical Manual of Mental Disorders (DSM) published by the American Psychiatric Association. At that time, the common term for the disorder among practitioners was the hyperactive child syndrome. The official DSM label was Hyperkinetic Reaction of Childhood Disorder. Under this heading the authors briefly described the excessive activity level of children but otherwise did not provide useful information for clinical diagnosis or research. Therefore, it was difficult for researchers to compare results obtained in different studies. Although the DSM did not include the areas of attention and impulsivity, they were commonly considered by researchers and clinicians to be significant in defining the disorder. Treatment of the disorder usually involved a multimodal approach which included parent training, behavior modification, psychotherapy, medication, and special education. This treatment is very similar to the prescription provided for ADHD children today.
Medication Issues

In the 1970’s, researchers continued to question the validity of the diagnosis of Minimal Brain Dysfunction and the common name for the disorder was changed to Attention Deficit Disorder because in most children with established brain damage, hyperactivity was not a symptom (Rutter, 1989). At the same time, it was discovered that stimulant medication was effective in ameliorating some of the symptoms of ADHD. This was a treatment breakthrough.

Stimulant medication is the most meticulously studied and best researched topic in pediatric psychopharmacology. Ritalin has been shown to work mainly on the attentional difficulties of children and does not have a sedating effect at the correct dosage. However, there is controversy over the use of a controlled substance to treat children over a long period of time. Clinicians are constantly looking for improved diagnostic instruments to avoid unnecessarily medicating children due to inaccurate assessment measures. This study will attempt to add to the literature in this area.

Other Symptoms of ADHD

At the same time that dissatisfaction was developing with the concept of Minimal Brain Dysfunction, researchers were beginning to notice of some of the other symptoms of the disorder. Douglas, a Canadian clinician (Barkley, 1990),
argued forcefully for the theory that the problems that ADHD children experience are more likely to be caused by difficulties in sustaining attention and impulse control rather than by an excess of activity. Her findings were confirmed by the McGill University research team. They found that children with the disorder experienced greatest difficulties on tasks requiring vigilance or sustained attention such as the Continuous Performance Test (CPT; Gordon, 1983). While the CPT does an excellent job of measuring sustained attention, it does not identify other dimensions of attention. Other diagnostic tools continue to be necessary.

Weiss (Weiss & Hechtman, 1986) found that activity levels became less of a problem for children with the disorder during adolescence, but the attentional difficulties and impulsivity continued to be problematic. This finding has been substantiated by more recent studies (Barkley, 1990), and led to the conclusion that a measure of attentional deficits needed to be developed. In 1980 the DSM-III (American Psychiatric Association, 1980) was published and the disorder was named Attention Deficit Disorder. At that point, deficits in attention and problems with impulse control were considered to be of more diagnostical significance than hyperactivity.
Attention Deficit-Hyperactivity Disorder

In the 1980's researchers attempted to operationalize ADHD so that it could be scientifically researched in a meaningful manner. This research attempted to develop criteria that would distinguish ADHD not only from normal populations but, more importantly, from other psychiatric disorders. ADHD was often misdiagnosed as Conduct Disorder and vice versa. At the same time ADHD was being differentiated from other disorders, ADHD was also divided into subtypes of ADD plus hyperactivity and ADD minus hyperactivity. ADD minus hyperactivity is not correlated with Conduct Disorder. Finally, in 1987, the DSM-III-R (revised, American Psychiatric Association) consolidated the ADD and hyperactivity disorders and labeled it Attention Deficit Hyperactivity Disorder. ADHD was classified with Oppositional Defiant Disorder and Conduct Disorder in an overarching category of Disruptive Behavior Disorders. This category was developed because there is substantial comorbidity in clinical populations of children.

Areas of controversy. Currently, there is disagreement as to the actual cause of behavioral deficits. While many feel it is a problem with attention (Douglas, 1990), others have posited a new array of mechanisms. Barkley (1990) suggested that the problem might be in the area of deficits in rule-governed behavior or in the area of response to consequences. Stroufe (1975) hypothesized that the problem...
might be one of motivation. These new ideas have been intriguing, but at this time are unproven. This paper will address the issue of ADHD in affected children with a focus on deficits in attention. While issues of impulsively and hyperactivity are also important, they are beyond the scope of this study.

A biological basis for the disorder. An interesting study (Semrud-Clikeman, et al., 1994) using magnetic resonance imaging (MRI) has shown that there may indeed be a biological basis for the difficulties in attention experienced by children with ADHD. The results of the study showed that the ADHD children had significantly smaller posterior corpus callosum regions than the control group. The splenium accounted for most of the variance between the two groups. The authors hypothesized that the smaller splenial areas are related to deficits in sustained attention and that these deficits in attention account for deficits in self-regulation. They consider self-regulation to be simply a more advanced level of attention. Self-regulation is a function linked to the anterior regions in the brain, and deficits in this area appear to have a negative impact on the development of more advanced levels of attention such as selective and alternating attention. Semrud-Clikeman, et al. (1994) further concluded that self-regulation may be interrelated and mutually reciprocal.
Current Views on ADHD

By 1990, ADHD was considered to be a “developmentally handicapping condition that is generally chronic in nature, has a strong biological or hereditary predisposition, and has a significant negative impact on academic and social outcomes for many children” (Barkley, 1990, p. 36). The environment, especially the family, was shown to influence the severity, comorbidity, and outcome of the disorder. The family is not the cause of the disorder, but they do influence the child’s prognosis. These findings are the basis of the DSM-IV (American Psychiatric Association, 1994) diagnostic category (see Appendix A).

The strongest current evidence suggests that ADHD is a consequence of problems in the brain which control frontal lobe functioning. The specific area of dysfunction is thought to be the frontal regions, anterior and medial to the precentral motor cortex, as well as frontolimbic pathways. This has been demonstrated by measuring cerebral blood flow rates which indicate lower perfusion rates in the frontal regions of some ADD children.

ADHD and Learning Disorders

Although there is much controversy regarding the diagnosis of ADHD as has been discussed previously, the three main symptoms, inattention, hyperactivity,
and impulsivity continue to be considered of ultimate diagnostic importance.

Difficulties in sustained attention are shared by children with Learning Disorders (LD). Both groups differ from normal children in the area of inattention. It appears that accuracy of performance is a more important criteria than speed of performance in differentiating ADHD children from normal controls (Robins, 1992). ADHD children appear to have difficulties with balancing the need for both accuracy and speed in a given task.

It has also been noted that ADHD children typically use more immature strategies for approaching tasks than do normally developing children. Originally it was thought that these children “caught up” with their peers during puberty, but this is no longer considered the case. ADHD is a pervasive disorder that often continues into adulthood. Affected children need to be taught new strategies for approaching and solving tasks.

**Prevalence and Outcome of the Disorder**

ADHD is quite possibly the disorder of childhood that has accumulated the most published research in the last decade. It affects between 3% and 5% of all school-age children and about 1% of adults. It is of great importance because ADHD is the leading concern of parents and guardians bringing children in for mental health treatment. It is a disorder that has a strong negative impact on those
persons involved in helping the affected child, and thus influences the child’s personality development.

ADHD children frequently have major problems in the area of self-esteem along with the more obvious behavioral problems. The disorder is associated with chronic academic difficulties which are often expressed as misbehavior, problems in staying seated, and problems in staying on task (Rapport & Kelly, 1993). ADHD children frequently fail to hand in homework or to even complete the assignments. This is especially baffling to those trying to assist affected children. Frequently, the helping adult will have seen the assignment completed and placed in notebook or bookbag, and yet for some reason the papers are never turned in. Failure to turn in completed assignment leads to poor grades and ADHD children are often retained in the same grade level for a second year (Weiss & Hechtman, 1986). This has a further negative impact on the child’s self-esteem.

As children reach adolescence, the restlessness, distractibility, and poor concentration tend to diminish so that the patient no longer looks hyperactive. The attentional and impulsive characteristics of the disorder remain, although not as obviously as when the patient was younger. Laboratory studies of the cognitive style of ADHD adolescents in comparison with normal adolescents shows that they are (a) more impulsive and field dependent, (b) more likely to respond without thinking, and (c) more easily distracted by incorrect but compelling cues (Sattler,
In the classroom, the student continues to display difficulties in attention and concentration.

Helpful interventions include teaching the patient to verbalize problem solving techniques. The patient needs to learn to break a large task down into a series of smaller tasks so that the job may be accomplished. In many children, this is a normal developmental process, but the ADHD student seems to be deficient in this area. The child must be taught to practice self-talk to help himself in order to control his own behavior and be self-reinforcing.

