ABSTRACT

Title of Dissertation: COGNITIVE PROCESSING IN CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER AS MEASURED BY THE THEMATIC APPERCEPTION TEST

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The present study attempted to add to the growing body of knowledge of ADHD by using the Thematic Apperception Test (TAT) to measure cognitive processing in children with ADHD. Forty-five Children between the ages of 7 and 13 were evaluated for ADHD through a semi-structured interview and behavioral rating scales. IQ, achievement, visual-motor integration tests as well as a continuous performance test were administered as part of a comprehensive evaluation. Out of the 45 children, 15 were identified as having ADHD (clinical group), 18 had attention deficit symptoms but were below the threshold for diagnosis (sub-clinical group), and 12 were found to be ineligible. Comparisons were made between the three groups of children referred for evaluation for ADHD and a group of 15 normal-control children taken from archival data who were

matched for age and gender with the clinical group. Significant differences were found between all three of the referred groups and the control group for the following four cognitive processing variables from the TAT; Perceptual Integration, Level of Abstraction, Cognitive-Experiential Integration, and Level of Associative Thinking. The three groups of children referred for evaluation did not differ from each other. Gender differences were noted in the clinical group only with girls with ADHD scoring higher on cognitive processing variables than boys with ADHD. Factor analysis of all the measures used revealed four factors; cognitive processing, behavioral performance, hyperactivity, and inattention. Exploratory analysis was conducted on 16 children from the clinical and sub-clinical groups who were retested using behavioral rating scales, the continuous performance test, and the TAT; however, the number of children retested was too few to draw conclusions from the data. These results are discussed along with issues surrounding the diagnosis of ADHD and future directions for research regarding the nature of cognitive processing in children with ADHD.

COGNITIVE PROCESSING IN CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER AS MEASURED BY THE THEMATIC APPERCEPTION TEST

by

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Overview

The present study investigated the cognitive processing abilities of children with Attention Deficit Hyperactivity Disorder (ADHD) using the Thematic Apperception Test (TAT). ADHD has been linked to deficits in cognitive processing. These deficits have been assessed in children with ADHD by using tasks that measure the ability to inhibit responding (Schachar, Tannock, Marriott, and Logan, 1995), the ability to switch from one task to another (Schachar et al., 1995), the ability to plan and organize (Seidman et al., 1995), the ability to identify emotional expressions from pictures (Singh, Ellis, Winton, Singh, Leung, and Oswald, 1998), the encoding of social cues from videotaped vignettes (Matthys, Duperus, and Van Engeland, 1999) and by using the TAT to measure the omission of details (Constantino, Colon-Malgady, Malgady and Perez, 1991). These measures of discrete aspects of information processing do not account for the complex processing necessary for successful behavioral functioning. It was proposed in the present study to use a new scoring method with the TAT to measure complex cognitive processing in children with ADHD. Several aspects of information processing including encoding, interpretation, planning and monitoring, integration, cause-effect reasoning, coordinating multiple perspectives, sequencing, generating outcomes, hindsight, and foresight can be measured using the method of interpreting TAT stories developed by Teglasi (1993; 2001).

Behavioral difficulties evidenced in children with ADHD can be linked to poor or lacking executive cognitive processing abilities. For example, the social difficulties that children with ADHD frequently experience may be due to poor encoding of social information resulting in responses that do not match the situation. Without the ability to

abstract meaning from events an individual will be unable to develop schema or rules to help to organize and understand experience, rather the situation will control the response by the individual. Poor encoding and disorganized schemas will result in TAT stories that misinterpret the stimuli or contain incompatible ideas. The way in which a person attends to, organizes and responds to TAT stories can reveal deficiencies in underlying schema. Behavior that is not based on schemata and that is controlled externally will be impulsive as is seen in many children with ADHD. Perceptual Integration and Level of Abstraction are two of the cognitive variables identified by Teglasi that will reveal encoding difficulties and deficient schemas.

If planning and organization skills are weak, then the individual will seem scattered in her/his thinking, will be forgetful, and will lose things often. Difficulty organizing tasks, often losing things, and forgetfulness are three of the DSM-IV (see appendix A; APA, 1994) symptoms of inattention that make up part of the diagnosis of ADHD. The Cognitive-Experiential Integration and Level of Associative Thinking variables can be used to measure planning and organization by assessing the way in which ideas are put together and how smoothly the events flow in the TAT story. Deficient planning and organization skills impact all areas of the individual's life.

Cognitive-Experiential Integration also measures the degree to which the individual is able to coordinate inner elements (intentions, motives, goals and principles) with outer elements (events, actions and outcomes). Without the ability to integrate inner and outer experience, the individual's behaviors or reactions will be based on external provocations. This type of behavior would appear poorly thought out and impulsive.

Children with ADHD do not seem to think before they act. They often do not consider the consequences of their actions until after they have acted.

The primary goal of this study was to show that these complex cognitive processing deficits exist in children with ADHD compared to normal-control children. By demonstrating these deficits it becomes possible to target these areas for intervention. Medication continues to be the most effective intervention available for children with ADHD (MTA cooperative group, 1999). The present study was designed to demonstrate that the TAT can measure deficits in information processing that correspond to behavioral difficulties seen in children with ADHD. To date, attempts to demonstrate deficits in executive control have focused on discrete cognitive tasks that have minimal connection with typical behaviors of children with ADHD in the classroom and at home. In the present study, complex cognitive processing was measured using the four variables identified by Tegalsi (1993; 2001) as measures of cognition; Perceptual Integration, Level of Abstraction, Cognitive-Experiential Integration, and Level of Associative Thinking. It was hypothesized that children with ADHD would score lower than normal-control children on each of these variables.

Although not a part of the initial project, and for merely exploration purposes, several students were re-evaluated. The purpose of this follow-up was to explore any changes that might have occurred over time and in response to possible interventions such as medication or behavior modification.

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is frequently diagnosed among children of preschool and school age. Several behavioral problems that impact academic and social functioning are associated with ADHD including, distractibility, poor concentration, poor school performance, poor regulation of behavior by rules and consequences, peer relationship problems, and antisocial behavior (Barkley, 1990). The extent of the social and academic impact of ADHD, and the frequency with which it occurs, make understanding and intervening in ADHD crucial to classroom success in the schools and to successful family functioning for those impacted by it. As the understanding of ADHD has evolved, new and exciting approaches to identifying ADHD have also developed (see below). One area that has become part of the focus of explorations into ADHD is cognitive processing. The conceptualization of ADHD has shifted from a mostly behavioral concern to a problem with cognitive structure and processing (Barkley, 1990; 1997a; 1997b). This new conceptualization has opened up the possibility of evaluating ADHD with tools other than strictly behavioral measures. The use and interpretation of the TAT has also developed into a projective measure of cognitive processing (Teglasi, 1993; 2001). This study was concerned with evaluating the cognitive processes of children with ADHD utilizing the unique approach to the problem that is offered by the TAT.

Definition of ADHD

One reason for continued concentration on ADHD in the literature is the diagnostic and definitional difficulties. Originally, ADHD was categorized along with learning disabilities as minimal brain dysfunction (MBD). Minimal brain dysfunction

was defined in 1966 as "children of near-average, average or above average general intelligence with certain learning or behavioral disabilities ranging from mild to severe, which are associated with deviations of function of the central nervous system. These deviations may manifest themselves by various combinations of impairment in perception, conceptualization, language, memory, and control of attention, impulse or motor function" (Clements, 1966; p. 9). Included under the category of MBD were learning disabilities, hyperactivity, distractibility, impulsivity, emotional problems and/or social problems (Silver, 1992).

The definition of ADHD was refined in the Diagnostic and Statistical Manual of Mental Disorder, Second Edition (DSM-II, American Psychiatric Association, 1968) which included the diagnosis of Hyperactive Reaction of Childhood or Adolescence. The term Attention Deficit Disorder (ADD) was first used as a diagnostic label in the DSM-III (American Psychiatric Association, 1980). In the DSM-III, the diagnosis of Attention Deficit Disorder had two subtypes: ADD with hyperactivity and ADD without hyperactivity. The onset of the behavioral symptoms before the age of seven was added as an additional prerequisite for a diagnosis of ADD adding further clarification of the disorder and its characteristics. The DSM-III-R (American Psychiatric Association, 1987) eliminated the two subtypes of ADD combining them to form the diagnosis of Attention-Deficit Hyperactivity Disorder (ADHD). The behavioral criteria of impulsivity, hyperactivity and inattention were lumped together to comprise a list of 14 symptoms, 8 of which were required to be present in order to be diagnosed ADHD. With the DSM-IV (American Psychiatric Association, 1994) came a new conceptualization of ADHD. Based on factor analytic studies and theoretical developments (Barkley, 1990)

inattention, impulsivity and hyperactivity were combined to form two factors: Inattention and hyperactivity/impulsivity.

According to Guevremont, DuPaul and Barkley (1990), hyperactivity is no longer seen as the only problem or even the primary one in children with ADHD. Other difficulties such as sustaining attention, inhibiting impulsive responses and carrying out instructions are equally important in the diagnosis of ADHD. Barkley (1990) has reconceptualized the nature of the problem of children with ADHD as follows;

> ADHD consists of developmental deficiencies in the regulation and maintenance of behavior by rules and consequences. These deficiencies give rise to problems with inhibiting, initiating, or sustaining responses to tasks or stimuli, and adhering to rules or instructions, particularly in situations where consequences for such behavior are delayed, weak, or nonexistent (Barkley, 1990; p. 71).

A controversy that has developed over the diagnosis and definition of ADHD is that children with ADHD do not behave the same way in different settings. The symptoms of poor sustained attention and impulse control problems may fluctuate across settings depending on the activity and the caregiver (Barkley, 1990; Guevremont et al., 1990). These symptoms are most pronounced when the activity is repetitive, of low intrinsic interest to the child, lacks novelty, and has a poor rate of feedback and reinforcement. In situations that are novel, that involve one-on-one attention, and that provide frequent and meaningful feedback and reinforcement the child with ADHD may perform as well or better than the normal child. Elements of the environment or situation affect the cognitive processing of individuals with ADHD.

Barkley (1997a; 1997b) has developed a new model for understanding ADHD and its impact on cognitive processing. In this model, the ability to inhibit behavior is required before executive control in cognitive processing can occur. When behavioral inhibition is lacking or weak the individual responds to the environment without executive control. When the individual is able to inhibit behavior, then time is available to utilize memory and experience, to self-regulate, to employ problem solving strategies, and to create goal-directed behavior (labeled reconstitution). According to Barkley (1997a), behavioral inhibition is the key to the initiation of these executive functions and children with ADHD are lacking in behavioral inhibition.

Although not clearly and directly addressed in the diagnostic criteria, children with ADHD have considerable difficulty with relationships (Sheridan, Dee, Morgan, McCormick, and Walker, 1996; Guevremont et al., 1990). Children with ADHD are described as bothersome, socially awkward, disagreeable, noncompliant, and are involved in negative social interactions. Failure in school and negative social interactions may impact the way in which children with ADHD view the environment leading to the anticipation of failure both academically and socially.

Diagnosis of ADHD

As stated previously, recent conceptualizations by the DSM-IV (APA, 1994) of ADHD have brought about the assumption that ADHD is made up of two factors, hyperactivity-impulsivity and inattention. In keeping with this hyperactivity-impulsivity and inattention dichotomy the DSM-IV delineates ADHD into three subtypes: Predominantly Inattentive Type, Predominantly Hyperactive-Impulsive Type, and Combined Type (See appendix A for a description of the DSM-IV criteria for ADHD).

The severity of symptoms of hyperactivity, impulsivity, and inattention need to be considered when diagnosing children or adolescents as having ADHD. It is important in defining ADHD to differentiate between situational and pervasive ADHD (McArdle, O'Brien and Kolvin, 1995). The symptoms of hyperactivity-impulsivity and inattention are diagnostically significant either in school only or at home only in situational ADHD, whereas, they are pervasive across both school and home in pervasive ADHD. Reported prevalence rates vary based on defining ADHD as situational or pervasive. Achenbach and Edelbrock (1981) report a rate of ADHD in 6- to 9-year-olds of greater than 30% based on a parent questionnaire. An overall rate of 16.5% was reported by Schachar, Rutter and Smith (1981) when situational and pervasive ADHD were combined. When situational hyperactivity was separated from pervasive hyperactivity, a rate of 2.2% remained.

It is also important to address the possibility that more than one diagnosis may be applicable to each child. McArdle et al. (1995) studied the comorbidity of ADHD and conduct disorder (CD) in 3,300 11- and 12-year-old, and 1,040 7- and 8-year-old children. Table 1 shows the percentages of children who had ADHD without CD, CD without ADHD, ADHD with CD, and the totals.

Halperin, Newcorn, Matier, Sharma, McKay, and Schwartz (1993) found that less than 25 % of 244 children referred to a child psychiatric outpatient clinic had only one pure diagnosis with no comorbid diagnosis. In another study comparing children with ADHD to clinic referred children with other diagnoses and normal controls, 22 of the 31 subjects with ADHD were diagnosed with at least one comorbid disorder (Halperin, Matier, Bedi, Vanshdeep, and Newcorn, 1992).

Table 1

Prevalence of ADHD and Conduct Disorder in 11- and 12-year-olds and 7- and 8-year-olds

Groups	Age	No HA (%)	Per. HA (%)	Sit HA (%)	Total (%)
No CD	11-12	2359 (71)	120 (3.6)	647 (19.6)	3126 (94.7)
	7-8	594 (57.1)	56 (5.4)	257 (24.7)	907 (87.2)
CD	11-12	61 (1.9)	46 (1.4)	68 (2.1)	175 (5.3)
	7-8	9 (0.9)	43 (4.1)	81 (7.8)	133 (12.8)
Total	11-12	2420 (73.3)	167 (5.1)	715 (21.7)	3301
	7-8	603 (58)	99 (9.5)	338 (32.5)	1040

Note: Table 1 adapted from McArdle et al. (1995). HA = hyperactivity, Per.HA = pervasive hyperactivity, Sit. HA = situational hyperactivity, CD = conduct disorder.