Academic difficulties are not the only problem facing the ADHD adolescent. Affected children have interpersonal problems in relationships and general deficits in social functioning. Adolescents with ADHD have increased incidences of rebelliousness, antisocial behavior, and low self-esteem. These problems, added to the normal difficulties experienced by adolescents, contribute to the frustration of teachers and parents attempting to assist the ADHD patient during this period. Adolescents and adults with ADHD have an increased prevalence of antisocial behavior, substance abuse, and emotional difficulties (Bellak & Black, 1992).

So far, research has been concentrated in two areas, diagnosis and etiology. Diagnostic advances need to continue because of the necessity to measure the progress of ADHD and the results of treatment over time. If untreated, the affected
child will not be able to develop the coping skills necessary for him or her to deal effectively with this disorder. Early identification and treatment provide affected children with the best prognosis. There is currently no cure for this disorder.

Attention

Attention has long been considered a defining symptom in ADHD. The DSM-IV (American Psychiatric Association, 1994) lists three varieties of ADHD depending on which of the features is predominant. The most common expression of the disorder is ADHD, combined type, in which inattention and hyperactivity-impulsivity are both present. There are also two subtypes: ADHD, Predominantly Inattentive Type; and ADHD, Predominantly Hyperactive-Impulsive Type. The subtypes are used when one of the symptoms is clearly the main difficulty. Healey et al. (1993) predicted that the ICD-10 (International classification of Diseases, 10th revision) will present a tridimensional item list for ADHD in which inattention, hyperactivity, and impulsivity will be identified separately. At this point, experts in the field, especially Barkley (1990), have stated that the use of behavioral ratings to identify children with ADHD is more ecologically valid and economical than laboratory tests.
One of the problems in measuring attention is the difficulty in defining and operationalizing the concept. According to Barkley (1994) attention "is not a thing nor an entity or action but a relationship—a correlation between or among events and reactions to them" (p. 27). This means that measuring attention requires the measuring of event-behavior correlations and therefore is contextually dependent. It is widely agreed that attention has a variety of components. Among these are arousal or alertness, impulsivity (which includes the accuracy of the response), selective or focused attention, sustained attention, divided attention, search approaches, and encoding strategies. Since there are a number of dimensions to the concept of attention, it makes sense that different children would experience deficits in differing combinations of attention.

Attention is a concept that is difficult to define and operationalize. There has been much written on the subject, but not significant agreement among authors. Lezak (1995) defined attention as referring to "several different capacities or processes that are related aspects of how the organism becomes receptive to stimuli and how it may begin processing incoming or attended-to excitation (whether internal or external)" (p. 39). Other important characteristics of attention that need to be considered are information processing, the ability to maintain and shift focus, limited capacity to focus on more than one activity at the same time, and differences in attentional ability between individuals and within an individual at
different times and under different conditions. Lezak (1995) identified five aspects of attention: (1) span of attention, (2) selective attention, (3) sustained attention, (4) divided attention, and (5) alternating attention. It is difficult to practically differentiate between attention, concentration, and tracking. "Pure attentional defects appear as distractibility or impaired ability for focused behavior, regardless of the patient’s intention" (Lezak, p. 352).

Assessment tools need to be developed to measure the different aspects of attention. Sustained attention refers to the maintenance of attending to a task over a period of time. This is an area of difficulty for children with ADHD, especially if the task is repetitive or boring. Divided attention is a new area for assessment. It refers to tasks where the individual must pay "attention and respond to two different tasks simultaneously" (Barkley, 1990). This is an area where ADHD children usually show weaknesses. The need to pay attention to more than one task at a time is a common expectation in the life of children attending school. In school they are required to pay attention to multiple tasks, while at the same time ignore any number of distractions in the class room.

Another attentional difficulty shared by ADHD children is the ability to delay responding to a stimulus prematurely. On tests such as the Matching Familiar Figures Test, which is a visual matching test, ADHD children respond more quickly than normal children and also make more mistakes. It is thought that
this might be due to problems of impulse control rather than difficulty with perceptual-motor control (Sattler, 1992).

Memorization Problems

Children with ADHD have difficulties in the area of memorization that may be due to problems with attention. ADHD children display deficits in short-term, one-trial rote verbal, and visual memory. They do not experience problems when learning takes place over repeated trials. They also have memory problems when the task requires rehearsal strategies and consideration of response alternatives. Wielkiewicz (1990) referred to these problems as executive process disruptions and suggested that it may be the interaction of short-term memory deficit and executive process deficit that occurs in ADHD children. These deficits are often reported by teachers and parents of children with ADHD.

Lezak (1995) wrote that working memory and immediate attention are basically the same in practical terms. Working memory is also controlled by the executive system which is affected by damage in the frontal lobes which mediates the capacity to make and control shifts in attention. Working memory holds information at the forefront of the mind where it can be used and internalized. Lezak further postulated that the problem may be in “remembering to remember” (p. 90) or using contextual cues to facilitate recall.
Assessment

In a complete assessment for ADHD there are four components of the protocol: clinical parent interview, child behavior rating scales, direct observation of the child, and clinical test measures (Guevremont, DuPaul, & Barkley, 1993). Each of the components has both inherent advantages and disadvantages. While ADHD is a chronic disorder, knowledge of the specific symptoms experienced by a particular child can be helpful in planning a comprehensive treatment program. Target behaviors can be measured and addressed. This requires an ongoing assessment process that measures the effect of therapeutic interventions (Grimley, 1993). ADHD is considered to be biological in origin, but many of the symptoms are exacerbated and maintained by the environment. Continual measurement of the intensity of the disorder can help pinpoint the areas of cognitive difficulty. While ADHD is a chronic disorder, the symptoms can be ameliorated with the proper interventions.

Behavior Checklists - Behavior Rating Scales

The most common diagnostic tool used to identify children with ADHD are behavioral checklists. Of these, the Child Behavior Checklist (Achenbach & Edelbrock, 1986a), Teacher’s Report Form (Achenbach & Edelbrock, 1986b),
Conners Parent Rating Scale and Conners Teacher Rating Scale (Conners, 1985) are the most frequently used. These are easily administered and scored and provide information from a variety of informants. However, there are problems. Behavioral checklists are most sensitive to hyperactivity and impulsivity. They do not measure attention very well. Further, Barkley called Behavior Checklists “quantified opinions” (1990, p. 284) and stated that as such they are subject to bias. He felt that they should not be our only means of assessing ADHD although they can be helpful in measuring the effectiveness of medication or therapeutic intervention. This author agrees and that is why this study has been initiated. To be most clinically helpful, we need an objective measure of the diagnosis.

Even though they all have some flaws, there are a number of assessment tools which measure sustained attention and impulsivity, and they have recently been standardized for use in evaluating symptoms of ADHD. These are potentially reliable and valid components of a multimethod assessment battery. There are also checklists now that separate out the attentional aspects of ADHD (e.g., the Metri Tech measure). The advantage of these measures is that the results are not influenced by biases or personal opinions in the same way as are behavior checklists. Also, normative data can be readily collected. As administration procedures become standardized, reliability will increase.
Testing for Attention

There are a number of clinical assessment tools currently utilized in the diagnosis of ADHD in addition to behavioral checklists. Each has its own strengths and weaknesses and functions best as part of an assessment battery. This study examines the Leiter-R, a test that is currently being revised. The original version of the Leiter was not designed to identify children with ADHD, but this has changed, and one of the specific disorders that the Leiter-R is designed to assess and identify is ADHD. Before examining the Leiter-R, however, it will be helpful to note the assessment tools that are currently being used. A few of the most widely used tests are described below.

Continuous Performance Test. The Continuous Performance Test (CPT) was originally designed to test for brain damage (Gordon, 1983; Grimley, 1993). Currently, it is the most widely used measure of attention span. There are a variety of instruments that fit in this category. Most of them require that a child watch a screen while stimuli such as letters or numbers are projected upon it. The child is asked to press a button when a certain stimulus or stimuli pair appear in sequence (Guevremont, et al., 1993). This task takes between nine and fifteen minutes and requires sustained attention, which was earlier mentioned as the probable site of difficulty for ADHD children (Dykman & Ackerman, 1993).
The CPT has been shown to discriminate between ADHD and normal children (Douglas, 1983) as well as to correlate with other measures of attention span, such as behavioral ratings (Guevremont, et al., 1993). In studies where hyperactive children were compared with a group of normal controls, the hyperactive children were found to make more errors of both commission (false alarms) and omission (failure to respond correctly) (Grimley, 1993). Another finding of this study was that the hyperactive childrens’ performances deteriorated as the test progressed while the performances of the normal children did not. Connors has developed a new version of the CPT which has had good results.