Prevalence of ADHD

One of the reasons ADHD is the subject of so much research is the frequency with which it occurs among children. According to Silver (1992), if the estimate is based upon teacher report, then 10 to 20% of children suffer from ADHD. If the estimate is based on parent report, the percentage increases to perhaps as high as 30%. The rate of occurrence of ADHD varies drastically based on the method of assessment and diagnosis. Relying solely on survey questionnaires, Goodman and Stevenson (1989) reported nearly 25% of 13-year-old children had symptoms of ADHD. Using the syndrome of ADHD as described in the DSM-III, Szatmari, Offord and Boyle (1989) report a rate of 6.9% among 12-13 year-olds. When clinical judgment was used, less than 1% of 10- to 11-year-old children were identified as having hyperkinetic disorder (Rutter, Tizard, & Whitmore, 1970). In a more recent study of 3,300 11-12 year-olds, and 1,040 7-8 year-

olds, McArdle et al. (1995) reported that 41.9% of the younger group and 26.7% of the older group had symptoms of hyperactivity as measured by the Rutter(B) Teacher Scales. Further, 18.3% of the younger group and 6.6% of the older group were statistically distinct based on diagnostic algorithm of the Rutter(B) parent and teacher scales. Finally, research psychiatrists blindly rated 3-4% of both groups as having ADHD based on screening data, school based measures, and semistructured parent interviews.

Overall rates of ADHD differ based on the source and extent of information gathered. The higher rates are based on either parent or teacher report. The lower rates occur when a professional evaluation utilizing multiple sources of information is conducted as a part of the study.

Assessment of ADHD

It is necessary to employ a multi-modal assessment in order to diagnose ADHD (Reid, 1995; Guevremont et al., 1990; Halperin et al., 1992; Cohen, Becker, and Campbell, 1990; DuPaul, 1991). Guevremont et al. (1990) state that, "The clinical evaluation and assessment of AD-HD in children requires knowledge of the relevant research and clinical literature, knowledge of the various forms of childhood psychopathology, sound clinical judgment, and sufficient resources for obtaining multiple measurements using a variety of instruments and methods" (p. 74).

Schaughency and Rothlind (1991) identify four questions that should be addressed when attempting to assess a child for ADHD. The first question is whether or not the child meets the DSM-IV diagnostic criteria for ADHD. The next question to address is whether or not an alternative diagnosis can account for the symptoms identified. Then, the assessor needs to determine whether the behaviors are present to an

extent that is inappropriate for the child's developmental level. For instance, behavior of an eight year-old child who is functioning at the five year-old level and exhibiting behaviors that were consistent with five year-old children would not be considered ADHD. Lastly, do the behaviors in question impair the child's ability to function in school and at home? Schaughency and Rothlind (1991) suggest that a structured or semi-structured interview would address the first two questions of diagnosis and differential diagnosis. In addition, an intelligence test as well as an achievement test may be necessary in order to rule out the possibility that the behaviors are the result of a poor match between task demands and the child's ability. Behavior rating scales with multiple informants can be used to determine that the behavior is not appropriate for the developmental level of the child. These rating scales can also be used to determine the extent of impairment in functioning exhibited by the child.

Guevremont et al. (1990) recommend that the following parameters should be addressed by an evaluation for ADHD in children; first, the symptoms of inattention, impulsivity and hyperactivity should be measured in a way that allows comparison with adequate norms to determine if the behaviors deviate from age-appropriate behaviors. Second, the possibility of other problems or disorders that coexist with ADHD should be determined. Third, information from various settings and multiple sources will address the pervasiveness of the symptoms. And fourth, the assessment needs to be able to accurately measure and compare behavioral symptoms to norms across a wide age range.

One of the difficulties in diagnosing ADHD is that there are several explanations for why a child may behave in ways that are consistent with ADHD such as a "mismatch between task demands and the student's ability level, emotional difficulties, behavioral

problems, pervasive developmental disorders such as Autistic Disorder, and childhood schizophrenia" (Schaughency & Rothlind, 1991, p. 187). Another factor complicating diagnosis is the frequency with which other childhood disorders such as conduct disorder, learning disability, and Tourette's Syndrome are coexistent with ADHD. Further complicating the diagnosis of ADHD is that the manifestation of ADHD varies across individuals (Frick and Lahey, 1991; Teeter, 1991). Finally, the behaviors of each child will vary depending on the setting, the activity, and the caregiver (Guevremont, 1990).

In keeping with Shaughency and Rothlind (1991), this study employed a semi-structured interview to determine diagnosis and to address any comorbid diagnoses. IQ and achievement tests were used to determine ability level and rule out interference from learning disabilities. Behavior rating scales were used to determine the level of functioning when compared to expected levels of behavior and to gain information across settings.

Clinical Interview. As mentioned above, structured and semi-structured clinical interviews have been used in research in an attempt to standardize diagnosis. Several different interviews have been developed (for a review of structured interviews see Hodges, 1993). Structured interviews typically include both an interview of the parent and the child and are designed to yield a DSM diagnosis. One of the most widely used interviews is the Schedule for Affective Disorders and Schizophrenia for School Aged Children (K-SADS). The K-SADS-P III-R is designed to provide information on 31 different diagnoses including affective disorders (such as depression and bipolar disorder), eating disorders, anxiety disorders (such as generalized anxiety and separation anxiety disorders), behavioral disorders (including ADHD, oppositional defiant disorder,

and conduct disorder), schizophrenic/ psychotic disorders, and three other disorders. A separate interview with the parent and with the child provides information regarding the period of time over the last year when the symptoms were most intense, as well as the severity of the symptoms over the last week.

In a study of the interrater reliability of videotaped K-SADS interviews Ambrosini, Metz, Prabucki and Lee (1989) report mean kappas of 0.88 for attention deficit disorder, 0.83 for major depression, 0.85 for overanxious disorder, 0.85 for separation anxiety, 0.64 for simple phobic disorder, and 0.89 for oppositional defiant disorder. The data from the child interview were missing in this study for ADHD. While subjects were diagnosed as ADHD based on the interview with the parent, these children seemingly did not report their ADHD symptoms accurately. Loeber, Green, Lahey and Stouthammer-Loeber (1989) indicate that for ADHD and oppositional defiant disorder children are less informative than their parents. They suggest not interviewing the child when assessing for ADHD. In contrast, when diagnosing depression and anxiety, it is necessary to interview the child (Puig-Antich, Chambers, and Tabrizi, 1983). Guilt, depressed mood, anxious worries and other symptoms may not be known to the parent. Research on depression and anxiety has suggested that children are better able to report their own feelings of depression and anxiety than are their parent (Kendall, Cantwell, and Kazdin, 1989). Therefore, it is necessary to interview the parents for broader information especially regarding ADHD symptoms. It is also necessary to interview the child in the areas of depression and anxiety to rule out comorbidity.

It is difficult to establish validity for structured interviews. Carlson, Kashani, Thomas, Vaidya, and Daniel (1987) report correlations of 0.56 for ADHD, 0.69 for

conduct disorder, 0.58 for depression, 0.35 for overanxious disorder, and 0.44 for separation anxiety disorder when the K-SADS was compared to the diagnosis made by a psychiatrist at discharge from an inpatient psychiatric hospital.

Based on the acceptable levels of interrater reliability and concurrent validity, the K-SADS was one of the instruments used in the current study to determine whether the children referred met the criteria for ADHD and to ascertain any coexisting psychiatric diagnoses.

Behavior Rating Scales. There are several behavior rating scales available that claim to measure ADHD. Behavior rating scales have indeed been able to differentiate children with ADHD from normal children on impulsivity, inattention and hyperactivity; however, they have not been able to differentiate children with ADHD from children with other psychiatric disorders on these same measures according to Halperin et al. (1992). Psychiatric patients with and without ADHD were rated as significantly more impaired than normal controls on the Conduct Problems and Inattention-Passivity scales of the Connor's Teacher Questionnaire (CTQ, 1978 version: Goyette, Conners and Ulrich, 1978). The scores of the psychiatric patients with and without ADHD were statistically indistinguishable on the Internalizing, Externalizing, and Total Behavior Problem scales of the Child Behavior Checklist (CBCL; Achenbach, 1991a). The only measure that differentiated the children with ADHD from the children with other psychiatric disorders was the Hyperactivity scale of the CTQ. In a review of the Attention Deficit Disorder Evaluation Scale (ADDES), Olejnik (1994) reported that this behavior rating scale was good at differentiating between children with ADHD and normal children. A review of

the same instrument by Collins (1994) suggested that the ADDES was less accurate in identifying children with ADHD who were not hyperactive.

When comparing the Connor's Teacher's Questionnaires (CTQ) of children with pure ADHD, pure anxiety disorder, either oppositional disorder or conduct disorder, and children with no psychiatric diagnosis, Halperin et al. (1993) found that only the anxiety group was rated as significantly more inattentive/passive than the normal controls. The ADHD group differed from the anxiety and normal control groups on the hyperactivity factor, but they did not differ from the other disruptive behavior group. On the CBCL, the disruptive behavior and the anxiety groups were rated significantly higher than the normal controls on the internalizing factor; however, the two groups did not differ statistically from the ADHD group. Both the disruptive behavior and the ADHD groups were rated higher than the anxiety group and normal controls on the externalizing factor. From these results, it may be concluded that rating scales such as the CTQ and the CBCL are not sufficient for distinguishing between diagnostic groups, even when they are pure diagnostic groups. When there is the possibility of comorbidity, these rating scales will likely yield results from which it will be more difficult to address diagnostic issues.

Steingard, Biederman, Doyle, and Sprich-Buckminster (1992) separated subjects into three groups based on the Diagnostic Interview of Children and Adolescents (DICA); normal controls, ADHD without any comorbid psychiatric condition (ADHD-), and ADHD with at least one other psychiatric disorder (ADHD+). They used the CBCL to compare normal controls with the ADHD- and the ADHD+ groups. The ADHD- group scored significantly higher than normal controls on only the Hyperactivity scale of the CBCL. The ADHD+ group was significantly higher than the normal group on all clinical

scales, but was higher than the ADHD- group only on the Hyperactivity scale. In this study they determined that using a cut-off score of 70 on the Hyperactivity scale failed to identify many children identified as ADHD by The Diagnostic Interview of Children and Adolescents, a semistructured interview. The authors conclude that the CBCL can be used to screen for psychiatric disorders; however, children with ADHD and with comorbid psychiatric disorders will score higher on all CBCL scales. In fact, the mean Hyperactivity score for pure ADHD children was below the CBCL threshhold for significance. A higher CBCL Hyperactivity score could be an indicator of comorbidity.

In a study by Biederman et al. (1993), children were diagnosed through the Schedule for Affective Disorders and Schizophrenia for School Aged Children (K-SADS, Orvaschel, 1985). They were placed into three separate groups; children with only ADHD (N = 65), children with ADHD and one other diagnosis (N = 68), and normal controls (N = 118). On the CBCL, the ADHD group was significantly higher than the normal controls on the Anxious/Depressed scale, the Social Problems scale, the Attention Problems scale, the Delinquent Behavior scale, and the Aggressive Behavior scale. The third group of ADHD children with at least one comorbid diagnosis scored significantly above the ADHD only group on all eight of the CBCL scales supporting the conclusions of Steingard et al. (1991).

It would seem that difficulties with attention, hyperactivity, anxiety, and depression will be reported on the CBCL for children with many different psychiatric disorders. There is a need for clear assessment procedures and clear definitions of diagnostic categories in order to make valid conclusions from research studies. Many of the symptoms reported overlap diagnostic categories.

Continuous Performance Tests. Continuous performance tests (CPTs) have been used in an attempt to improve the diagnostic accuracy for ADHD. Several studies have been conducted with mixed results regarding CPTs (Halperin et al., 1993; Halperin et al., 1988; Corkum and Siegal, 1993; Fischer, Newby, and Gordon, 1995; Aylward, Verhulst and Bell, 1990; DuPaul, Anastopoulos, Shelton, Guevremont, and Metevia, 1992)

In an attempt to determine the extent to which individuals with ADHD but without other comorbid diagnoses differed from individuals with other pure psychiatric diagnoses, Halperin et al. (1993) used multiple measures to accurately identify 13 children with ADHD, 20 with anxiety disorders, 15 with disruptive disorders other than ADHD (oppositional defiant disorder and conduct disorder), and 8 non-referred controls. The CPT employed in this study involves responding to the presentation of an X only if it follows the presentation of an A. The ADHD group made significantly more inattention, impulsivity and dyscontrol errors than the other groups which did not differ from each other on any of these measures. They defined inattention as the number of missed targets (omissions) and the number of commission errors to X-only that involved a slow reaction time (RT). Slow response time commission errors represent not attending to the letter presented just prior to the X. Impulsivity was made up of the number of fast RT A-not-X responses plus the number of long RT A-only responses, both of which may represent the inability to wait until the second letter is presented. Dyscontrol was defined as the number of commission errors other than those used for inattention and impulsivity, such as responding when neither A nor X were presented. Their conclusion was that the CPT accurately differentiated between children with pure ADHD and children with pure anxiety disorder, other disruptive behavior disorders and normal controls.

Errors of omission were significantly correlated with the inattention/passivity factor of the CTQ and with the inattention items of a questionnaire based on the DSM-III symptoms for ADD with hyperactivity in a study of 72 non-referred children from an urban parochial school (Halperin et al., 1988). Errors of commission to a letter other than the target letter following the cue letter were significantly correlated with CTQ ratings of conduct problems and the hyperactivity factor as well as the ratings of impulsivity and hyperactivity on the DSM-III scale.

In a review of the research on continuous performance tests, Corkum and Siegel (1993) determined that 60% of the studies found no significant differences between children with ADHD and normal children on errors of omission, and 50% found no significant differences on errors of commission. In respect to challenges about excluding studies in generating the previous percentages, Corkum and Siegel (1995) included the studies they were reported to have omitted and revised the percentages to 53% and 59% respectively, adding weight to their conclusion. These findings bring into question the validity of CPTs to differentiate between ADHD and normal children. However, Corkum and Siegel (1993) question the methods utilized in the 13 studies of CPT including the criteria for selection of ADHD groups and the manipulation of task, situational and external variables.

Fischer et al. (1995) suggest that the utility of a continuous performance test may not be in its ability to diagnose ADHD, but in its ability to identify differences among children with ADHD. They focused their study on attempting to discover the difference between children with ADHD who did well on the Gordon Diagnostic System (GDS) Vigilance Test (VT) and children with ADHD who did not do well on this test. Children

who did well on the VT (the DISAGREE group) did not differ from children who did poorly on the VT (the AGREE group) on the number or severity of problems identified on the Home Situation Questionnaire (HSQ) or the School Situation Questionnaire (SSQ; Barkley, 1981). They also did not differ on the CBCL Internalizing, Externalizing, Schizoid, Depressed, Hyperactive, Aggressive, or Delinquent factors, or the Teacher Report Form (TRF; Achenbach, 1991b) Internalizing, Externalizing, Inattentive, Nervous-Overactive, or Aggressive factors. In contrast, the DISAGREE group was rated as having higher levels of Conduct Problems and Psychosomatic Problems. Fischer et al. (1995) also included a behavioral observation rating the children for "off-task," fidgeting," "vocalizing," "playing with objects," and "out of seat" behaviors while completing math problems during a 10-minute time period. The DISAGREE group scored significantly better than the AGREE group on all of these categories except for fidgeting indicating better ability to attend. The authors conclude that children with ADHD whose performance is worse on the VT, reflecting greater attentional problems, may represent a more "pure" ADHD group. They cite other studies to support the conclusion that children who do more poorly on the CPT tasks are more purely ADHD. Unfortunately, the children were diagnosed as ADHD based solely on the Connors Parent- and Teacher Rating Scales and the CBCL. Performance on the VT was used to separate the groups. No other measure of comorbid conditions was utilized bringing into question any conclusion made about pure ADHD versus comorbid ADHD.

Aylward et al. (1990) used the VT (Gordon Diagnostic System) to measure the continuous performance of 253 children referred for problems with attention, concentration, high activity levels, or poor grades. The authors used clinical observation,

Connors Parents' Questionnaire (Goyette et al., 1978), and ADD-H Comprehensive Teacher's Rating Scale (ACTeRS; Ullman, Sleator, & Sprague, 1984) to identify which children met the DSM-III criteria for ADD with hyperactivity and without hyperactivity. The group of ADD/ADD-H made fewer correct responses on the VT (Gordon Diagnostic System), and a greater number of incorrect responses than did children without ADD. These two groups differed on these measures regardless of the presence of a learning disability. In conducting studies using CPTs, Aylward et al. (1990) recommend that age, IQ, and gender may impact the score and should be controlled. They also suggest that the researcher use an Accuracy Index made up of the number of correct responses minus the number of commission errors divided by 45. This would rule out the possibility that the individual achieved a higher number of correct responses by overresponding to correct and incorrect items.

DuPaul et al. (1992) found no correlation between the VT, the Matching Familiar Figures Test (MFFT), and parent and teacher rating scales. The children with ADHD in their study were selected based on the reports of the teachers (TRF, School Situation Questionnaire and the ADHD Rating Scale) and the parents (CBCL and the Home Situation Questionnaire) as well as a semistructured interview developed by Barkley (1990). The CBCL scales have shown variable reliability regarding the diagnosis of ADHD. Finally, the semistructured interview based on the DSM-III-R developed by Barkley has not gone through the rigorous validation process as other semistructured interviews nor have norms for its reliability and validity been reported. The identification of individuals as ADHD in this study is suspect. In addition, the CPT utilized did not include such variables as reaction time. The optimal time of exposure to the stimulus for

differentiating ADHD was found to be between 50 and 200 msec (Corkum and Siegel, 1993) while DuPaul et al. (1992) had a stimulus exposure time of 800 msec. Therefore, the selection of subjects for this study and the methodology used bring the results into question.

Halperin et al. (1992) compared the CPT performance of 31 children with ADHD referred to an outpatient clinic in an urban setting to 53 children without ADHD referred to the same clinic and 18 normal-controls. The ADHD and non-ADHD groups scored significantly worse on both inattention and dyscontrol than did the normal-control children; however, the two clinic referred groups were not differentiated from each other on either the inattention or dyscontrol scales. The ADHD group performed more poorly on the impulsivity scale than the normal-controls. The non-ADHD group was statistically indistinguishable from the other two groups on impulsivity. By using a device attached to the child's belt, Halperin et al. (1992) found that the activity level of the ADHD group children was greater than that of the other two groups. The authors explained these results by concluding that children with ADHD are indeed hyperactive and impulsive but perhaps not necessarily inattentive. They suggest that inattention is a characteristic of children with other psychiatric or educational difficulties and not a characteristic of purely ADHD children.

A continuous performance test was included in the present study to compare with the diagnostic results of the semi-structured interview and parent and teacher questionnaires. Given the mixed results reported above, the information gained from the CPT was not used for diagnostic purposes but was used to compare the initial evaluation with the follow-up evaluation.

Information Processing Theory

Another way in which to conceptualize the behavioral and cognitive difficulties of ADHD is through the use of the constructs of information processing theory. Information processing theory has been used to explain the way in which people interact with the environment. Information processing involves encoding of stimuli, interpreting the input, storage into memory, retrieval from memory, problem solving or decision making, and output or action based on the decision made (Crick and Dodge, 1994). Schachar et al. (1995) have attributed the impulsiveness, inattentiveness and overactivity of children with ADHD to deficits in the higher-level cognitive functions of *self-regulation* and *executive control*. Self-regulation and executive control are the functions that oversee and direct the encoding, interpretation, retrieval from memory, problem solving, decision making and behavioral output of cognitive processing. The results of deficits in information processing are diminished capacities to initiate, inhibit and alter one's actions. Lack of the ability to inhibit behavior constitutes the impulsive behavior seen in ADHD children.

With the advent and development of information processing theory of cognition, approaches to the interpretation of the TAT have increasingly adopted many of the ideas offered by this theory. With the ongoing use of the TAT and the continuing efforts to enhance the interpretive yield from the TAT it is little wonder that the concepts of information processing would find their way into interpretive models (Dana, 1959; Whiteley, 1966; Rapaport, Gill, and Shafer, 1969; Teglasi, 1993, 2001).

Some of the concepts of information processing that are pertinent to the task of story telling include the encoding of information, the integration of the encoded

information with memory and prior learning, and the production of a story consistent with the individual's understanding of and beliefs about the world (Teglasi 1993, 2001). According to Siegler (1986), children often find themselves in novel situations about which they know little or nothing. Their ability to identify and encode important information from the situation will significantly impact their ability to adapt and learn. It is not possible to attend to or process (encode) every aspect of the environment, or even any one situation. Therefore, the individual must selectively encode the most relevant information. "Encoding involves identification of the critical information in a situation, and use of it to build internal representations." (Siegler, 1986; p. 73). As was discussed above, individuals with ADHD may be weak at selective encoding.

In order to represent the input internally the individual actively selects and organizes input into sets (Siegler, 1986). Through this process of repeated encoding of information into sets children develop rules by which they know and understand the world. For instance, toddlers use plural and past tense rules, sometimes erroneously, to govern language without being taught these rules. Rules that govern behavior begin to develop as the language of others (parents) controls behavior. Behavior then becomes progressively more controlled by self-directed speech which eventually becomes internal. Finally, the individual will create new rules through the use of self-directed questions (Barkley, 1997a). Through this process, control of behavior shifts from the surrounding context of a situation to internally represented information (rules). Rules are used by older children to memorize, to solve problems, and to form concepts. When faced with unfamiliar situations or problems, children utilize "fall-back" rules to make sense of the situation. Without the ability to selectively encode, the individual with ADHD will be

unable to organize input into sets. The inability to organize input into sets results in the lack of or poorly developed rules for governing behavior.

Schema theory has emerged as a possible way of explaining some of the mechanisms involved during information processing and how these sets or rules develop. Schemata are comprised of clusters or units of knowledge which organize objects, percepts, events and social situations into general categories which help to organize human experience (Anderson, 1990; Thorndyk and Yekovich, 1980). Schemata are developed or "induced" from experiences. As people experience events, they abstract meaning from these events. Similarities between the abstracted meanings of events are then related to each other in such a way that expectations are developed for future events to occur that are consistent with past events. These organized expectations or concepts can then be called up into working memory when an individual is faced with a similar situation allowing the individual to more efficiently process the incoming information and to act accordingly. Schemata help the individual to encode new events and new information (Anderson, 1990). This process is at the core of selective attention. Schemata help the individual to recognize and attend to important aspects of the stimuli.

As stated above, when an individual encounters a situation, it is not possible to encode all of the information available. Therefore, the individual must selectively encode the most important information (Siegler, 1986). The relevancy of different aspects of the stimulus to the individual is determined by its relationship to prior knowledge, its capacity to activate the relevant schema, and the importance of the information to the schema (Alba and Hasher, 1983). Different aspects of the stimulus will be selected and encoded to the degree that they are relevant to prior knowledge and schemata. Crick and

Dodge (1994) indicate that schemata or "heuristics" are involved at every level of cognitive processing influencing and being influenced by the process.

Epstein (1994) suggested that schemata are not isolated and detached; rather they are organized into a system that serves the function of adapting to the environment. In Epstein's theory, people adapt to the world through two separate systems, the rational and the experiential systems. The rational system is analytical, deliberative, and rational. The experiential system is intuitive, automatic, natural, and experiential. In each of these two systems individual constructs are developed about the self and the world. Rational system constructs are called beliefs. Experiential system constructs are implicit beliefs or schemata which are generalizations made from emotionally laden past experiences. The experiential system with its affect laden schemata can bias the processing of the rational system. This biasing can be seen in TAT stories when the picture evokes the activation of an emotionally laden schema which then influences the interpretation of the encoded input. Also, the schema that is activated will tend to influence ongoing encoding of the stimulus biasing what the narrator perceives. In addition, emotionally laden schemata will impact the organization of the story being told guiding it in a direction that is consistent with the schemata. Measures that assess aspects of the rational system such as IQ tests do not access the experiential, emotionally laden side of cognitive processing, nor do impersonal computer tests. The TAT has the capacity to bring forth these experiential aspects of cognition.

Another aspect of self-regulation that Schachar et al. (1995) set out to measure is cognitive flexibility, which they define as the child's ability to rapidly and appropriately switch from one thought or activity to another. To measure cognitive flexibility Schachar

et al. used a signal to cue subjects to stop their responses to computer generated stimuli. After a trial without a stop-signal and a trial with a stop-signal, subjects were asked not only to inhibit their responses when they heard the signal but also to press a separate button. This third trial represented the child's ability to switch from merely stopping the responding to responding differently as well. The authors found that children with pervasive ADHD (symptoms present both at home and school) were less able to inhibit their responses than the normal control group. Pervasive ADHD children were also less able to alter their responses after being signaled to stop responding than normal control children. Schachar et al. (1995) split the ADHD group into pervasive ADHD, home-only ADHD (symptoms present only in the home), and school-only ADHD (symptoms present only in the school). The home-only and the school only ADHD groups did not differ from either the pervasive ADHD group or the normal-control group on either the measure of behavior inhibition or cognitive flexibility. Deficient inhibitory control is implicated by Schachar et al. (1995) as the cause for what appears to be impulsiveness in children with ADHD. The inability to execute a different action after one has been stopped results in the appearance of inattention in situations that demand shifting from one activity to another. During the development of a TAT story, the individual needs to be able to shift from encoding and retrieval of relevant memories to sequencing of events and coordinating actions, intentions, thoughts and feelings. If the child with ADHD has difficulty making this shift then the stories will be poorly integrated, concrete, and limited in their usage of time (past, present and future).

Poor inhibitory control resulting in impulsiveness, and the inability to switch from one activity to another resulting in inattention, may be due to the lack of properly

developed rules for the governing of behavior (Barkley, 1990; Schachar et al, 1995). Either the rules are not developed enough to regulate behavior, or they are not activated at the proper time to bring about efficient regulation of behavior (Alber and Hasher, 1983). Behavior that is not governed by rules or underlying schema will result in TAT stories that are aimless, poorly integrated, possibly associative, and lacking in elements significant to the integration of inner and outer experiences.

In a comparison of 65 children with ADHD with 45 normal-control children, Seidman et al. (1995) found that the children with ADHD received lower organization scores on the Rey-Osterrieth Complex Figure even when controlling for IQ, age and copy accuracy. Children with ADHD and learning disabilities (LD) scored significantly more poorly than children with ADHD with no LD, who in turn scored significantly lower then normal-controls. The authors attribute these lower scores to the executive cognitive processes of planning and organization which they implicate as representative of the neuropsychological impact of ADHD. Planning and monitoring deficits will result in TAT stories that are associative in nature with one idea triggering another. Without planning stories will lack time perspective. Stories will be poorly integrated if the narrator is unable to monitor the various elements of the story.

Singh, Ellis, Winton, Singh, Leung, and Oswald (1998) studied the ability of children with ADHD to correctly identify emotions based on facial expressions. The ability to recognize facial expressions of emotion is a cognitive processing skill that impacts the individual's response to others. Because children with ADHD are reported to frequently respond poorly in social settings, the authors wanted to determine if they were deficient in their ability to encode and process social/emotional information. Singh et al.

(1998) found that children with ADHD were less accurate in correctly identifying facial expression of happiness, sadness, surprise, disgust, anger and fear.

In a study of the way in which children process emotional stimuli, Cadesky, Mota, and Schachar (2000) presented participants with pictures of adults or children expressing one of four emotions, happiness, sadness, anger and fear. They also presented aurally a sentence read with one of these four emotions expressed. Children with ADHD and children with conduct problems made significantly more errors interpreting emotions than did normal-control children. The children with conduct problems misinterpreted other emotions as anger, whereas, the children with ADHD made errors on all four emotions randomly. Children with conduct problems may be more biased to interpret emotions as anger. Children with ADHD randomly misinterpret emotions as a probable result of inattention to or improper encoding of social cues. Accurate encoding of social and emotional information is necessary to tell rich TAT stories and will likely be missing or weak in children with ADHD.