The Wechsler Intelligence Scale for Children - Revised Edition. The Wechsler Intelligence Scale for Children - Revised Edition (WISC-R; Wechsler, 1974) is a commonly used instrument for measuring children’s intelligence. For children with ADHD, the Arithmetic, Coding, Information and Digit Span (the ACID profile; Prifitera & Dersh, 1992) subtests are of special interest because they seem to be a measure of sustained attention.

The four subtests mentioned above have been identified as measuring Freedom from Distractibility by Kaufman (1979), although this label is controversial. Douglas (1984) argued that where distractibility was present in children with ADHD it was due to a variety of factors, one of which was an unusually weak inclination to invest attention and effort in demanding tasks.
Previous attempts to identify ADHD children by standardized testing relied mainly on the WISC-R Freedom From Distractibility (FFD) Factor. Since the WISC-R has been replaced by the WISC-III, the FFD factor (arithmetic, digit span, information and coding) was replaced by a factor index (comprised of arithmetic and digit span subtests). Anastopoulos, Spisto, and Maher (1994) designed a study to discover whether the FFD factor index score in the WISC-III correctly identified children with ADHD. Their research showed that for the ADHD group of children, the FFD factor index score was significantly lower than either the Verbal Comprehension or Perceptual Organization factor index scores. These scores also correlated positively with teacher ratings of inattention. However, when analyzed individually, the FFD factor was not useful to identify individual children with ADHD. There is still a need for an accurate test to use as a diagnostic tool with children.

Other commonly used tests. Another test that is frequently used is the Peabody Individual Achievement Test (PIAT) (Dunn & Markwardt, 1970). This test has lower reliability coefficients than some tests, but it is valuable with ADHD children because they are more likely to do well on a test that is individually administered than on one that is presented to a group. It is most useful as a screening measure of achievement rather than counted as a comprehensive test (Grimley, 1993).
The Wide Range Achievement Test - Revised (WRAT-R) (Jastak & Wilkenson, 1984) is commonly used with ADHD children. The popularity of the WRAT-R is possibly due to the ease and speed with which it provides test scores (Grimley, 1993). Another test by the same publisher that has shown promise with ADHD children is the Wide Range Assessment of Memory and Learning. It is designed to test memory functions which were previously noted to be deficient in children with ADHD.

Kagan and his associates (Kagan, Rosman, Day, Albert, & Phillips, 1964) developed the Matching Familiar Figures Test (MFFT) in order to measure whether the cognitive style is impulsive or reflective. Since impulsivity is one of the hallmarks of ADHD, this is important. In this test, impulsivity has been operationally defined as a combination of fast response latencies and high error scores. The test is a 12-item match-to-sample type test in which the child is required to select from an array of six pictures the one that correctly matches the sample. This measure has been shown to differentiate between control children and hyperactive children at different age levels. ADHD children typically respond rapidly or make many errors on this test (Kagan et al).

Another test that has been found effective in differentiating between groups of hyperactive children and groups of normal children is the Porteus Maze Test (Porteus, 1959). It challenges the ADHD child’s ability to plan and organize. This
is an area of difficulty for ADHD children. The test itself consists of a series of mazes that are arranged in ascending order of difficulty.

The Wisconsin Card Sorting Test is a commonly used instrument in the diagnosis of neurological disorders. It is sensitive to frontal lobe dysfunction in adults. It has been tested on ADD children with a control group of normals who were matched for age and IQ. The results showed 85% accuracy in identifying ADHD affected children.

While there are a number of assessment tools available, none are adequate by themselves. Behavioral checklists provide information mainly on the hyperactivity aspect of ADHD. The CPT addresses the subject of attention, but only the domain of sustained attention. The WISC-R Freedom from Distractibility Factor is insufficient to identify individual children with ADHD. Other tests discussed are helpful in confirming a diagnosis, but do not identify affected children by themselves. There is still a need for reliable and valid tests to measure deficits in attention.
ADHD is a mental disorder that affects a significant portion of our population. The disorder causes difficulties in social, emotional, and educational facets of life. Although it was originally thought that children outgrew the disorder at puberty, it is now known that over 50% of affected children will continue to experience disabling symptoms into adulthood.

When ADHD is correctly diagnosed there are interventions that have proven helpful. These include medication, cognitive and behavioral therapy, modifying the environment, and parent training. One serious difficulty is the problem of correct diagnosis and identification of affected children. This is an area that needs to be addressed.

**Statement of the Research Question**

This study will address the question of assessing attentional deficits using a newly developed nonverbal cognitive test battery. Two general research questions are the focus of the study:

1. What are the differences between children with ADHD and a normative group of the same age on attention and memory tests? Three groups of children
will be identified: (a) typical children who do not have learning disorders or ADHD; (b) children with ADHD, Predominantly Inattentive Type; and (c) children with ADHD, Predominantly Hyperactive-Impulsive Type. The research question identifies the dimensions of attention, memory, reasoning, and visualization which show significant differences between the groups.

2. After examining the mean profiles of nonverbal abilities for each of the three groups listed above, strengths and weaknesses will be identified. The battery of nonverbal reasoning, visualization, spatial ability, attention and memory will be used to construct the mean profiles. The research question asks, “On which facets of nonverbal cognitive ability do ADHD children show relative strengths or weaknesses?” The purpose of this portion of the study will be to identify strengths which can be used in therapy to teach compensation skills to the ADHD child.
Chapter Two

Methods

This study is part of a larger project that involves updating the Leiter International Performance Scale. A portion of that revision involved designing subscales that would be useful in identifying attentional and memory deficits in children, specifically children with ADHD. The standardization of the test protocol included groups of children identified as having ADHD and Attention Deficit Disorder, Predominately Cognitive Type (ADD) as well as typical children.

Instrument

History of the Leiter Scale

Dr. Russell Graydon Leiter developed the original Leiter International Performance Scale in 1929 while he was employed at the Psychological Clinic of the University of Hawaii. The test was initially field tested in Hawaii.

Improvements to the scale were made over several decades at the University of Southern California (Levine, 1982). The test was designed to meet a need presented by the many children and adults with communications disorders. It is
also appropriate and helpful for assessing persons who speak English as their second language. For such affected persons, the verbal portions of commonly used cognitive batteries, such as those for measuring IQ, do not reflect their true abilities (Roid, 1995). The test has the advantage of being developed and refined in a multi-cultural environment. It is a truly non-verbal scale designed to parallel the Stanford-Binet, minus the language portion, that assesses general intelligence fairly across cultural and linguistic subgroups (Leiter, 1959).

The Leiter International Performance Scale was originally published in 1940. It was revised in 1979, and is currently undergoing another revision and standardization. This study will consider the results of the standardization procedures for the current revision which is scheduled to be published in 1997.

The items on the original scale are very similar to those on various subtests of the Stanford-Binet and Wechsler tests. The original test consists exclusively of items that require the placement of wooden blocks into a wooden frame. The frame contains various slots that allow each block to be aligned with a printed strip designed to cue the test-taker regarding the desired order of blocks. Examples of the subtests include visual matching of color and shape, classification of pictures or geometric shapes into conceptual classes, block design, symbol-digit coding, logical sequences of pictures or designs, and the counting of three-dimensional cube displays (1995).
Design of the New Scale

The new revision of the Leiter is co-authored by Roid and Miller (1995). They decided to expand the original scale to a modern subtests format after careful research of the literature and after consulting with other professionals. The original version consisted of a single, age-graded scale containing an unbalanced mixture of item types. On the new version, each item type on the Leiter was considered for expansion into a subtest containing items ranging from easy to difficult. The items span the age range of 2 years, 0 months to 20 years, 11 months. The reasoning behind this change is based on the findings that the reliability, validity and clinical usefulness of a test battery containing subtests far exceeds that of a single scale containing a factorially-complex mixture of items.

Another factor considered in this change was the finding that a single age-graded scale provides too crude a measure of the complex domain of intellectual ability (Thorndike, Hagen, & Sattler, 1986). Also considered was the difficulty of achieving psychometric standards for reliability and validity of the original single scale due to its factorial complexity, the instability of age-based estimates of item placement, and the use of an all-or-none scoring system for each set of blocks. A final factor taken into consideration of the new revision of the Leiter was complaints from professionals regarding the weight of the wooden blocks and the
difficulty in maintaining them in hygienic condition considering the porosity of the wood (Roid, 1995).