Projective Techniques

As was demonstrated above, assessment of ADHD involves multiple measures. The measures used focus on reports of behavior by parents and teachers as well as behavior samples such as continuous performance tests. There have also been studies that have evaluated cognitive/information processing in children with ADHD. As reviewed above, Schachar et al (1995) used a stop signal and an alternate response to measure the cognitive processes of behavioral inhibition and cognitive flexibility. Planning and organization were measured in children with ADHD by Seidman et al (1995). Matthys et al. (1999) measured the encoding of social cues when viewing

videotaped vignettes of social situations. Constantino et al. (1991) used a thematic apperception technique (the Tell-Me-A-Story test) to show that children with ADHD omitted pertinent information about the characters, events, settings, and psychological conflicts depicted in the pictures. Singh et al. (1998) and Cadesky et al. (2000) measured the encoding of emotional expression.

Information processing has also been evaluated using projective techniques such as the TAT (Constantino et al., 1991; Dana, 1959; Rapaport et al, 1968; Ronan, Colavito, and Hammontree, 1993; Ronan, Date, and Weisbrod, 1995; Teglasi, 1993, 2001; and Whiteley, 1966). Rapaport et al, (1968) describe projective procedures as follows, "...procedures in which the subject actively and spontaneously structures unstructured material, and in so doing reveals his structuring principles--which are the principles of his psychological structure." (p. 225). They define psychological structures as principles governing all behavior of the individual. From this perspective, all of the behavior of an individual utilizes the process of structuring and giving meaning to experience and perception. All behavior can then be considered projective. Projective techniques represent a sample of behavior from which conclusions can be reached regarding the individual's structuring principles. Based on this assumption, the way in which an individual completes the projective task should be reflective of the way in which that individual responds to other tasks. In telling stories to TAT pictures, "individuals bring their basic approach to information processing, including intellectual and conceptual skills, attentional processes, and organizational capacities, to the interpretations of the scene and to generating the content and structure of the story." (Teglasi, 1993; p. 7). The power of the projective technique is to reveal the manner in which a person perceives,

interprets and responds to others and to the environment. The projective technique does not merely assess the personality, but also the functionality of the individual's personality.

Thematic Apperception Test (TAT)

The TAT and a method of interpretation were introduced by Murray (Morgan and Murray, 1938). Since then, the use of the TAT did not remain coupled to Murray's approach to interpretation and many interpretive systems were introduced. From its inception, the TAT has been used for various purposes. As noted, Murray developed the TAT to identify recurrent themes that were a reflection of unconscious needs. According to Eron (1965), the TAT was developed to elicit the individual's fantasy from which inferences about the individual's needs and motivation can be made. The TAT has since been used to assess motives, as a diagnostic tool, to measure the content of an individual's conscious and preconscious fantasy, and to assess a variety of specialized functions such as patterns of interpersonal interactions (Rosenwald, 1968).

Several attempts have been made to develop scoring systems for the TAT in order to establish a standardized and objective system to aid in the interpretation of TAT stories (Dana, 1959; Whiteley, 1966; Teglasi, 1993). According to Dana (1959), those employing an objective scoring system assume that the behavioral sample elicited by the TAT is representative of the way in which that individual interacts with the environment. It is also assumed that the way in which the person tells stories to TAT pictures reflects aspects of that person's personality. In the scoring system developed by Dana (1959) the story teller receives credit for the inclusion of several components that involve cognitive

processing such as the accurate perception and inclusion of picture details, the inclusion of feelings and thoughts, time references, and the resolution of the story.

More recent approaches to the interpretation of the TAT expand upon prior conceptualizations. Rapaport et al. (1968) suggest that the individual's thought processes are being measured by the TAT. These thought processes are a reflection of ego function which is based on the underlying psychological structure residing in the unconscious. Whiteley (1966) has referred to this as adaptive ego functioning and suggests that the way in which an individual responds to the TAT reflects the way in which that individual will respond to other environmental stimulation. Ronan et al. (1993) and Ronan et al. (1995) have focused on personal problem solving in evaluating TAT responses. Formal aspects of TAT stories were assessed by McGrew and Teglasi (1990). These attempts to grasp what the TAT is measuring seem to focus on the underlying structures or cognitive processes that guide and direct the individual's ability to respond and adapt to life.

Teglasi's TAT Scoring System

No single scoring system is capable of capturing all of the interpretive aspects of the TAT (Teglasi, 1993, 2001). Teglasi has approached interpretation from several dimensions including cognition, emotion, relationships, motivation, and self-regulation. The focus of this study was on the evaluation of cognition.

Cognition during story telling involves the content of the story, the structure, cognitive processes, and products. Content (information held in memory), structure (how the information is organized and stored in memory), and processes (how information is organized and attended to) are incorporated with schemata to provide the "sets" from which TAT stories are generated. Disorganized, inappropriate or incomplete schemas

will result in misinterpretation of the stimulus or the introduction of incompatible ideas into the story. The way in which the individual attends to, organizes, and responds to TAT pictures can be evaluated to reveal deficient schemas. Cognition in the system developed by Teglasi (1993, 2001) is measured in terms of encoding and interpretation of the stimulus, coordination of the ideas represented in the story, time references, and integration of the internal (thoughts and feelings) and external (actions and outcomes) worlds. In this system four aspects of cognition are evaluated; Perceptual Integration, Level of Abstraction, Cognitive-Experiential Integration, and Level of Associative Thinking.

Perceptual Integration. There are three facets to perceptual integration. The story-teller must first be able to identify the features of the stimulus in order to create a story that is consistent with the depicted scene. Deficits in this area would include the omission of major details or people. Secondly, the degree to which the narrator is able to accurately identify and interpret subtleties of interpersonal relationships is indicative of the level of perceptual integration. Finally, the ability to conceptualize the relationships between the events, the individuals and the interpersonal aspects of the scene is evaluated as a part of perceptual integration.

Level of Abstract Thinking. The level of abstract thinking is measured by the degree to which the individual is bound to or free from the stimulus in the telling of the story. The concrete thinker is unable to process the story beyond the situation or the stimulus, whereas the abstract thinker produces an internal representation or conceptual model in order to coordinate multiple aspects of the story. For the abstract thinker the story is directed from an internal framework of thoughts and ideas. For the concrete

thinker the story is directed by the stimulus. Stories told by the concrete thinker do not account for past or future considerations, but rather focuses on the here-and-now. Stories that are based on the immediate situation are lacking in motivations of the characters or causes for events. Transitional events explaining changes in feelings or sequence of events are problematic (e.g., magical or arbitrary transitions) or non-existent. Events are not placed in proper context when stories are concrete. Concrete thinking is evidenced when inner life such as ideas or feelings is poorly integrated with external circumstances.

Cognitive-Experiential Integration. The processes of attention and reasoning are involved in the development of stories through the interpretation of the stimuli and the planning and monitoring of the story (Teglasi, 2001). Working memory and activated schema from long-term memory are also involved in the creating of a story. Cognitive-Experiential Integration as defined by Teglasi (1993, 2001), provides a framework for measuring these various aspects of information processing as follows.

Accurate interpretation of the pictures is one indication of attention. The individual's focus of attention can be drawn away from the overall significance of the scene in many ways. As discussed previously, schema strongly influence the focus of attention. Therefore, the interpretation of the stimulus is based on the narrator's attentional capacity which is directed by the schemas that are activated at the time the story is told.

Because of the complexity of the TAT task, planning and monitoring of one's own behavior during the telling of stories as well as monitoring the progression and organization of the story is required. Planning and monitoring deficits will result in

stories that are not cohesive or accurate to the stimuli. Individuals with ADHD will tell stories that reflect planning and monitoring difficulties.

The time frame from which the story is generated is indicative of the complexity of thought processes. Stories in Teglasi's system (1993, 2001) are evaluated for the degree to which they integrate events, action and outcomes within an appropriate time frame. At the most simplistic level, the story is based in the immediate time frame without connections to the past events or to outcomes. At the highest level, outcomes are tied to actions and there is a clear connection between the past, the present, and future.

The process of reasoning is essential to the integration of cognition and experiences. When stories contain major contradictions, gaps in logic, fragments of ideas, gross distortion, or bizarre content, the likely thought disturbance precludes the ability to generate integrated or cohesive stories. The presence of these qualities within stories results in low cognitive-experiential scores.

Teglasi (2001) indicates that reality testing involves the coordination of internally represented information with external cues. The coordination of inner elements (intentions, motives, goals, and principles) with outer elements (events, actions and outcomes) affects the degree to which TAT stories are integrated. When inner and outer elements are not well coordinated events, actions and outcomes are based on external provocations rather than on intentions, goals and principles. When inner and outer elements are coordinated then behavior will be guided by internal processing of information.

The final aspect of cognitive-experiential integration is the coordination of the perspectives of different individuals. This facet of integration is measured by the degree to which the inner and outer experiences of different characters in the story are weighed against each other and coordinated.

Production of Ideas/Level of Associative Thinking. The production of ideas is evidenced in the progression of the details of a story. When evaluating the level of associative thinking stories are coded on "whether ideas are successive associations elicited by a previous thought, stimulus, feeling, specific experience, or stereotype, or whether ideas are guided by organized personal schemas that lend coherence to the story details." (Teglasi, 2001; p. 26).

Summary

Because of the frequency with which ADHD occurs and the profound social and academic impact upon children, there is a need to continue to refine the definition and diagnosis of ADHD. In a review of the history of the disorder, Lakoff (2000) traces the definition of ADHD from moral defect to brain damage due to encephalitis through minimal brain dysfunction to attention deficit disorder to the current understanding that ADHD is a disorder of response inhibition and executive control. Barkley (1997b) implicated deficits in executive functions critical to planning and self-regulation as central to the problems in children with ADHD. These executive functions make "intentional, purposive, future-oriented, self-disciplined, and reasoned behavior" possible (Barkley, 1997b, p. 273).

Executive control and information processing deficits result in inattentive and impulsive behaviors in children with ADHD. Difficulty with selective encoding,

interpretation, and organization of input into schema results in behaviors that are not governed by rules. Without schemas the individual is unable to organize objects percepts, events, and social situations into categories making the understanding and organization of experience impossible.

Several discrete aspects of information processing have been identified as deficient in children with ADHD. Schachar et al. (1995) indicated that self-regulation and executive control oversee encoding, interpretation, retrieval from memory, problem solving, decision making and behavioral output; however, these authors measured only the ability to inhibit responses to computer generated stimuli and the ability to switch responding from one task to another. Seidman et al. (1995) measured planning and organization through a visual-motor task but did not assess the organization of cognitions or planning strategies. Cadesky et al. (2000), Matthys et al. (1999), and Singh et al. (1998) measured the encoding of emotional information more closely approximating complex cognitive processing. Constantino et al. (1991) used story telling to measure encoding omissions. These studies assessed discrete aspects of cognitive processing that serve as precursors and that point to the need for the assessment of more complex information processing which can be measured by TAT stories using the system developed by Teglasi (1993, 2001).

The present study was designed to compare the cognitive processing abilities of children with ADHD to those of normal-control children utilizing the TAT to measure information processing. The scoring system developed by Teglasi (1993, 2001) was designed to measure encoding, interpretation of input, the use of schemas to organize information, the ability to integrate past, present and future, the ability to abstract and

internally represent information, the integration of multiple perspectives, the ability to organize thoughts into stories, and cause-effect reasoning. Possible results of deficiencies in these areas are distractibility, poor concentration, poor school performance, poor regulation of behaviors by rules and consequences, poor peer relationships, and what appears to be antisocial behavior. These are the behaviors that Barkley (1990) identified as characteristic of children with ADHD. In addition, the child with deficits in these information processing abilities may seem disorganized, may tend to lose things frequently, may not learn from past mistakes, and may not understand the feelings and opinions of others.

The complex cognitive processing abilities of children with ADHD and normal-control children were compared utilizing a story-telling task and the scoring system for the TAT developed by Teglasi (1993, 2001). All of the information processing variables came from the Teglasi system for scoring TAT. The following hypotheses were tested:

1. Children with ADHD will have difficulty encoding and integrating perceptions while telling TAT stories as evidenced by lower scores on Perceptual Integration than those of normal/control children.
2. Children with ADHD will tell TAT stories that are more concrete than those of normal/control children based on the Level of Abstraction score.
3. The ability of children with ADHD to tell stories that integrate cognitive and experiential variables will be lower than that of normal/control children as measured by the Cognitive-Experiential scale.
4. The level of Associative Thinking scores will be lower for children with ADHD than those of normal/control children.

For exploration pruposes, it was decided to make an effort to retest as many participants as possible to note changes on the IVA and the four TAT variables.

Method

Participants

Information regarding the nature of this study and the types of subjects desired was sent to local pediatricians and psychiatrists in an effort to elicit referrals (see Appendix B). The information was also given to private schools and a local home schooling network. From these sources 45 children between the ages of 7 and 13 (average age 9.89, standard deviation 1.78) were referred for evaluation. Participants were seen at either the Center for Children in Waldorf, MD where the examiner was employed, or at the examiner's private office. The Center for Children, a Community Mental Health Center serving children and their families, allowed the examiner to evaluate the participants at no cost to them. Participants were offered a complete psychoeducational evaluation for ADHD including IQ testing, achievement testing, as well as testing for attention problems and hyperactivity. Upon completion of the evaluation, the parents of all of the participants were provided psychological reports including recommendations for interventions. In addition, the researcher collaborated with the schools in some cases to assist in educational planning. In some cases the referring physician was contacted regarding the results of the evaluation. Of the 45 children evaluated, 28 were referred by their teacher and 17 of the referrals were initiated by the parents. Participants included 22 children from private schools (either Catholic or Protestant Christian schools), 17 from public schools and 6 were home-schooled. For the home-schooled children, the parents were asked to fill out the parent and the teacher questionnaires attempting to separate the child's behavior during school time from the

rest of their behavior. The reported teacher data from these six participants were not included in any of the statistical analyses.