As part of the Leiter revision development, a series of subtests was included to assess children with ADHD. Current research points to difficulties and impaired performance on verbal cognitive tasks which require frontal lobe functions (Grodzinsky & Diamond, 1992). This has been confirmed in studies of the Arithmetic, Coding, Information and Digit Span subtests of the WISC-III (Wechsler, 1991). Kateria, Hall, Wong and Keys (1992) discovered that ADHD children experienced problems in sequencing on auditory tasks of the Learning Efficiency Test. Research on the Wisconsin Card Sort Test found that ADHD children perseverated in the completion of the task (Chelune, Ferguson, Koon and Dickey, 1986). Poor performance on the Porteus Mazes was felt to suggest frontal lobe dysfunction by Conners and Wells (1986). Gordon (1983) found a relationship between sustained attention and impulsivity through the use of computerized continuous tasks. Based on administration of an adaptation of the Keagan Matching Figures Test by Messer and Brodzinsky (1981), impulsivity in ADHD children was considered to impair perception search strategies which include attention to detail and information processing time. Each of the tests have produced contradictory results which leads to the need for further study.
The current Leiter-R, the Standardization Edition, is designed to measure nonverbal domains of intelligence in children. It was redesigned on the basis of the results of the Tryout Edition. Poor functioning items or subtests were removed or replaced. A new type easel format and "playing card" response pieces were developed. The battery was divided into a core and supplemental set. Subtests with low reliabilities at certain age levels were either supplemented with extra items or restricted to certain age levels in the Standardization Edition. A balanced set of subtests for each factor, verified by factor analysis, were included with a minimum of two subtests representing each factor. Current subtests measure such factors as visualization, reasoning, memory and attention. The Core Battery consists of five visualization and five reasoning subtests. The Supplemental Battery for the diagnosis of ADHD includes eight memory and two attention subtests (Roid & Miller, 1995).
Procedures

Subjects

Children and adolescents were used as the subjects for the project standardization. It was determined that the risk to human subjects was negligible and the benefits far outweighed any potential harm. Madsen (1994) provided the following stratification information. A national stratification plan was developed using age, gender, socioeconomic level (based on parent’s educational level), ethnic background (African American, Asian, Hispanic, Native American, white-nonhispanic, and other categories), and geographic region were the stratification variables. A total of 1,890 children from ages 2.0 to 20.11 years of age distributed among the four census regions of the United States (based on the 1993 update data from the 1990 census) were tested. These subjects included 87 children identified with ADHD, either predominately cognitive type or hyperactive type.

For purposes of this study, approximately two typicals were matched with each of 87 ADHD children on the basis of age, gender, and mother’s level of education. The large number of ADHD children was selected so that the maximum identification of memory and attention deficits could be identified. The visualization and reasoning subtests were given to a smaller group of children (control = 65, ADHD = 18, ADD = 10).
Data were collected by examiners on each of the ADHD and ADD children selected for this study. Most of the selected children had been diagnosed by a private physician who also prescribed the child’s medication. Some were identified by psychological or neuropsychological examination. Protocol examiners attempted to obtain data regarding assessment measures used to diagnose ADHD but were frequently unsuccessful. The protocol examiners collected their information from a combination of parent interview and school and medical records.

All ADHD children were identified based on DSM-IV criteria (see Appendix). Children with ADHD participating in the standardization sample were instructed to refrain from ingesting their prescribed dosage of stimulant medication on the day that they were tested in order to avoid contamination based on medication usage.

Selecting the Matched Sample

The ADHD and ADD children were divided into 36 age by gender by parent education subgroups for purposes of matching with the typical children. They were first divided into two groups by gender, and then by parent education (11 years or less, 12 years or GED, 13 + years), and separated further based on the age groupings shown in Table 2. Each subgroup was then examined to determine the distribution of age in months. For selection purposes, the matching children
were required to be within 3 months +/- of the ADHD and ADD children identified within each group. Each of the suitable typical children was then assigned a number. A random number table was then used to select approximately two typical children for every ADHD/ADD child.

Examiners

One hundred eight examiners were selected and trained as field researchers. These examiners were drawn from all four major regions of the United States (Northeast, South, Midwest, West). A four day training workshop was held in Chicago in June 1995 at which each examiner was trained to administer the tests and collect data for the project. The examiners were individually examined during the training, required to file sample protocols for approval prior to testing, and were monitored by phone during data collection. At the training meeting, each examiner was taught the proper recruitment and informed-consent procedures. Each examiner conducted between 20-40 1 hour test sessions with subjects. A newsletter was distributed to each examiner during the data-collection phase. This newsletter contained advice and instructions for the collection of data and was designed to be helpful for the examiners. Most of the examiners were either clinical or school psychologists, special-education or occupational-therapy assessment professionals, and all had
Table 2

Comparison Between the ADHD and ADD Sample Groups and the Control Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample Groups</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>85.7</td>
<td>85.8</td>
</tr>
<tr>
<td>Female</td>
<td>14.3</td>
<td>14.2</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 - 7</td>
<td>9.5</td>
<td>8.6</td>
</tr>
<tr>
<td>10-11</td>
<td>29.8</td>
<td>31.5</td>
</tr>
<tr>
<td>12-13</td>
<td>20.2</td>
<td>21.0</td>
</tr>
<tr>
<td>14-15</td>
<td>7.1</td>
<td>6.1</td>
</tr>
<tr>
<td>16 +</td>
<td>6.0</td>
<td>6.2</td>
</tr>
<tr>
<td>Mother's Education Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 12</td>
<td>8.3</td>
<td>8.0</td>
</tr>
<tr>
<td>12 or GED</td>
<td>19.0</td>
<td>21.6</td>
</tr>
<tr>
<td>13 +</td>
<td>72.6</td>
<td>70.4</td>
</tr>
</tbody>
</table>

(table continues)
Table 2 - Continued

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample Groups</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnic Group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>83.3</td>
<td>67.9</td>
</tr>
<tr>
<td>Black</td>
<td>3.6</td>
<td>13.6</td>
</tr>
<tr>
<td>Hispanic</td>
<td>13.1</td>
<td>13.0</td>
</tr>
<tr>
<td>Asian</td>
<td>0</td>
<td>3.7</td>
</tr>
<tr>
<td>Native American</td>
<td>0</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Community Size</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural ≤ 2500 population</td>
<td>9.5</td>
<td>8.6</td>
</tr>
<tr>
<td>Urban 2501 +</td>
<td>90.5</td>
<td>88.9</td>
</tr>
<tr>
<td><strong>Region</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>8.3</td>
<td>12.3</td>
</tr>
<tr>
<td>South</td>
<td>51.2</td>
<td>27.8</td>
</tr>
<tr>
<td>Midwest</td>
<td>11.9</td>
<td>29.6</td>
</tr>
<tr>
<td>West</td>
<td>28.6</td>
<td>29.6</td>
</tr>
</tbody>
</table>

**Note.** Ethnic group, community size, and region of the country are included for information purposes only. Groups were not matched on these criteria.
extensive experience with individually-administered tests for children and adolescents. Most of the examiners were associated with school districts or universities.

Statistical Design

The differences between ADHD (Hyperactive type), ADD (Cognitive type), and typical controls were evaluated using one-way analysis of variance (ANOVA). The ANOVA is the appropriate design to use when examining how two or more independent factors affect a single dependent variable. The means and standard deviations of each group were then inspected in cases of significant differences. Significance was defined by the p-value of the F statistic having a value below .05. Post-hoc comparisons were made using the Bonneferoni’s significant difference procedure available in SPSS. Also, mean scores for each of the three groups will be plotted on a standardized profile to assess the strengths and weaknesses of the ADHD and ADD groups.
Chapter Three

Results

This chapter presents the results of a series of One-Way ANOVAs used to determine whether there was a significant difference distinguishing between three groups in terms of their mean scores on the Leiter-R. The three groups were a control group, an ADHD group, and a smaller ADD group. The groups were matched for age, mother's level of education, and gender. The results are listed in Tables 3 and 4. For the Memory and Attention subtests the control group consisted of 162 children, the ADHD group had 54 children, and the ADD group had 30 children. The Visualization and Reasoning subtests were part of a supplemental battery given to a smaller group of children (control = 65, ADHD = 18, ADD = 10).

The post-hoc Bonferroni procedure identified the ADHD group as significantly different from controls for nine of the subtests: Matching, Sequential Order, Classification, Design Analogies, Form Completion, Figure Rotation, Paper Folding, Transformation, and Spatial Memory. Of these subtests, two were significant at the $p < .001$ level. These were the Form Completion and Spatial Memory subtests. Four subtests were significant at the $p < .005$ level. These subtests were Matching, Classification, and Transformation. The others were
significant at the $p < .05$ level. Two subtests separated the ADD Cognitive group from the control group as confirmed by the Bonferroni post-hoc comparisons. These were the Delayed Recognition and Attention Sustained subtests, both significant at the $p < .01$ level.

Table 3

Means, Standard Deviations (in parentheses), and F-ratios for One-Way ANOVAs for the Memory and Attention Subtests

<table>
<thead>
<tr>
<th>Subtest</th>
<th>Control</th>
<th>ADHD</th>
<th>ADD</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n = 162$</td>
<td>$n = 54$</td>
<td>$n = 30$</td>
<td></td>
</tr>
<tr>
<td>Matching</td>
<td>10.41</td>
<td>8.96</td>
<td>9.38</td>
<td>4.57 **</td>
</tr>
<tr>
<td></td>
<td>(2.21)</td>
<td>(5.45)</td>
<td>(2.64)</td>
<td></td>
</tr>
<tr>
<td>Repeated Patterns</td>
<td>10.18</td>
<td>9.18</td>
<td>9.33</td>
<td>2.43</td>
</tr>
<tr>
<td></td>
<td>(3.35)</td>
<td>(3.20)</td>
<td>(2.44)</td>
<td></td>
</tr>
<tr>
<td>Sequential Order</td>
<td>10.03</td>
<td>8.56</td>
<td>9.59</td>
<td>3.89 *</td>
</tr>
<tr>
<td></td>
<td>(3.35)</td>
<td>(3.60)</td>
<td>(2.83)</td>
<td></td>
</tr>
</tbody>
</table>

(table continues)
Table 3 - Continued

<table>
<thead>
<tr>
<th>Subtest</th>
<th>Control</th>
<th>ADHD</th>
<th>ADD</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 162</td>
<td>n = 54</td>
<td>n = 30</td>
<td></td>
</tr>
<tr>
<td>Picture Context</td>
<td>9.58 (3.81)</td>
<td>8.23 (8.31)</td>
<td>9.80 (3.58)</td>
<td>1.46</td>
</tr>
<tr>
<td>Classification</td>
<td>10.21 (2.69)</td>
<td>8.47 (3.46)</td>
<td>9.13 (4.40)</td>
<td>6.88 **</td>
</tr>
<tr>
<td>Figure Ground</td>
<td>9.89 (3.07)</td>
<td>9.20 (3.29)</td>
<td>8.87 (3.81)</td>
<td>1.86</td>
</tr>
<tr>
<td>Design Analogies</td>
<td>10.12 (2.96)</td>
<td>8.78 (3.29)</td>
<td>9.16 (2.82)</td>
<td>4.54 *</td>
</tr>
<tr>
<td>Form Completion</td>
<td>10.14 (3.05)</td>
<td>8.22 (4.34)</td>
<td>8.93 (3.13)</td>
<td>7.09 ***</td>
</tr>
<tr>
<td>Figure Rotation</td>
<td>10.30 (3.11)</td>
<td>9.09 (1.86)</td>
<td>9.08 (1.65)</td>
<td>5.42 *</td>
</tr>
<tr>
<td>Paper Folding</td>
<td>10.12 (2.71)</td>
<td>9.01 (2.57)</td>
<td>9.47 (2.18)</td>
<td>3.91 *</td>
</tr>
</tbody>
</table>

Note: Boldface identified as significantly different by the Bonferroni post-hoc test.

*p < .05.  **p < .005.  ***p < .001.
Table 4

Means, Standard Deviations (in parentheses), and F-Ratios for One-Way ANOVAs for the Visualization and Reasoning Subtests

<table>
<thead>
<tr>
<th>Subtest</th>
<th>Control</th>
<th>ADHD</th>
<th>ADD</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 65</td>
<td>n = 18</td>
<td>n = 10</td>
<td></td>
</tr>
<tr>
<td>Associated Pairs</td>
<td>9.79</td>
<td>9.12</td>
<td>10.24</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>(3.21)</td>
<td>(3.13)</td>
<td>(3.92)</td>
<td></td>
</tr>
<tr>
<td>Immediate Recognition</td>
<td>9.55</td>
<td>7.96</td>
<td>7.11</td>
<td>3.10 *</td>
</tr>
<tr>
<td></td>
<td>(2.93)</td>
<td>(4.76)</td>
<td>(4.10)</td>
<td></td>
</tr>
<tr>
<td>Transformation</td>
<td>9.94</td>
<td>7.43</td>
<td>7.25</td>
<td>5.35 **</td>
</tr>
<tr>
<td></td>
<td>(3.07)</td>
<td>(4.67)</td>
<td>(3.57)</td>
<td></td>
</tr>
<tr>
<td>Attention Sustained</td>
<td>10.41</td>
<td>11.26</td>
<td>15.48</td>
<td>3.03 *</td>
</tr>
<tr>
<td></td>
<td>(3.39)</td>
<td>(6.78)</td>
<td>(11.91)</td>
<td></td>
</tr>
<tr>
<td>Forward Memory</td>
<td>9.81</td>
<td>8.54</td>
<td>10.07</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td>(3.05)</td>
<td>(3.35)</td>
<td>(3.01)</td>
<td></td>
</tr>
<tr>
<td>Attention Divided</td>
<td>10.01</td>
<td>9.48</td>
<td>8.51</td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td>(3.08)</td>
<td>(2.43)</td>
<td>(3.31)</td>
<td></td>
</tr>
</tbody>
</table>

(table continues)
Table 4 – Continued

<table>
<thead>
<tr>
<th>Subtest</th>
<th>Control</th>
<th>ADHD</th>
<th>ADD</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 65</td>
<td>n = 18</td>
<td>n = 10</td>
<td></td>
</tr>
<tr>
<td>Reverse Memory</td>
<td>9.69</td>
<td>10.14</td>
<td>10.19</td>
<td>.243</td>
</tr>
<tr>
<td></td>
<td>(3.22)</td>
<td>(2.56)</td>
<td>(2.05)</td>
<td></td>
</tr>
<tr>
<td>Spatial Memory</td>
<td>10.37</td>
<td>7.05</td>
<td>8.05</td>
<td>10.88 ***</td>
</tr>
<tr>
<td></td>
<td>(3.02)</td>
<td>(2.53)</td>
<td>(2.18)</td>
<td></td>
</tr>
<tr>
<td>Delayed Pairs</td>
<td>9.74</td>
<td>9.46</td>
<td>10.01</td>
<td>.120</td>
</tr>
<tr>
<td></td>
<td>(2.94)</td>
<td>(2.40)</td>
<td>(3.75)</td>
<td></td>
</tr>
<tr>
<td>Delayed Recognition</td>
<td>9.86</td>
<td>7.91</td>
<td>6.99</td>
<td>4.66 *</td>
</tr>
<tr>
<td></td>
<td>(3.09)</td>
<td>(4.27)</td>
<td>(3.57)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Boldface identified as significantly different by the Bonferroni post-hoc test.

*p < .05. **p < .005. ***p < .001.

The Leiter-R (Roid & Miller, 1995) combines four subtests to provide a short IQ score. The subtests which are used for this purpose are the Form Completion, Figure Ground, Repeated Patterns, and Sequential Order. These subtests were selected because they include two visual tests and two fluid reasoning tests. These tests apply to all age groups. When the three groups were compared,
an F-ratio of 6.22 (df = 2 and 243, p ≤ .005) was obtained. The Bonferroni post hoc comparison showed that test scores were useful, in most cases, for separating the ADHD group from the control group. The difference between the ADD group and the control group was not statistically significant.

The following two graphs show the mean profiles of the three groups for comparison purposes. They are included to help the reader visualize the patterns of strengths and weaknesses.

Figure 1
The ADHD group scored lower than the control group on every subtest. The lowest scores for the ADHD group were on Picture Context and Form Completion. Form Completion is very significant as shown by the Bonferroni post hoc test. However, although Picture Context appears to be useful for diagnostic purposes, it did not prove to be significant statistically. The ADD group’s score on the Picture Context subtest was very similar to that of the control group. The ADD group scored lower than the ADHD group on the Figure Ground subtest only. The ADD groups scores were between the ADHD group and the control on all other subtests.

Figure 2
This graph is much more dramatic than the first one. These tests were designed specifically to identify children with ADHD and ADD. According to this graph, the control group had a very steady set of scores all clustering around the ten point mark. The ADHD and ADD groups were much more varied. In five cases the ADD group scored the same or higher than the control group. The same phenomenon occurred three times with the ADHD group. This result was unexpected.

The results on this graph could be misleading if the post-hoc Bonferroni comparisons were not considered. These show a somewhat different picture than that presented by the graph. Immediate Recognition scores show a significant difference between the control and ADHD groups with the control group scoring higher. Transformation also shows a significant difference between the control and ADHD groups (F-ratio = 5.35, df = 2 and 90, \( p = .006 \)). As would be expected from viewing the graph, the significant difference on the Attention Sustained subtest is between the ADD and control groups. The ADD group scored more poorly than did the control group. The ADHD group also scored lower than the control group on this test, but the difference was not statistically significant.