The referred participants were comprised of 29 males and 16 females and were divided into 3 groups. The groups were as follows, clinically eligible, sub-clinical for ADHD, and ineligible. Five separate instruments were used to determine eligibility, the K-SADS, the CBCL, the Teacher Report Form (TRF), and the Conners' Parent and Conners' Teacher Rating Scales (CPRS and CTRS). One parent of each participant completed the CBCL and the CPRS. One teacher for each participant completed the TRF and the CTRS. Participants were included in the clinical group as Primarily Inattentive if they met the following criteria: (a) They were described by the parents during the semi-structured interview (K-SADS) in such a way as to meet at least six of the criteria (DSM-IV) in the inattentive category, and, (b) If at least three of the four inattentive scales of the CBCL, the TRF, the CPRS, and the CTRS were two or more standard deviations above the mean ($\geq$70) and the remaining scale was at least one standard deviation above the mean ($\geq$60), or two of the four inattentive scales were two standard deviations above the mean ($\geq$70) and the remaining two scales were one and one-half standard deviations above the mean ($\geq$65). They were included in the clinical group as ADHD/Primarily Hyperactive/Impulsive if they were described on the K-SADS as meeting six of the criteria for hyperactive/impulsive and they were rated as hyperactive on both the Conners' Parent and Teacher Rating Scales ($\geq$70). To be in the sub-clinical group participants had to meet the following criteria: (a) They were described by their parents in such a way as to meet four or more of the criteria for ADHD either Inattentive or Hyperactive/ Impulsive on the K-SADS, and (b) they were rated by their parents and

teachers one or more standard deviations above the mean (≥60) on the CBCL, the TRF, and on the Conners Rating Scales for inattention or hyperactivity. The remainder of the participants were placed in the ineligible group. Data from parents and teachers were used to insure that the behavior in question was evident in at least two different environments.

A control group was created with 15 subjects to match the 15 subjects of the clinical group for age and gender. The control group was made up of 12 non-referred children who had participated in previous research studies. The selection of these children was based on matching them to a child of the same age and gender from the clinical group. They were all middle-class children with average intelligence from private and public schools (approximately half from private and half from public schools). The range of ages available for selection from previous research for the control group was 7 to 12 year-olds. Because three of the children from the clinical group were 13 years old, the examiner recruited 3 additional participants based on their age and gender to complete the control group derived from archival data. Average intelligence or better was assumed for these 3 additional participants based on successful performance in school and indication by the parents of no academic concerns.

Clinical Group. The clinically eligible group was comprised of 15 children, 7 of whom were male and 8 of whom were female. Among the clinical group, 6 were from private schools, 6 from public schools and 3 were home-schooled. In the clinical group there were 11 Caucasians and 5 African Americans. All but 2 of the clinical group were from middle class families. The families of the remaining two participants were receiving public assistance. The average age for the clinical group was 9.68, and the

average IQ for the clinical group was 100.80 with a range from 84 to 127 and a standard deviation of 13.77.

The children in the clinical group were determined to be eligible based on meeting the criteria for one of the three ADHD diagnoses represented in the DSM-IV. Nine of the participants in this group met the criteria for ADHD/ Primarily Inattentive Type, three met the criteria for ADHD/Primarily Hyperactive/Impulsive, and three met the criteria for ADHD/Combined Type. Among the clinical group there were six students who were comorbid for Oppositional Defiant Disorder, two who were comorbid for depression, and one who was comorbid for anxiety. One of the participants from the clinical group evidenced a learning disability in written language based on a comparison of IQ and achievement scores.

The referral of the participants in the clinical group was initiated by the parent for 5 of the children and by the teacher for 10. There were also several reasons for referral which are shown in Table 2 as reported by parents for each of the groups. In addition to the reasons reported in the table other reasons for referral included, two students for depression, one for impulsive behavior, one for not following directions, and one for having difficulty understanding instructions.

Sub-clinical Group. The sub-clinical group was comprised of 18 children made up of 14 males and 4 females. Of these 18 participants, 12 were white, 5 were African American, and 1 was Hispanic. Among the sub-clinical children 8 attended public school, 8 were in private schools, and 2 were home-schooled. Parents initiated the referral for 6 of the sub-clinical children while teachers initiated the referral for 12. The average age for the group was 10.04 and the average IQ was 97.83 with a standard

deviation of 11.60 and a range of 75 to 113. Of the participants of the sub-clinical group, 13 were at-risk for ADHD/Primarily Inattentive, 2 were at-risk for ADHD/Primarily Hyperactive/ Impulsive, and 2 were at-risk for ADHD/Combined. All of the children in this group were at least middle class. In addition to the reasons presented in Table 2, other referral issues included, slow processing, apathetic attitude, and difficulty following directions. One of the participants from the sub-clinical group was comorbid for Oppositional Defiant Disorder, three evidenced written language learning disability, and one evidenced a cognitive processing deficit relative to his IQ scores.

Table 2

Additional reasons given by parents for referral for evaluation

	Clinical Group (N = 15)	Sub-clinical Group(N = 18)	Ineligible Group (N = 12)
Attention/Focus	11	10	9
Hyperactive Behavior	6	4	2
Not completing Work	5	10	2
Academic Problems/Failing	4	7	2
Behavior/Discipline Problems	4	3	1
Distractible	3	7	4
Distracting to Others	3	2	1
Social Problems	3	1	2
Organizational Difficulties	2	3	0
Forgetful	1	2	0

Ineligible Group. The remainder of the participants referred for evaluation did not meet the criteria for inclusion in either the clinical or the sub-clinical group. There were 12 participants in the ineligible group of which 8 were male and 4 were female. Their parents initiated the referrals of 8 of the participants; the remaining 4 referrals were initiated by their teachers. There were 9 white children, 2 African American, and 1 African American/Hispanic in the ineligible group. Eight of these participants came from private schools, 3 from public schools, and 1 child was home-schooled. The average age of the group was 9.93 and the average IQ was 106.17 with a range of 86-136 and a standard deviation of 13.37. One participant from the ineligible group evidenced a written language learning disability.

The information on comorbidity from the three groups indicates that the greatest comorbidity existed in the clinical group (66%) and the least existed in the ineligible (8%) with the sub-clinical group falling in the middle (29%). This would suggest that greater symptoms of ADHD within the referred groups was consistent with greater comorbidity.

Control Group. There were 7 males and 8 females in the control group. The average age of the group was 9.73. All participants in this group were of average intelligence or higher.

Re-tested Participants. An attempt was made to retest each of the participants in the clinical and sub-clinical groups. Out of a possible 33 participants, 16 were retested. Attempts to retest the remaining 17 participants were unsuccessful due to either the inability to contact the parents or unwillingness by the parents to participate. Of these 16, 9 were from the clinical group and 7 were from the sub-clinical group. A follow-up

interview was conducted with one parent of each of the retested participants (see appendix C for a copy of the follow-up interview questions). One parent and one teacher were asked to complete Conners' Rating Scales-Revised, and the IVA and the TAT were re-administered to the children. The duration between the first and the second administration ranged from 11 to 22 months with the average being 15.65 months.

From the interview it was determined that there were several different approaches to helping these children overcome the problems identified at the initial referral. Five of the participants were placed on stimulant medication, four of them from the clinical group and one from the sub-clinical group. Behavioral intervention was used for three children from the clinical group and two from the sub-clinical group. Two children from the clinical group and one from the sub-clinical group received extra tutoring. One clinical child was changed from public school to home-school. In addition to receiving medication, one child from the clinical group received counseling. Five parents reported making no changes between the evaluations, one child from the clinical group and four from the sub-clinical group.

The parents of the children who received stimulant medication were the most positive about the changes that they perceived had occurred. They described the changes in the children as follows:

Attending well

Not misbehaving

Went from almost suspended in the 7th grade to not being in trouble in the 8th after beginning the medication

Much better socially

No trips to the office

Like a sponge in the classroom

The parents of the children from the behavioral intervention group and the group that received no intervention were less positive in their comments. Parents from the behavioral groups made the following statements:

Falls behind and can't catch-up less often

Very good year

Continues to seem depressed

Continues to be distractible, disorganized and has mood swings

Poorly motivated

Taking some initiative

Improvement in completing assignments

The parents of the children from the group that received no intervention reported the following:

Improved academically from F's to C's

Prepared for class

Conduct in school is better

No changes at all

Extremely poor organizational skills

Needs supervision to complete work

Hitting mother and grandmother

Measures

K-SADS. The Schedule for Affective Disorders and Schizophrenia for School Aged Children (K-SADS) is a semi-structured interview that asks parents about symptoms that they have observed in their children. Ambrosini (2000) indicates that there are several versions of the K-SADS in use including the K-SADS-E (Epidemiologic version), K-SADS-P/L (Present and Lifetime version), and K-SADS-P IVR (Present State version). The one utilized in this study was the K-SADS-P III-R (Ambrosini et al, 1989) which was the precursor to the K-SADS-P IVR. The K-SADS-P III-R was selected because it measures current symptoms and symptoms occurring in the previous 12 months. It also requests information regarding the severity and frequency of symptoms. The K-SADS-E and the K-SADS-P/L rate the presence or absence of a symptom and not the severity. In addition, the K-SADS-E assesses the most severe episode of symptoms as well as current symptoms (Ambrosini, 2000). The K-SADS-P III-R bases diagnoses on the symptoms for disorders from the DSM-III-R. The present study was begun prior to the revision of the K-SADS-P to include symptoms that were consistent with the DSM-IV. There were three symptoms added to the DSM-III-R diagnosis of ADHD when it was revised into the DSM-IV that were not a part of the K-SADS P-IIIR. The following questions were formed in keeping with the style of the K-SADS and added to include the three additional symptoms:

(1) Does your child tend to pay poor attention to detail or make careless mistakes?

(2) Does you child tend to avoid work that will involve sustained mental concentration?

(3) Is your child often forgetful?

The K-SADS is an interviewer-based-interview which means the examiner using the K-SADS has the flexibility to ask additional questions and adjust the interview in order to have a clear understanding of the symptoms being presented. Because it is an interviewer-based-interview experience with clinical interviewing of children with psychiatric disorders is important, as is familiarity with the K-SADS, to reliable administration (Hodges, McKnew, Burbach, Roebuck 1987). The examiner has had experience evaluating and treating children with emotional disorders in clinical settings and in the school system as well as experience working in an emergency room setting conducting psychiatric interviews of children and adults. The questions from the K-SADS correspond to DSM symptoms for various disorders including, depression, bipolar disorder, anxiety disorders, oppositional defiant disorder, attention deficit hyperactivity disorder, conduct disorder, and schizophrenia.

Responses by the parent were rated on a severity scale of either 0 to 4 or 0 to 6. The severity ratings are as follows for items that are rated from 0 to 6: 0-No information, 1-Not at all, 2-Slight (or occasionally), 3-Mild (sometimes), 4-Moderate (often), 5-Severe (most of the time), 6-Extreme (almost all of the time). For items that were rated from 0 to 4, the ratings were as follows: 0—No information, 1—Not at all, 2—Slight (or occasionally), 3—Mild/Moderate (sometimes/often), 4—Severe/Extreme (most/all of the time). The scores of 3-Mild and 4-Moderate were combined to become 3-Mild/Moderate as per the unpublished manual provided by Ambrosini (1992). The scores of 5-Severe and 6-Extreme were combined to become 4-Severe/Extreme. The items used to diagnose ADHD were all based on scores of 0 to 4. Ambrosini (1992) indicates that researchers

can decide between using 3 or 4 (Mild or Moderate) as the cut-off for symptom presence. Because scores of 3 and 4 were combined as 3 on items for ADHD, the present study used 3 as the cut-off for the presence of symptoms of ADHD. As per the DSM-IV, the criterion for the diagnosis of ADHD/Primarily Inattentive is the presence of at least six of nine behavioral symptoms. For ADHD/Primarily Hyperactive/Impulsive, the presence of at least six of the behavioral symptoms from the two categories of hyperactivity and impulsivity is required for diagnosis. For the Combined Type of ADHD the child needs to be positive for six symptoms in the inattentive category as well as six symptoms between the two categories of hyperactivity and impulsivity.

Reliability. Because of the developing nature of the K-SADS-P III-R, there is currently no published manual reporting reliability and validity. The researcher obtained the most recent version of the unpublished manual from the author (Ambrosini, 1992). In order to establish reliability for the K-SADS, Ambrosini et al. (1989) used two independent raters to diagnose 25 students. The first rater conducted the interview and the second rater watched a videotape of the interview. Half way through the subjects, the raters switched so that the first rater watched the video for the second half. Ambrosini et al. (1989) report interrater kappa scores between 0.83 and 0.92 for six of the seven most frequent diagnoses (major depression, minor depression, overanxious disorder, separation anxiety, oppositional disorder, and attention deficit). The kappa score for attention deficit disorder was .88. They also reported internal consistency Cronbach alpha scores of 0.82 for inattention, 0.82 for impulsivity, and 0.82 for hyperactivity. In a study of 26 adolescents at an outpatient clinic Chambers, Puig-Antich, and Hirsch (1985) reported test-retest kappa scores of 0.77 for major depression, 0.89 for minor depression, 0.72 for

separation anxiety, 0.46 for oppositional disorder, and 0.91 for attention deficit disorder. Ambrosini et al. (1989) and Chambers et al. (1985) suggest that these are acceptable interrater reliability scores. The K-SADS continues to be frequently used for the identification of ADHD as well as other clinical concerns (e.g. Ambrosini et al., 1999; Carlson and Kelly, 1998; Deas, Randall, Roberts, and Anton, 2000; Deas-Nesmith, Brady, and Campbell, 1998; Garralda, Rangel, Levin, Roberts, and Ukoumunne, 1999; Hamilton and Gillham, 1999; Masi, Mucci, Favilla, and Poli, 1999; Smalley et al., 2000; Williamson, Birmaher, Brent, Balach, Dahl, and Ryan, 2000; Yeschin, 2000).