Other subtests showing significant differences in scores were the Spatial Memory and Delayed Recognition subtests. Spatial Memory showed a significant difference between the control and ADHD groups. The significant difference on
the Delayed Recognition subtest was between the control and ADD groups with the ADD group scoring lower than the control.

Because the standard deviations were large on the memory and attention subtests, it was difficult to determine if there was another extraneous variable not accounted for by the statistical design of the original sample. One hypothesis for this was that IQ levels accounted for a major portion of the differences in scores. To test this hypothesis, another set of calculations was performed. A new design was created to test the interaction between group and IQ consisting of a 3 by 2 factorial ANOVA. The group variable consisted of control, ADHD, and ADD groups while the IQ factor consisted of low (< 100) and high IQ (100 or more). This statistical design was applied to each of the memory and attention subtests and the standard ANOVA calculations were performed. Of the 13 subtests examined, the F-tests for the interaction of group and IQ were only significant for the Immediate Recall and Attention Sustained subtests. These findings are summarized in Tables 5 and 6.

Tables 5 and 6 show that an interactive pattern was found on the Immediate Recall and Attention Sustained subtests. Children with both low IQ and ADD cognitive typed had the lowest scores on these two subtests with scores approximately two standard deviations below the scores obtained by the other five
Table 5

**Immediate Recall Subtests**

<table>
<thead>
<tr>
<th>IQ</th>
<th>Control</th>
<th>ADHD</th>
<th>ADD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low IQ</td>
<td>9.28</td>
<td>8.42</td>
<td><strong>4.63</strong></td>
</tr>
<tr>
<td>99 + below</td>
<td>(n = 24)</td>
<td>(n = 12)</td>
<td>(n = 6)</td>
</tr>
<tr>
<td>High IQ</td>
<td>9.72</td>
<td><strong>7.06</strong></td>
<td>10.83</td>
</tr>
<tr>
<td>100 + above</td>
<td>(n = 35)</td>
<td>(n = 6)</td>
<td>(n = 4)</td>
</tr>
</tbody>
</table>

Bold type indicates scores 1 + standard deviation below average

Table 6

**Attention Sustained Subtests - Errors**

<table>
<thead>
<tr>
<th>IQ</th>
<th>Control</th>
<th>ADHD</th>
<th>ADD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low IQ</td>
<td>9.48</td>
<td>11.02</td>
<td><strong>4.06</strong></td>
</tr>
<tr>
<td>99 + below</td>
<td>(n = 26)</td>
<td>(n = 8)</td>
<td>(n = 4)</td>
</tr>
<tr>
<td>High IQ</td>
<td>9.88</td>
<td>8.04</td>
<td>11.91</td>
</tr>
<tr>
<td>100 + above</td>
<td>(n = 29)</td>
<td>(n = 6)</td>
<td>(n = 4)</td>
</tr>
</tbody>
</table>

Bold type indicates scores 1 + standard deviation below average
groups in the design. An interesting finding was that the ADHD group with higher IQ scored almost one standard deviation below the other groups on the Immediate Recall subtest. The F-test for significance of interaction between IQ and group for the Immediate Recall subtests that the interaction was significant ($F = 5.025$, $df = 2$ and 86, $p = .022$). The F-test for significance of interaction between IQ and Group for errors on the Attention Sustained subtest also demonstrated a significant interaction ($F = 6.625$, $df = 2$ and 71, $p = .002$). Although these findings are interesting and may prove to be useful to clinicians, further research with larger samples of children with ADHD and ADD needs to be conducted to assess the generalizability of these findings.

**Summary**

All of the subtests in the Leiter-R (Roid & Miller, 1995) battery were compared across groups. This chapter presented basic descriptors for each subtests and then presented ANOVAs of the groups which included Control, ADHD, and ADD. Of these subtests, a number were statistically significant for identifying children with ADHD. These subtests were Matching, Sequential Order, Classification, Design Analogies, Form Completion, Paper Folding, Transformation and, Spatial Memory. The Short IQ cluster of subtests also was
significant for comparing ADHD children with typical children. Delayed
Recognition and Attention Sustained were significant for purposes of identifying
children with ADD from the control group. On these two tests a surprising result
was that the ADD children scored higher than the control children on the Attention
Sustained subtest. It was expected that the control group would score higher.
Chapter Four will discuss the possible meanings of these results.
Chapter Three

Discussion and Conclusion

Overview

Approximately 3%-5% of all school age children have ADHD. It is the most common reason for referral and treatment of children in mental health centers. Affected children experience difficulties in a number of areas of life such as at school, at home, and with peers. These difficulties lead to problems with self-esteem and confidence. The disorder tends to be chronic, often continuing into adulthood.

Current diagnostic tools are inadequate, often based mainly on behavioral ratings which do not address the cognitive difficulties experienced by children with ADHD. The latest research points to frontal lobe dysfunction and problems with executive processing (Lezak, 1995). This is most clearly seen in the difficulties affected children experience with attention and memory.

This study examined the new revision of the Leiter International Performance Scale to ascertain if it was effective for identifying children with
ADHD and ADD. Children were selected for this study from a national sample based on US census data. Three groups (control, ADHD, ADD) were compared on the twenty subtests of the Leiter-R.

Restatement of the Research Question

This study addressed the question of assessing attentional deficits using a newly developed nonverbal cognitive test battery. Two general research questions were the focus of the study:

1. What are the differences between children with ADHD and a normative group of the same age on visual and reasoning, attention and, memory tests? Three groups of children were identified: (a) typical children who do not have learning disorders or ADHD; (b) children with ADHD, Predominantly Inattentive Type; and (c) children with ADHD, Predominantly Hyperactive-Impulsive Type. The research question was designed to identify the dimensions of nonverbal cognitive abilities which showed significant differences between the groups.

2. After examining the mean profiles of nonverbal abilities for each of the three groups listed above, strengths and weaknesses were identified. The battery of nonverbal reasoning, visualization, spatial ability, attention, and memory were used to construct the mean profiles. The research question asked, “On which facets of
Results

The purpose of this study was to assess nonverbal cognitive functioning in children with ADHD and ADD. Current assessment measures depend greatly on behavioral observation to make the diagnosis of ADHD. These are largely inadequate to provide the information to make cognitive interventions with affected children. The Leiter-R was created to specifically measure nonverbal cognitive dysfunction. Three groups were selected (control, ADHD, ADD) and children in each group were given the Leiter-R. Scores were compared and it was found that the Leiter-R was significant in discriminating between the control group and the ADHD and ADD groups on several subtests.

The subtests that showed significant differences between the ADHD group and the control group were Matching, Sequential Order, Classification, Design Analogies, Form Completion, Figure Rotation, Paper Folding, Immediate Recognition, Transformation, and Spatial Memory. Significant differences between the ADD group and control group were found on the Attention Sustained and Delayed Recognition subtests. These are subtests which highlight areas of weakness for the ADHD and/or ADD children. Interestingly, none of the subtests
significantly separated both the ADHD and ADD groups from the control. Of the 20 subtests in the Leiter-R, twelve of them were shown to be statistically significant for separating either the ADHD or ADD group from the control group.

Three subtests on the WISC-R were used to identify children with ADHD. These were Arithmetic, Digit Span, and Coding. On the new WISC-III, Arithmetic and Digit Span compose the Freedom from Distractibility factor which is also used in ADHD research. Similar results were found with the Leiter-R, but on the Leiter-R twelve subtests were significant for identifying affected children. Thus the Leiter-R would appear to be a stronger diagnostic tool for identifying children with ADHD. Since children with ADD were separated from the ADHD group, the Leiter-R can also be used to identify these children using the two subtests that showed significant differences: Attention Sustained and Delayed Recognition.

The ADHD children had difficulties on subtests that required attention to detail and holding and using the material in memory before making a decision regarding the answer. An example of this would be paper folding which requires that the child examine drawings of a 3-dimensional object and that the child match a card showing the object unfolded. ADHD children demonstrated difficulty with this task which required taking in and then using information. A high degree of attention and concentration is required for this task and these are deficits in the ADHD child. The other subtests that showed significant differences between the
ADHD and control groups required similar skills, such as holding a visual-coding key in working memory while performing the Transformation subtest. These findings are similar to those of Lezak (1995) who found working memory to be important in attentional difficulties.

The testing results provided with the Wechsler-R (digit span) would lead one to expect that children with ADHD would score poorly on the Forward and Reverse Memory subtests on the Leiter-R. This was not demonstrated by the scores used for this study. As a matter of fact, neither the Forward Memory or Reverse Memory was significant for separating the ADHD group from the control group. Perhaps the difference in the findings is because the Wechsler-R subtests are given orally and the Leiter-R is presented visually. If ADHD children learn better with a visual rather than an oral presentation, this has implications for teaching these children. Research with children suffering Traumatic Brain Injury (TBI) affecting the frontal lobes has shown that these children experience deficits in memory similar to that of children with ADHD (Donders, 1992, 1993). The TBI children with mild to moderate injuries have better results with visual information than with verbal information. Teaching methods have been developed to help these children which may be useful in working with children with ADHD.

Based on the literature review, it would be expected that ADHD children would show significant differences in scores with the control group on the
Attention Sustained and Delayed Recognition subtests. These findings were not confirmed with the ADHD group, but the subtests did show significant differences between the ADD group and the control group. This was somewhat of a surprise and may be due to the small size and other characteristics of the ADD group. Deficits in sustained attention and memory are considered to be hallmarks of ADHD. These subtests do have a use however. There are very few diagnostic tools available to identify ADD children, and these two subtests show significant scores useful for identifying these children.

The Leiter-R was shown to be effective in identifying ADHD children on ten of the twenty subtests and in identifying children with ADD on two subtests. This was very promising and suggested that the Leiter-R will be a useful diagnostic tool for this disorder. ADHD children will still be measured on behavioral constructs, but this test will provide additional cognitive information for therapists and educators that will prove helpful in the school setting.

Limitations

As in all research, especially that based on a national sample, there are a number of limitations to this study. First, the diagnosis of ADHD was made based on DSM-IV criteria, but this allows for a great deal of heterogeneity. It would be helpful if each of the children had been screened using the same diagnostic tools.
There was space on the ADHD interview form where the examiner could indicate the measures used to make the diagnosis, but this portion of the screening sheet was very seldom completed. Therefore, it was difficult to tell how the diagnosis was made and by whom.

Another limitation of the study was in the area of medication. Children selected for the ADHD sample were instructed to refrain from taking their prescribed medication on the day of the testing. Unfortunately, not all of the children complied with this request. A number of them had been given their regularly scheduled dosages, thus confounding the results. It is interesting to note that the Leiter-R still discriminated between the control and ADHD/ADD groups even under these conditions. If the medication alleviated all the difficulties these children face, there should not have been a difference between the control group and the ADHD children who had ingested their prescribed stimulant medication.

A third limitation of this study involves the small size of the ADD group which may have reduced the statistical power for detecting differences between the ADD and control groups. This small group size (ADD) may account for the fact that there were no subtests in which both the ADHD and ADD groups differed significantly from the control.

A fourth limitation revolves around the size of the group given the memory and attention subtests. These subtests were designed specifically to identify
children with ADHD/ADD. However, they were only administered to about half of the total group. This somewhat limits the generalizability of the results obtained for this portion of the study.

The scores used for this study were the results of preliminary scoring methods in the development of the Leiter-R, and these methods were the cause of some difficulties in making comparisons between groups. First, the study used age-corrected z-scores and the final published Leiter-R will have standard scores based on final age norms. (The norm tables are not yet finalized.) Second, some of the subtests may require new scoring methods. For example, the ADD group had higher numbers of correct pictures identified on the Attention Divided subtest which made it appear that they had performed better than the control group. This is misleading. This subtest actually required that the child perform two separate tasks at the same time (matching pictures while at the same time sorting cards). A better way of calculating the scores on this subtest would be to take the number of cards sorted minus the number of pictures matched.
Recommendations

Clinical. It was originally hypothesized that the ADHD and ADD children would show some strengths relative to the control group, but this did not prove to be true. There were several subtests where all three groups achieved similar scores (Reverse Memory, Delayed Pairs) but none where the ADHD or ADD groups scored significantly higher. Considering previous research, it would be expected that ADHD and ADD children would perform poorly on Reverse Memory and Delayed Pairs. Instead, the scores on these tests were very similar for all three groups. The meaning of this is not apparent, but suggests that previous assumptions need to be reconsidered. The difference between the Leiter-R and other diagnostic tools is that the Leiter-R is a nonverbal instrument. Thus, the possibility that these children learn more efficiently using visual methods needs to be explored.

It has been generally assumed that fluid reasoning (ability to develop solutions to novel situations) is innate. This idea is currently being challenged. Educators now realize that all abilities are developed through experience and exercise (Lohman, 1993). The Leiter-R was designed to measure fluid intelligence, or aptitude. However, aptitude is not static. Problem solving approaches that are learned intuitively by many children need to be taught to children with ADHD and ADD. The ADHD and ADD children performed most
poorly compared to the control group on the subtests that required the transformation of material held in working memory. This is a necessary skill that is frequently required in the classroom setting and which these children need to be taught. If they are not taught this skill, they will continue to lose ground compared to unaffected children and this will greatly limit their options as they approach adulthood.

Many interventions with ADHD children are aimed at behavioral deficits. These are certainly important areas to be addressed as a child who is behaving in ways that are distressful or distracting to others will not be accepted in his peer group or by adults who interact with the child. A child that is constantly off task will also perform poorly in academic situations. However, sitting quietly at a desk will not ameliorate all the problems. Once the ADHD child is attempting to complete a task, the child is faced with a concurrent deficit in problem solving approaches. Such children are frequently instructed in problem solving approaches to relational problems. They need to be instructed in ways to approach academic situations as well. Children without ADHD learn skills intuitively that need to be formally taught to ADHD and ADD children.

Feuerstein and colleagues (Feuerstein, Rand, & Hoffman, 1979) have developed learning potential teaching methods that may be useful in working with ADHD and ADD children. Their approach identifies those cognitive tasks that are
required in approaching a typical fluid reasoning task and systematically teaches the necessary skills to children with deficits in this area. To some extent what is required is the ability to internally scan a list of possible approaches to a problem and apply the appropriate one to the task at hand. A major difficulty for ADHD and ADD children is to refrain from responding impulsively, and this is a skill that can be developed with practice. Persons working with ADHD and ADD children would benefit by examining the learning potential teaching methods.

Future Research. This study provided a mean profile for purposes of comparing control, ADHD, and ADD children on the Leiter-R. It is helpful to know that a difference exists between the two groups on this test and where the comparative weaknesses of the ADHD and ADD groups are located. It would be even more helpful if a further study was done that could provide a cut-off score for ADHD for diagnostic purposes. This would make the Leiter-R a much easier tool to interpret.

Based on the above recommendations for cognitive intervention with ADHD and ADD children, a study needs to be conducted to determine if the interventions are effective. This could be accomplished using a pre/post-test experiment with both experimental and control groups. Information gained in such a study could prove to be invaluable to both teachers and therapists that work with ADHD and ADD children.
Summary

This study reviewed the literature on ADHD/ADD including a survey of the history of the disorder, current clinical interventions, and diagnostic techniques. Then data was collected comparing three groups of children (control, ADHD, ADD) on a newly developed nonverbal assessment tool, the Leiter-R. The findings showed that the Leiter-R resulted in significant differences in scores between the control group and the ADHD and ADD groups on twelve of the twenty subtests. This demonstrates the efficacy of the Leiter-R as an assessment tool for ADHD and ADD.

Based on the literature review and the results of this study the following tentative recommendations were proposed to assist children with ADHD and ADD:

1. Children with ADHD and ADD appear to experience cognitive difficulties in addition to their behavioral and interpersonal difficulties. These need to be addressed in school and therapy settings.

2. Children with ADHD and ADD may perform better than expected in testing situations when the material is presented visually rather than verbally. This has implications for their cognitive processing that need to be considered by persons working with these children.
3. Children with ADHD and ADD do not appear to learn certain kinds of problem solving skills intuitively. These skills need to be taught and reinforced or the affected children will lose ground in comparison to their peers over a period of years.