Validity. Attempts to establish concurrent validity have involved the development of the concept of the best estimate diagnosis (Young, O'Brien, Gutterman, and Cohen, 1987). Because clinical interviews are a part of the best estimate diagnosis it is difficult to establish validity with the K-SADS. According to Gutterman, O'Brien, and Young (1987), the K-SADS has been used as a standard for other interviews to be measured against because it utilizes not only a comprehensive evaluation of symptoms and behaviors relevant to psychiatric disorders, but also allows flexibility for the clinician to clarify inconsistencies. In a study of 20 boys and 10 girls, Carlson et al. (1987) compared the K-SADS and the Diagnostic Interview for Children and Adolescents (DICA) to the best estimate diagnosis. The best estimate diagnosis was made at discharge based on the admission history, mental status, nursing observations, psychological testing results, hospital course and treatment. Two psychiatrists were utilized to make blind diagnoses of the children in this study. Table 3 presents the sensitivity, specificity and overall Kappa scores for the K-SADS. The sensitivity of the

K-SADS (its ability to correctly diagnose individuals) is quite acceptable except for the diagnosis of oppositional defiant disorder. The specificity of the K-SADS (the ability to correctly identify individuals that do not meet the criteria for a certain diagnosis) was acceptable for all diagnoses. The Kappa scores ranged from the low to the high range

Table 3

Comparison of K-SADS and best estimate diagnoses

Diagnosis	Sensitivity	Specificity	Kappa
Conduct Disorder	84%	82%	0.69
ADHD	100%	61%	0.56
Oppositional Defiant Disorder	14%	100%	0.16
All Affective Disorders	81%	79%	0.58
Overanxious Disorder	50%	92%	0.35
Separation Anxiety	100%	93%	0.44

Table adapted from Carlson et al. (1987).

except for oppositional defiant disorder and overanxious disorder. Hodges et al. (1987) suggests that it is widely accepted that kappa scores below .40 are considered low, scores between 0.40 and 0.59 are considered moderate, and scores 0.60 or greater are considered high. Overall, the K- SADS had a 70% agreement rate with the best estimate diagnosis. One conclusion that Carlson et al. (1987) reached was that both the K-SADS and the DICA overreported symptoms compared to the best estimate diagnosis.

Conners Rating Scales. The Conners' Parent Rating Scale-Revised (CPRS-R) and the Conners' Teacher Rating Scale-Revised (CTRS-R) were used in this study in order to provide information from both the home and school environments which is

necessary for diagnosing ADHD (Conners, 1997). For the initial evaluation the CPRS-R (S) and the CTRS-R (S) short forms were used. The CPRS-R (S) consists of 27 questions for which the possible responses are (0) not true at all, (1) Just a little true, (2) pretty much true, (3) very much true. The CTRS-R (S) consists of 28 questions with the same possible responses as the CPRS-R. Both the CPRS and the CTRS have the following sub-scales, Oppositional, Cognitive Problems/Inattention, Hyperactivity, and the ADHD Index. One parent and one teacher were asked to complete the Conners' Rating Scales for each participant.

The CPRS was normed on 2482 children between the ages of 3 and 17. The CTRS was normed on 1973 children with the same age ranges as the CPRS. Test-retest reliability scores range from .47 to .85 for the scales of the CPRS and .47 to .88 for the CTRS scales. Internal consistency ranged from 0.73 to 0.94 for the CPRS and 0.77 to 0.96 for the CTRS (Conners, Sitarenios, Parker, and Epstein; 1998a: Conners, Sitarenios, Parker, and Epstein; 1998b).

One problem with the CPRS and the CTRS is the Cognitive Problems/Inattention scale. If an individual scores in the significant range it can be difficult to know whether it was learning and cognitive problems or problems with attention. According to Conners' (1998) inattention and learning problems loaded on the same factor (as was true of the CBCL; Achenbach, 1991a, 1991b) resulting in the Cognitive Problems/Inattention Scale. Conners suggests that the two are likely to be closely related because attention problems will cause learning difficulties in elementary aged children.

In order to enhance cooperation with the retest, the CPRS-R (L) and the CTRS-R (L) long forms were used instead of the CPRS-R (S), the CTRS-R (S), the CBCL and the

TRF. The CPRS-R (L) consists of 80 questions with the same possible responses as the CPRS-R (S). It contains the same four scales, Oppositional, Cognitive Problems/ Inattention, Hyperactivity, and the ADHD index in addition to the following scales; Anxious-Shy, Perfectionism, Social Problems, Psychosomatic, Global Index: Restless-Impulsive, Global Index: Emotional Lability, and Global Index: Total. There are also three DSM-IV scales, Inattentive, Hyperactive-Impulsive, and DSM-IV Total. The CTRS-R (L) contains all of the above scales except for the Psychosomatic scale.

Child Behavior Checklist (CBCL) and Teacher Report Form (TRF). The CBCL (Achenbach, 1991a) was used for the initial assessment to assist in the process of differential diagnoses by providing scores for withdrawal, somatic complaints, anxiety, depression, social problems, thought disorder, attention problems, and delinquent and aggressive behavior. The Attention Problems scale of the CBCL combines attention items as well as items related to learning difficulties, and therefore, causes the same difficulty as the CPRS in separating attention from learning problems.

For the initial evaluation, one parent and one teacher were asked to complete the CBCL and the TRF (Achenbach, 1991a, 1991b) respectively. The two forms contain similar items and identical scales. Achenbach (1991a) reports the mean inter-parent agreement correlation between mother and father for all problem scales as .65 for girls and .75 for boys. In a study in which low and normal birthweight children were followed for two years, Achenbach (1991a) reports mean correlations for all problem scales of .75 for the one year interval and .71 for the two year interval indicating high stability of the measure. When interviewers were used, interclass correlation coefficient (ICC) of .959 for the problem scales was obtained. Test-retest reliability for the TRF was calculated

after a 15 day interval and resulted in a mean correlation of .92. The mean correlation reported over a two month period was .75, and over a 4 month period was .66 despite possible interventions. Teacher agreement yielded a mean correlation of .54 and agreement between a teacher and a teacher's aide resulted in a mean correlation of .55.

Reported validity for the CBCL includes correlations ranging from .59 to .86 with comparable scales on the Conners Parent Questionnaire (1973), and from .59 to .88 with the Quay-Peterson (1983) Revised Behavioral Problem Checklist. Achenbach (1991b) reports a correlation of .80 between the Attention Problems scale of the TRF and the Inattentive/Passivity scale of the Conners Revised Teacher Rating Scale (Goyette, Conners, and Ulrich, 1978). Both the CBCL and the TRF were able to separate referred from non-referred children (Achenbach, 1991a, 1991b).

Intermediate Visual and Auditory Continuous Performance Test. Each child included in this study was administered the Intermediate Visual and Auditory Continuous Performance Test (IVA). The IVA is a 13-minute continuous performance test that utilizes visual and auditory presentations. The individual is asked to click the mouse on a desktop computer when presented with a "1" either visually or aurally, and to not click the mouse when presented with a "2". Following a sub-test of simple reaction times, the subject is presented 500 trials in five sets of 100 trials each. Each set is split into two blocks of 50 trials each. Each trial lasts 1.5 seconds. The visual numbers are presented for 167 milliseconds (ms) and are about 1.5 inches high on a 14-inch color monitor. The auditory numbers are presented within 500ms. The first block of 50 trials on the IVA measures impulsivity. Among the 42 "1"s presented are mixed 8 "2"s to which the test taker must inhibit responding. During the second block of 50 trials, there are only 8 "1"s

while there are 42 "2"s. This block is considered to be a measure of inattention. The visual and auditory stimuli are reported to be in a "pseudo-random" combination (Sandford, 1995).

Reported in the manual for the IVA are reliability and validity data (Sandford, 1995). From a study of 70 individuals without neurological, psychological, learning, attention, or self-control problems, Sandford (1995) reports test-retest correlations between .37 and .75 for the six IVA Composite Quotient Scores. Test-retest correlations for 20 of the 22 IVA scale raw scores were significant ranging from .26 to .88. The test-retest scores for the IVA are in the acceptable range. In a study of validity, the IVA correctly identified 24 of 26 ADHD children ages 7-12 years old diagnosed as ADHD by a psychiatrist or psychologist (method of diagnosis not available) yielding a Sensitivity rate of 92%. The IVA also correctly identified 28 of 31 normal controls yielding a Specificity rate of 90% (Sanford, 1995). Sandford (1995) also reports 90% agreement rate between the IVA and the TOVA, 100% agreement with the Gordon CPT, 91.7% agreement with the CPRS-39, and 100% agreement with the Children's Attention Scale (CAS) when diagnosing ADHD. The rate of false negatives of the above measures when compared to clinician diagnosis was 7.7% for the IVA, 12.5% for the TOVA, 36% for the Gordon CPT, 45.5% for the CPRS-39, and 59.1% for the CAS.

The IVA produces 22 raw scale scores which form 4 categories for evaluating performance. The Response Control Quotient, the Attention Quotient, and the Validity Scales each utilized 6 of the raw scores to yield scores that are based on an average of 100 and a standard deviation of 15. The remaining 4 scales make up the Attribute Scale. The manual for the IVA indicates that a score below 80 on the Response Control

Quotient would result in a diagnosis of ADHD/Primarily Hyperactive/Impulsive Type. A score below 80 on the Attention Quotient would result in a diagnosis of ADHD/Primarily Inattentive Type. For this study the Response Control Quotient, the Attention Quotient, and the Fine Motor Regulation Quotient were used to compare with eligibility data from the K-SADS, the CBCL, the TRF, and the Conners' Rating Scales-Revised. The Fine Motor Regulation Quotient is a measure of off-task clicks of the mouse such as extra clicks during a trial, anticipatory clicks (response times < 70 ms), holding down the mouse, and spontaneous clicks during the Warm-up, Cool-down, or Practice periods. If either the auditory or the visual domain is considered invalid, the IVA provides an Auditory Response Control Quotient, a Visual Response Control Quotient, an Auditory Attention Quotient and a Visual Attention Quotient.

Thematic Apperception Test. The Thematic Apperception Test (TAT) consists of 30 pictures depicting one or more people in an emotionally ambiguous situation. The examinee is asked to generate a story to each of a selected group of pictures with the following instructions originally developed by Murray (1943) and adapted by Teglasi (1993),

> "I want you to tell me a story. Tell me a story about what is happening in the picture, what happened before that led up to the picture, how the story turns out and what the people are thinking and feeling. So, tell me a story with a beginning, middle, and an end."

The stories were recorded on a microcassette and transcribed verbatim including any questions or comments made by the examiner or the examinee. The cards that were administered to every subject and chosen for evaluation in this study are cards #1, 2,

3BM, 4, 5, and 8BM. The TAT stories were coded using the categories described below (for more detail see Teglasi, 2001).

Perceptual Integration. There are two aspects of perception that contribute to perceptual integration. First, the narrator needs to accurately identify the details and the emotional tension represented in the picture. Then, the narrator needs to be able to create a story that posits a meaningful relationship among the perceived elements. There are four levels that indicate increasing breadth of perceptual integration.

1. Discrepant. The premise of the story is not appropriate to the overall stimulus configuration as indicated by significant misperception of emotions and relationships depicted and/or by misreading or failing to recognize tensions in the stimulus.

2. Literal. Failure at this level is in the misperception of the implicit meaning of the stimulus. The emotions and ages of the characters are identified but without identifying or understanding the underlying processes that connect the various components of the story such as events, intentions, feelings and actions.

3. Imprecise. Here, the story generally captures the implications of the stimulus with respect to emotions and relationships and the tension state is recognized. However, the fit is not precise and may not match with subtle contextual cues or may not convey accurate cause-effect understanding.

4. Accurate. The accurate story incorporates all cues and subtleties in the interpretation of feelings and relationships and a meaningful interpretation is posited that accurately portrays the meaning of the picture.

Level of Abstraction in Explaining the Stimulus. "Abstraction is defined as the degree to which the internal representation of perceived objects (schemas) are detached from their concrete form" (Teglasi, 2001). Concrete thinking is tied to the stimulus while abstract thinking is freed from the context.

1. Enumerative Description. At this level the story teller merely names the details in isolated or irrelevant ways with no connecting theme.

2. Concrete Description. The elements and emotions of the story are related to each other in meaningful ways, but the narrator does not process the psychological intentions, purposes or impact of the emotions or the events.

3. Interpretive Explanation. The story connects the inner attributes and psychological process with the external events identifying motives, reasons, or causes. The ideas that are abstracted from the stimulus help to explain the interaction between the inner world and the specific events.

Level of Cognitive-Experiential Integration. Subsumed within the level of Cognitive-Experiential Integration are several constructs including attentional processes, meaningful interpretation of the stimuli, planning and monitoring of the story, time perspective, coherence of the story, coordination of inner (thoughts and emotions) and outer (events) elements of experience, and the coordination of different perspectives.

1. Disorganized. Impairment is evidenced in social information processing in any of the following ways: a) faulty interpretation of the picture, b) highly idiosyncratic or illogical assumptions about the self or the world (unrealistic events or contradictory ideas in the story), c) Poor or lacking monitoring of the flow of ideas, d) content is outside of social expectations, e) faulty reasoning such as putting ideas together

that are incompatible, f) inability of the narrator to understand the task, g) the narrator is unable to maintain distance from the stimulus.

2. Rudimentary. This level is indicated by simplified reasoning that incorporates minimal causal connections, feelings that are not explained beyond simple connection to the stimulus, differences in intentions and feelings are not indicated, vague outcomes, and unexplained feelings or transitions.

3. Superficial. At this level of integration, the story is socially appropriate but lacks "depth". A naïve, stereotyped or wishful view of events and relationships is evident. Actions are extrinsically driven by external incentives or consequences. The story may seem "borrowed" as if from a movies, a book, or from an actual experience of the narrator.

4. Realistic. The story is organized in realistic and practical ways that are conceptually clear and specific. Inner states, actions and outcomes are reconciled in the sequence of events. Characters act towards a clear purpose, but intrinsic sources of motivation and satisfaction are not as prominent as in the highest level.

5. Complex and Responsible. Inner (feelings and thoughts) and outer (actions and outcomes) worlds are well coordinated within and across individuals. An understanding of the complexities of the psychological world is reflected in the balance of long and short term needs, aspirations, intentions, actions and outcomes of the various characters. Self-development, consideration of other's feelings, and a desire to contribute to improving social conditions may be reflected in the goals of the characters.

Level of Associative Thinking. Associative thinking in the evaluation of TAT stories refers to the way in which the sequence of ideas is generated. The progression of

ideas and the schema that underlie that progression are the source of evaluating the level of associative thinking. The way in which the sequence of ideas is generated in the story is coded into one of five levels according to the cohesiveness and causal connections of the ideas to the story.

1. Tangential Association. At this level, one idea is triggered by another without causal connection and without contributing to or being based on a central concept. Stories are marked by loose or tangential associations. Poor control over attentional and cognitive processes interferes with the integration of ideas. Content may be personalized or irrelevant.

2. Linear Association. Ideas that are triggered by previous ones rather than by an organizational framework are linearly associated. Unfocused sequences of ideas are not organized around the task demand. A difficulty shifting from one dimension of experience to another is characteristic of linear association. Proximal story details may be connected but there is a lack of conceptual coherence to the story.

3. Patterned Association. Ideas are triggered by patterns of regularities in experience or by story lines. The story teller may borrow story lines from a familiar movie, television show, or from his/her own experience in order to avoid generating an original story. The progression of the story, therefore, does not need to be monitored by the story teller, and there may be a limited understanding of social causality evidenced.

4. Logical Association. The organized processing of ideas evidenced at this level of association reflects well developed schema that underlie the sequence of the story. Details and transitions are tied together with various dimensions of experience into a common context. Causal reasoning is evident and logical.

5. Integrative Association. This level of associative thinking is characterized by a greater level of organization around a central theme. Well integrated schemata connect intentions, actions, and outcomes as ideas shift conceptually.

In order to illustrate the scoring system two stories from one of the children from the clinical group followed by two stories from one of the control group children will be presented. Both children were boys between seven and one-half and eight years old with at least average IQs.

Clinical Child

Card 1: The person is sad and he's looking at his violin (okay what happened before) he was playing the violin (okay what happens) um he is probably playing, playing sad music and he's still sad (what's going to happen, how does it turn out) um even sadder.

Perceptual Integration: Level 2—Literal: In this story the implicit meaning of the picture which is the frustration over having to play the violin, is not indicated. In addition, there is no integration between the boy, his actions and his feeling sad.

Level of Abstraction: Level 2—Concrete: The narrator goes beyond merely naming the items in the picture in identifying the emotion being felt; however, there is no processing of the intentions or purposes of the emotions.

Cognitive-Experiential Integration: Level 1—Disorganized: The narrator misinterpreted the emotional content of the picture.

Level of Associative Thinking: Level 2—Linear: Each thought is triggered by the previous thought and the ideas are unfocused.

Card 2: Umm, the, the boy might mow the lawn or might clean the vegetables and stuff and the girl she um she able she might read those books (okay what happened before) uh, he was probably mowing the grass (what's going to happen how does it turn out) uh, he will probably go to the barn that's it (what are they thinking and feeling) they are probably feeling sad and hot.

Perceptual Integration: Level 1—Discrepant: The perception of a boy mowing the lawn is discrepant from the picture where the older male in the picture is seen with a horse.

Level of Abstraction: Level 1—Enumerative: The narrator is merely describing the scene with no connection between the characters or the emotions felt and there is no elaboration beyond the description.

Cognitive-Experiential Integration: Level 1—Disorganized: There is a faulty interpretation of the picture and a lack of flow of ideas and sequence of events.

Level of Associative Thinking: Level 1—Tangential: The ideas in this story are triggered by each other and by the questioning by the examiner and there is no connection between the ideas.

Normal-Control Child

Card 1: Once upon a time there was a boy who just started school and he wanted to play music and he didn't know how to play the violin. Then he felt sad that other kids next to him knew how to do it. Then he starts studying how to play it and he learns how to play it. Then he started playing the flute and he learned how to play that

because his father taught him. He said he liked to play the flute better. That made his father happy that he liked the flute better and now they can play music together.

Perceptual Integration: Level 4—Accurate: In this story, the narrator has correctly perceived that a boy is having trouble with a violin. He has identified that the boy is frustrated because he wants to play but does not know how to play the violin. The frustration precedes the sadness.

Level of Abstraction: Level 3—Interpretive: this story connects the inner world "he didn't know how to play" and "he wanted to play" with the events of the story.

Cognitive-Experiential Integration: Level 4—Realistic: The story is realistic and reconciles the feelings and motivations of the character and integrates the feelings of the father who is not pictured.

Level of Associative Thinking: Level 4—Logical Association: The ideas are organized and centered on the theme of learning how to play an instrument.

Card 2: Once upon a time there lived a girl who's name was Sally. She went to school and she had straight A's and she lived on a farm and one day her father and mother was planting some corn. Then she thinked to herself could I do this? Then the next day she tried it. Then she planted a apple tree. Then her mother and father were glad. Then she helped her mother and father plant other things. Sally felt happy and the mother and father felt happy too.

Perceptual Integration: Level 4—Accurate: The narrator has correctly identified the people, the school books, and the farm and has integrated them into a family.

Level of Abstraction: Level 3—Interpretive: The story moves beyond being descriptive to what the family will be doing together. The psychological processes "thinked to herself could I do this?" and emotions of feeling happy about accomplishments are abstracted from the picture but connected to the stimulus and the story.

Cognitive-Experiential Integration: Level 4—Realistic: The people, the background, the thoughts and feelings are all integrated into a story that is realistic.

Level of Associative Thinking: Level 4—Logical Association: The story is centered around the farm and the family and how the girl is connected to both. The ideas, while somewhat simplistic, flow out of the premise of the story.

Other Measures. In order to provide a comprehensive evaluation, the Wechlser Intelligence Scale for Children-Third Edition (WISC-III; Wechsler, 1993), either the Woodcock-McGrew-Werder Mini-Battery of Achievement (MBA; Woodcock, McGrew, and Werder, 1994) or the Woodcock Johnson-Revised Tests of Achievement (Woodcock and Johnson, 1990), and the Bender Visual-Motor Gestalt Test (Bender, 1938) were administered. The MBA was administered unless the parents indicated that the child had a learning problem that was not due to ADHD. In such cases the Woodcock-Johnson-Revised Tests of Achievement provided a broader sense of where the learning problem may be. Reliability and validity data on these instruments are well established. Generally, the Bender Visual-Motor Gestalt Test was administered first, followed by the WISC-III. The IVA was administered half way through the first session to insure that the novelty of the assessment had dissipated. The appropriate achievement test was then administered followed by the TAT.

Results

Interrater Reliability

In order to establish interrater reliability, the examiner was trained on the TAT scoring system developed by Teglasi (1993, 2001). The TAT stories of 12 students unrelated to the current study were evaluated. Acceptable interrater reliability scores were achieved before the TAT stories of this study were evaluated (interclass correlation coefficient (ICC) alphas for Perceptual Integration $\alpha = .9511$, Level of Abstraction $\alpha = .8713$, Cognitive-Experiential Integration $\alpha = .9578$, and Level of Associative Thinking $\alpha = .9729$). In order to assure continued interrater reliability during this study, the TAT stories of six of the participants were scored by Teglasi. There was an average of 6.5 cards per subject evaluated for interrater reliability. Reliability between the examiner and Teglasi were in the acceptable range as follows; $\alpha = .8693$ for Perceptual Integration, $\alpha = .8079$ for Level of abstraction, $\alpha = .8179$ for Cognitive-Experiential Integration, and $\alpha = .8100$ for Level of Associative Thinking. Reliability of .80 or higher is considered adequate (Feldt and Brennan, 1989).

In addition to interrater reliability, several of the TATs were rescored by the author to determine the extent to which the scoring was reliable over time. There was a two month interval between the first and second scoring by the author. The ICC alpha scores between the first and second scoring by the author are, $\alpha = .8714$ for Perceptual Integration, $\alpha = .7135$ for Level of Abstraction, $\alpha = .8218$ for Cognitive-Experiential Integration, and $\alpha = .8037$ for Level of Associative Thinking. Finally, interrater reliability was again calculated comparing the author's second scoring with Teglasi's scoring resulting in the following, $\alpha = .8219$ for Perceptual Integration, $\alpha = .8497$ for

Level of Abstraction, α = .8475 for Cognitive-Experiential Integration, and α = .7882 for Level of Associative Thinking. The combination of these results suggests adequate interrater reliability.

Table 4

Inter- and intra- rater reliability

TAT Variable	A1 with Teglasi	A1 with A2	A2 with Teglasi
Perceptual Integration	.8693	.8714	.8219
Level of Abstraction	.8079	.7135	.8497
Cognitive-Experiential	.8179	.8218	.8475
Associative Thinking	.8100	.8037	.7882

Note: A1 = first scoring by the author; A2 = second scoring by author

Correlations

There were no correlations between the four cognitive variables of the TAT and any of the IQ scale scores or any of the subtest scores. Correlations of all of the variables used to diagnose ADHD were calculated in order to determine how these variables related to each other. Table 5 shows the means and standard deviations for these variables. As discussed in the introduction, the diagnosis of ADHD is complicated and no single measure is adequate. The results indicate that there was no significant correlation between age and any of the variables used to categorize the sample including the K-SADS, the Child Behavior Checklist, the Teacher Report Form, and the Conners' Parent and Teacher Rating Scales-Revised. It was anticipated that age would not be correlated with any of these variables except possibly the K-SADS because participants

Table 5

Ns, means, and standard deviations for ADHD diagnostic variables

Measure	N	Mean	Standard Deviation
K-SADS Inattentive	37	6.919	1.722
K-SADS Hyperactive/Impulsive	37	4.027	2.619
CBCL Parent Attention Problems	36	67.220	10.10
Teacher Report From Attention	31	65.52	8.53
Conners' Parent Cognitive/ Inattention	37	72.35	8.83
Conners' Parent Hyperactivity	37	64.16	14.29
Conners' Parent ADHD Index	37	70.78	8.10
Conners' Teacher Cognitive/Inattention	32	60.62	12.80
Conners' Teacher Hyperactivity	32	64.09	15.81
Conners' Teacher ADHD Index	32	69.34	10.89
IVA Full Scale Response Quotient	38	96.18	14.39
IVA Full Scale Attention Quotient	38	79.58	21.35
IVA Fine Motor Regulation	38	91.21	24.69

were compared to individuals of the same age. The Full Scale Attention Quotient (FSAQ) of the IVA correlated with age (r = .388) as well as the Auditory and Visual Attention Quotients (r = .369 and .354 respectively) which are combined to make up the FSAQ. The IVA also compares individuals with others of the same age; therefore, the correlations between age and attention on the IVA are not based on age alone. Therefore, the older participants in this study were less able to attend as measured by the FSAQ

when compared to their peers than were the younger participants when compared to their peers.

The following three tables show the correlations between all of the variables used to measure and identify ADHD including the K-SADS, The Child Behavior Checklist, the Teacher Report From, the Conners' Rating Scales (parent and teacher), and the IVA. As stated previously, age correlated only with the Full Scale Attention Quotient of the IVA, and therefore, age was not included in these tables. Table 6 shows that the three separate measures of attention provided by the parents, the K-SADS, the Child Behavior Checklist, and the Conners' Parent Rating Scale, were all correlated and also correlated with the CPRS-R ADHD Index. Additionally, none of the attention measures were correlated with the measures of hyperactivity; however, the two measures of hyperactivity were correlated with each other. Parental ratings were consistent across all three measures for both attention and hyperactivity.

Table 7 shows the correlation between the separate measures completed by teachers. The data from the six home-schooled participants were not included in this analysis because these questionnaires were completed by the parent. The two attention variables (Teacher Report Form Attention Problems and Conners' Teacher Rating Scale Cognitive/Inattentive Scale) were correlated with each other but not with the CTRS-R ADHD Index. The CTRS-R Hyperactivity Scale was correlated with the ADHD Index but not with the attention scales. These results indicate that teachers were consistent in their reporting of participants' behavior across measures.

Table 6

Correlation of attention and hyperactivity variables as reported by parent

Variable	K-SADS Inattentive	K-SADS Hyperactive	CBCL Attention	CPRS-R Cog/Inatt.	CPRS-R Hyperactive
K-SADS Hyp.	-.203 (44)	--			
CBCL Attention	.393* (41)	-.056 (41)	--		
CPRS-R Cog/Inatt.	.462** (41)	-.231 (41)	.481** (40)	--	
CPRS-R Hyp.	-.090 (41)	.645** (41)	.273 (40)	.151 (43)	--
CPRS-R Index	.438** (41)	.106 (41)	.613** (40)	.797** (43)	.535** (43)

Note: Number of participants is in parentheses.

*p < .05. **p < .01

Table 7

Correlation of attention and hyperactivity variables as reported by teachers

Teacher Questionnaires	TRF Attention	CTRS-R Cog/Inatt	CTRS-R Hyperactivity
CTRS-R Cog/Inatt	.432* (29)	--	
CTRS-R Hyperactivity	.099 (29)	-.008 (32)	--
CTRS-R ADHD Index	.306 (29)	.263 (32)	.849** (32)

Note: Number of participants is in parentheses.

*p < .05. **p < .01.

The correlation between the parent and teacher scores for inattention and hyperactivity are reported in table 8. The Conners' Parent Cognitive/Inattention scale was significantly correlated with the Conners' Teacher Cognitive/Inattentive scale. The way in which parents described their children as hyperactive on the K-SADS correlated significantly with the way in which their teachers described them on the Conners'

Teacher Hyperactivity scale. Overall, there was good intra-parent and intra-teacher agreement on the attention and hyperactivity measures, however, there was little agreement between the parents and the teachers.

Table 8

Cross-correlation of parent by teacher for attention and hyperactivity variables

	Teacher Variables			
Parent Variables	TRF Attention	CTRS-R Cog/Inatt	CTRS-R Hyperactivity	CTRS-R ADHD Index
K-SADS Inattention	.173 (30)	.127 (30)	.129 (30)	.033 (30)
K-SADS Hyperactivity	.112 (30)	.333 (30)	.376* (30)	.094 (30)
CBCL Attention	.117[a] (29)	-.052 (30)	.052(29)	-.105 (29)
CPRS-R Cog/Inattention	.262 (30)	.356*[a] (32)	-.125 (32)	.070 (32)
CPRS-R Hyperactivity	-.064 (30)	-.164 (32)	.343[a] (32)	.159 (32)
CPRS-R ADHD Index	.273 (30)	.132 (32)	.222 (32)	.258[a] (32)

Note: Number of participants is in parentheses.

[a]Represents parent and teacher versions of the same instrument.

*p < .05. **p < .01.

IVA. A total of 21 participants out of 45 possible scored in the significant range for ADHD on the IVA. The IVA identified 10 of the 15 subjects in the clinical group as ADHD. One of the children from the clinical group was unable to complete the IVA due to the inability to sit still and focus on the test, resulting in missing data from the IVA for this child. Of the 10 clinical children identified as ADHD, 7 were identified as ADHD/Primarily Inattentive. These 7 were similarly identified by the other measures. One participant who was identified as ADHD/ Primarily Hyperactive by the other measures fell into the ADHD/Primarily Inattentive category according to the IVA. One

child was identified as ADHD/Combined by both the IVA and the other measures, and one child who was identified as Primarily Inattentive by the other measures was categorized as ADHD/Combined by the IVA. The remaining 11 subjects were from the sub-clinical or ineligible groups. From the sub-clinical group, 7 of the 18 children were identified as ADHD by the IVA, and only 4 of the 12 in the ineligible group were identified as ADHD.