4. Research on children with TBI has resulted in teaching techniques that can be helpful for children with ADHD and ADD since they share a common frontal lobe dysfunction with TBI children.
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Appendix A

Diagnostic Criteria for Attention Deficit Hyperactivity Disorder
Diagnostic Criteria for Attention-Deficit/Hyperactivity Disorder

A. Either (1) or (2):

(1) six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

Inattention

(a) often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities

(b) often has difficulty sustaining attention in tasks or play activities

(c) often does not seem to listen when spoken to directly

(d) often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)

(e) often has difficulty organizing tasks and activities

(f) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
(g) often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)

(h) is often easily distracted by extraneous stimuli

(i) is often forgetful in daily activities

(2) six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

Hyperactivity

(a) often fidgets with hands or feet or squirms in seat

(b) often leaves seat in classroom or in other situations in which remaining seated is expected

(c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness

(d) often has difficulty playing or engaging in leisure activities quietly

(e) is often “on the go” or often acts as if “driven by a motor”

(f) often talks excessively
Impulsivity

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

B. Some hyperactive-impulsive or inattentive symptoms that caused the impairment were present before age 7 years.

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

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

E. The symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder and are not better accounted for by another mental disorder (e.g., Mood disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder).
Code based on type:

314.01 Attention-Deficit/Hyperactivity Disorder, Combined Type: if both Criteria A1 and A2 are met for the past 6 months

314.00 Attention-Deficit/Hyperactivity Disorder, predominantly Inattentive Type: If Criterion A1 is met but Criterion A2 is not met for the past 6 months

314.01 Attention-Deficit/Hyperactivity Disorder, Predominantly Hyperactive-Impulsive Type: if Criterion A2 is met but Criterion A1 is not met for the past 6 months

Coding note: For individuals (especially adolescents and adults) who currently have symptoms that no longer meet full criteria, “In Partial Remission” should be specified.

314.9 Attention-Deficit/Hyperactivity Disorder Not Otherwise Specified. This category is for disorders with prominent symptoms of inattention or hyperactivity-impulsivity that do not meet criteria for Attention-Deficit/Hyperactivity Disorder.
Appendix B

Subtests and Items in the Leiter-R
All the subtests have been given “game names” on the Record Form to encourage examiners to call them by fun names when they are testing young children. When testing older students the use of game names is inappropriate. A description of each domain assessed by subtest is listed on the Record Form. The primary ability measured on each subtest is noted below:

Easel Book One

1. Visual Discrimination: The Matching Game (23 items). The ability to perceive visual stimuli and to discriminate from other similar stimuli.

2. Repeated Patterns: The Over and Over Game (18 items). The ability to perceive a pattern, and to hold it in memory long enough to reproduce it several times.

3. Sequential Order: The Which One Comes Next Game (18 items). The ability to perceive a logical progression of stimuli and the specific characteristics which make the progression ordered; selection of related stimuli that progress in a related order.

4. Classification: The Goes Together Game (16 items). The ability to categorize objects and designs to determine what characteristics they have in common.
5. Picture Context: The Where Did it Come From Game (10 items). The ability to determine from contextual clues that enable the choice of which small segment of a picture corresponds to the same small segment of a larger scene which is left out of the larger scene.

Easel Book Two

6. Figure Ground: The Find it Game (10 items). The ability to visually perceive an object or shape embedded in a complex figure; to pick a figure out of a background.

7. Design Analogies: The Which One is it Like Game (23 items). The ability to perceive analogous pairs of geometric shapes/drawings and to select related pairs from several choices.

8. Form Completion, Part A: The Fix it Game (18 items). The ability to perceive a whole object when it is presented in non-contiguous parts; “part to whole” or simultaneous perception.

Easel Book Three

9. Form Completion, Part B: The Fix it Game (14 items). The ability to perceive a whole object when it is presented in non-contiguous parts; “part to whole” or simultaneous perceptions.
10. Figure Rotation: The Turn It Around Game (14 items). The ability to mentally rotate an object or shape in space and to perceive what it would look like from another perspective.

11. Paper Folding: The Paper Game (15 items). The ability to perceive what an unfolded shape would look like if it were folded; a form of spatial reasoning.

Easel Book Four: Supplementary Battery:

12. Associated Pairs: The Partners Game (12 items). The ability to briefly store information about both associated and dissociated pairs and recognize them when presented again.

13. Immediate Recognition: The Something’s Missing Game (22 items). The ability to perceive non-verbal stimuli, store it briefly, and recognize it when presented again.

14. Transformation: The Changing Game (13 items). The ability to briefly store in working memory pairs of non-verbal stimuli and to recognize which stimuli represents the other stimuli.

15. Sustained Attention: The Drawing Game (12 items). The ability to sustain attention to a simple task over time including the ability to select correct stimuli, and to inhibit the selection of incorrect stimuli over time.
16. Forward memory: The Remembering Game (28 items). The ability to perceive, remember and repeat by pointing the order of the stimuli to which the examiner pointed.

17. Attention Divided: The Do Two Things at Once Game (6 items). The ability to split attention between two simple, but quite different tasks, attending to each for part of the time, but neither exclusively.

18. Reverse Memory: The Backwards Remembering Game (23 items). The ability to perceive, remember and recode in backwards order, and point to the stimuli to which the examiner pointed.

19. Spatial Memory: The Place Game (21 items). The ability to perceive and remember the position in space of visually represented objects.

20. Delayed Pairs: The Partners Game Again (8 items). This is a delay trial of Subtest 11, tapping incidental learning and short-term memory.

21. Delayed Recognition: The Something’s Missing Game Again (17 items). This is a delay trial of Subtest 12. The ability to perceive and store information for a short time (20-30 minutes). Also assesses incidental learning which occurs in the process of completing the task.
Appendix C

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Education:

1994 - Present  
Doctoral Candidate, Clinical Psychology  
George Fox University, Newberg, Oregon  
Graduation - May 1997

1994  
M.A. in Clinical Psychology  
George Fox College, Newberg, Oregon

1992  
One year graduate coursework in Marital and Family Therapy  
Azusa Pacific University, Azusa, California

1989  
B.S. Management of Human Resources  
George Fox College, Newberg, Oregon

1978  
A.A. General Studies  
Moorpark College, Moorpark, California

Professional Experience:

1996 +  
Psychology Intern  
Chehalem Youth and Family Services  
Individual, group and family counseling. Psychological assessment.

1995 +  
Mental Health Assistant  
Salem Hospital Psychiatric Medicine Center  
Patient care, including individual and group counseling.

1994 - 1995  
Clinical Practicum  
Tualatin Valley Mental Health, Tigard, Oregon
Child and Family Program - Individual and family therapy
Co-facilitator of a women’s group for parents of sexually
abused children

1994 - 1995
Graduate Assistant - Dr. Rodger Bufford, Department Chair
George Fox College Graduate School of Clinical Psychology

1994 -1995
Psychological and Intelligence Test Administrator
Newberg Public Schools

1993 - 1994
Clinical Practicum
John Wetten Elementary School, Gladstone, Oregon
Individual and group counseling with children between the
ages of 5 and 10.

1992 - 1994
Direct Care Worker
MRDD Adult Group Home
Adult Learning Systems, Newberg, Oregon
Dually diagnosed adult males, implemented treatment plans.

1989 - 1992
Lead House Parents (Working as a team with my husband)
Psychological Group Home
Seriously Emotionally Disturbed 6 - 12 year olds
Provided training and support for 20 group home parents.
Riverside County Family Care, Redlands, California

1985 - 1988
Teaching Assistant - Hearing Impaired Preschool
Linn-Benton ESD, Albany, Oregon

1984 - 1986
Dormitory Counselor - Girls’ Dormitory and
Residential Treatment Program for Emotionally Disturbed
Hearing Impaired Children
Oregon State School for the Deaf, Salem, Oregon

1983
Summer Staff - Children’s Farm Home
Corvallis, Oregon - Girls’ Cottage
1980 - 1983  Group Home Provider - CSD, Corvallis, Oregon
Head Quarters Girls Group Home
Serving Teenage Girls - Emotionally disturbed and sexually abused.

1976 - 1979  Treatment Home Parent - Ventura County, California
Professional Foster Home
Serving Preschool and Elementary Aged Children

Workshops Attended:

1996  Attention Deficit Hyperactivity Disorder
      Dr. Russell Barkley
      Portland, Oregon

1996  Working with Angry Adolescents
      Portland, Oregon

1995  Attachment Disorders - High Risk Children
      “Understanding and Treating Difficult Children”
      Dr. Foster Cline, Newberg, Oregon

1995  Play Therapy
      Dr. Garry Landreth, Portland, Oregon

1991  Advanced Menninger Training - CHARLEE Program
      Working with Children in Residential Treatment
      E. Kent Hayes, Alex Lazzarino

1990  Children’s Home Training Institute
      Doc Downing on Parenting

1988  Working with Developmental Disabilities
      Portland, Oregon
Workshops Presented:
All workshops were presented in a team format with my husband, Gene Head.

1994  8 Week Program - Grief Recovery
1993  12 Week Program - Parenting Issues
1993  8 Week Program - Conflict in Marriage
1992  4 Week Program - Assertive Discipline
1992  8 Week Program - Excellence in Parenting

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