The three variables used to identify ADHD on the IVA, Full Scale Response Quotient (FSRQ), Full Scale Attention Quotient (FSAQ), and Fine Motor Regulation (FMR), were significantly correlated with each other (FSRQ with FSAQ r = .561; FSRQ with FMR r = .553; FSAQ with FMR r = .508). FSAQ also correlated with the Attention scale of the Teacher Report Form (r = -.403) and with the Cognitive Problems/Inattentive scale of the Conners' Teacher Rating Scale (r = -.400). There were no further correlations between IVA variables and the K-SADS, the Child Behavior Checklist, the Teacher Report Form, Conners' Parent or Teacher Rating Scales. These correlations confirm that a different set of participants were identified by the IVA when compared to the other measures of ADHD. If the IVA had been used as the sole criterion to qualify individuals for the clinical group for this study, there would have been 21 clinical subjects, 11 of whom were not eligible based on the other measures. The IVA, in general, agreed with other measures of ADHD; however, there were 5 false negatives and 11 false positives assuming that the other measures were accurate in diagnosing ADHD. Based on these results and in keeping with the literature on continuous performance tests, caution should be observed in using the IVA as the sole criterion for diagnostic purposes.

Factor Analysis

To examine how the various components of attention and hyperactivity cluster together, a factor analysis of all of the diagnosing variables along with the TAT and IVA variables was calculated. The data from the six home schooled children were excluded from the factor analysis because the teacher information was supplied by the parents. Four factors emerged that had eigenvalues of greater than 1.00 and together explained 71% of the variance (see table 9). The measures that loaded on each component are presented in table 9. All four of the TAT variables loaded highly on the first component and no other variables loaded on this component indicating a cognitive processing variable. The second component consisted of loadings from the three IVA variables as well as the teacher reports of inattention (Teacher Report Form Inattention and Conners' Teacher Cognitive Problems/Inattention scales). The third factor consisted of only the three measures of hyperactivity as reported by the parents and the teachers. The fourth component consisted of loadings from the three scales on which parents reported attention. The first four factors are cognitive processing, performance on a CPT coupled with teachers' perception of inattention, hyperactivity, and parents' perception of inattention. These four factors accounted for 27%, 18%, 15%, and 12% of the variance respectively.

TAT. The TAT variables were highly correlated with one another as is shown in table 11. It is understandable that these variables would be highly correlated because they are each measuring related aspects of cognitive processing. All four TAT variables were positively correlated with gender with girls scoring significantly higher than boys

Table 9

Varimax orthogonal factor loadings; four-factor solution of attention and hyperactivity [a]

Item	Component			
	1	2	3	4
Cognitive/Experiential Integration	**.911**	.164	-.164	.137
Level of Abstract Thinking	**.856**	.101	.306	-.008
Level of Associative Thinking	**.855**	-.120	.221	-.129
Perceptual Integration	**.846**	.238	-.199	-.133
IVA FSAQ	.229	**.823**	.169	-.006
IVA FSRQ	-.006	**.785**	-.173	.116
IVA Fine Motor Regulation	.341	**.665**	-.003	-.233
CTRS-R Cognitive/Inattentive	.007	**-.651**	-.519	-.141
TRF Attention Problems	-.003	**-.583**	.006	.237
K-SADS Hyperactive/Impulsive	.004	-.115	**.891**	-.007
CPRS-R Hyperactivity	.142	.004	**.810**	.009
CTRS-R Hyperactivity	-.006	.002	**.684**	-.292
CBCL Attention Problems	-.175	.143	.181	**.828**
K-SADS Inattentive	.001	-.188	-.134	**.749**
CPRS-R Cognitive/Inattentive	-.002	-.237	-.398	**.682**
Eigenvalues	3.996	2.657	2.239	1.767
Percent of variance	26.64	17.71	14.93	11.78

Note: Extraction method: principle component analysis, rotation method: Varimax with Kaiser normalization.

[a.] Rotation converged in 6 iterations.

Table 10

Ns, means, and standard deviations for age and TAT

Variable	N	Mean	Standard Deviation
Age	59	9.851	1.807
Perceptual Integration	50	15.220	4.669
Level of Abstraction	50	13.840	2.965
Cognitive-Experiential	50	13.110	4.661
Associative Thinking	50	13.680	4.580

on all four TAT variables. Age was correlated with Perceptual Integration, Level of Abstraction, and Cognitive-Experiential Integration, but not with Level of Associative Thinking. It is expected that cognitive processing ability, such as is being measured by the TAT, would increase with age. It is unclear why Level of Associative Thinking did not increase with age. Of all of the measures of ADHD (K-SADS, Child Behavior Checklist, Teacher Report Form, Conners' Parent and Teacher Rating Scales, and IVA) the TAT correlated only with the Full Scale Attention Quotient (FSAQ) of the IVA (see table 12). Perceptual Integration, Level of Abstraction, and Cognitive-Experiential Integration were significantly correlated with the FSAQ of the IVA but Associative Thinking was not. The FSAQ is made up of the Vigilance, Focus and Speed subscales. The Vigilance subscale represents the number of omission errors (i.e. not responding to the target during blocks when the targets are few). Focus is a measure of the variation in response time which indicates the individual's attention to the task is unreliable. Speed is a measure of the average reaction time for correct responses to the target and represents

Table 11

Intercorrelation of TAT variables for the total sample and by group

Group	Variable	Age	Gender	Perceptual Integration	Level of Abstraction	Cognitive/ Experiential
Total	PI	.396**	.415**	--		
	AB	.408**	.343*	.792**	--	
	CE	.358**	.389**	.902**	.809**	--
	AT	.231	.356*	.777**	.788**	.857**
Clinical	PI	.508	.770**	--		
	AB	.553*	.542*	.838**	--	
	CE	.496	.698**	.966**	.801**	--
	AT	.245	.651*	.813**	.697**	.816**
Sub-clinical	PI	.710**	-.029	--		
	AB	.588*	.097	.873**	--	
	CE	.666**	-.020	.939**	.918**	--
	AT	.509	.021	.844**	.909**	.915**
Ineligible	PI	.582	.306	--		
	AB	.665*	-.119	.342	--	
	CE	.164	.011	.490	.441	--
	AT	.111	-.270	-.080	.641*	.492

(Table 11 continues)

(Table 11 continued)

Group	Variable	Age	Gender	Perceptual Integration	Level of Abstraction	Cognitive/ Experiential
Control	PI	.269	-.536	--		
	AB	-.138	-.134	.702*	--	
	CE	.388	-.187	.875**	.606	--
	AT	.239	-.082	.819**	.689*	.937**

Note: PI = Perceptual Integration, AB = Level of Abstraction, CE = Cognitive/ Experiential Integration, AT = Level of Associative Thinking

*p < .05. **p < .01.

discriminatory processing speed throughout the entire test (Sandford, 1995). However, it should be noted that there was a restricted range for these correlations as the analysis was conducted only with the referred children because attentional measures were not available for the control group.

Analysis of Variance

A four (groups) by two (gender) MANCOVA with age as a covariate was used to test differences on the four TAT scores which comprise the first four hypotheses stated in the introduction. Age was used as a covariate because of its significant correlations with three of the four TAT variables. The analysis of the data for homogeneity of regression slopes resulted in no significant differences between the slopes indicating that the assumption of homogeneity was met. Using all 6 of the TAT cards resulted in very small Ns in some of the cells due to different sets of cards being administered for the control

group. Therefore, Table 13 reports the Ns, means, and standard deviations based on stories 1, 2, 3BM, and 4.

Table 12

Correlations of diagnostic measures of ADHD with TAT variables

Measures	N	Perceptual Integration	Level of Abstraction	Cognitive/ Experiential	Associative Thinking
K-SADS Inatt.	39	.029	-.025	.061	-.011
KSADS- Hyp.	39	-.185	.098	-.146	-.059
CBCL Attention	37	-.185	-.286	-.120	-.245
TRF Attention	37	-.170	-.019	-.085	-.002
CPRS Cog/Inatt	38	.040	-.110	.019	-.040
CPRS Hyperactivity	38	.050	.122	-.041	.046
CPRS Index	38	.082	-.025	.052	.022
CTRS Cog./Inatt.	32	.131	.027	.174	.233
CTRS Hyperactivity	32	-.004	.170	.034	.188
CTRS Index	32	.193	.307	.223	.311
IVA FSRQ	39	.203	.118	.125	-.079
IVA FSAQ	39	.365*	.386*	.344*	.221
IVA FMR	39	.127	.090	.093	.031

Note: Correlations do not include control group; Inatt. = Inattention; Hyp. = Hyperactivity; Cog/Inatt. = Cognitive/Inattention Problems; FSRQ = IVA Full Scale Response Quotient; FSAQ = IVA Full Scale Attention Quotient; FMR = IVA Fine Motor Regulation

*p. < .05.

Table 13

TAT Ns, Means, and Standard Deviations for groups by gender

			Perceptual Integration		Level of Abstraction		Cognitive/ Experiential		Associative Thinking	
Group	Sex	N	M	SD	M	SD	M	SD	M	SD
Clinical	M	7	5.93	1.17	7.21	1.91	5.50	1.38	6.43	1.99
	F	8	11.25	3.12	9.56	2.23	10.12	2.86	9.25	1.77
	T	15	8.77	3.60	8.47	2.35	7.97	3.26	7.93	2.32
Sub-clin.	M	13	8.42	3.20	8.27	2.42	7.46	2.69	7.27	2.20
	F	4	8.25	1.71	8.50	1.29	7.37	1.11	7.00	2.00
	T	17	8.38	2.87	8.32	2.17	7.44	2.38	7.21	2.10
Ineligible	M	8	9.56	2.19	9.00	1.07	7.37	1.30	8.75	1.58
	F	4	9.75	2.36	8.25	1.26	7.50	2.08	7.75	0.50
	T	12	9.62	2.14	8.75	1.14	7.42	1.50	8.42	1.38
Control	M	6	13.50	2.59	10.50	1.52	12.00	2.76	12.00	2.53
	F	8	14.12	0.99	11.00	1.07	12.94	2.73	12.87	3.48
	T	14	13.86	1.79	10.79	1.25	12.54	2.68	12.50	3.03

Note: Scores are based on TAT cards 1, 2, 3BM, & 4 only.

The MANCOVA reveals that there were significant group differences for each of the four TAT variables (see Table 14). In order to determine which groups differed, post-hoc independent-samples T test with Bonferroni corrections were calculated. This procedure was chosen to reduce the risk of committing Type I errors as a result of computing multiple comparisons (Stevens, 1986). As hypothesized, post hoc analysis reveals that the children identified as having ADHD by this study (the clinical group)

differed significantly from the control group (see table 15). The other two referred groups (the sub-clinical and ineligible groups) were also significantly different from the control group; however, there were no significant differences between the three referred groups on any of the four TAT variables. The four cognitive processing variables of the TAT were able to discriminate between children referred for evaluation of attention problems and non-referred children; however, these variables were unable to discriminate between the referred groups.

As can be seen in table 14, there were also significant gender differences for Perceptual Integration and Cognitive/Experiential Integration. There was, however, no multivariate difference between the genders increasing the potential Type I error in rejecting the null hypothesis based on the univariate results. These gender differences are clarified by the significant group by gender interaction effects on Perceptual Integration and Cognitive/ Experiential integration, but not on Level of Abstraction or Associative Thinking. However, there was no multivariate difference for the interaction of group and gender indicating the need for caution in interpreting the univariate differences. The group and gender interaction effect for the TAT was the result of the differences between males and females in the clinical group only with females scoring higher than males. An ANCOVA was run for the clinical group to determine the extent of the gender differences. Significant differences were noted between males and females on Perceptual Integration $F(1, 14) = 18.00$, $p < .01$, Cognitive/Experiential Integration $F(1, 14) = 13.67$, $p < .01$, and Level of Associative Thinking $F(1, 14) = 7.31$, $p < .05$, but not for Level of Abstraction $F(1, 14) = 3.86$, $p > .05$. Similar ANCOVAs run for the other three groups

Table 14

MANCOVA of group, gender, interaction on TAT variables while keeping age constant

Source	Dependent Var.	df	F[a]	Significance
Group	Multivariate	12	4.266	.000**
	Perceptual Integration	3	20.407	.000**
	Level of Abstraction	3	6.872	.001**
	Cognitive/Experiential	3	18.508	.000**
	Associative Thinking	3	16.953	.000**
Gender	Multivariate	4	1.898	.127
	Perceptual Integration	1	5.741	.020*
	Level of Abstraction	1	1.363	.249
	Cognitive/Experiential	1	5.087	.029*
	Associative Thinking	1	.893	.349
Group X Gender	Multivariate	12	1.159	.318
	Perceptual Integration	3	4.099	.011*
	Level of Abstraction	3	1.403	.253
	Cognitive/Experiential	3	2.888	.045*
	Associative Thinking	3	1.495	.228

Note: Scores are based on TAT cards 1, 2, 3BM, & 4 only. Multivariate F ratios were generated from Pillai's statistic.

[a]Multivariate df = 12, 144 for group and for group by gender interaction, 4, 46 for gender. Univariate df = 3, 49 for group and group by gender interaction, 1, 49 for gender.

* p. < .05; **p. < .01.

resulted in no significant gender differences. Caution is necessary in interpreting these data because there was no significant multivariate differences noted.

Table 15

Post hoc (independent-samples T test with Bonferroni correction) analysis

	Clinical		Sub-clinical		Ineligible		Control	
TAT Variable	M	SD	M	SD	M	SD	M	SD
Per. Int.	8.77_{a}	3.60	8.38_{b}	2.87	9.62_{c}	2.14	$13.86_{a,b,c}$	1.79
Abst. Think.	8.47_{a}	2.35	8.32_{b}	2.17	8.75_{c}	1.14	$10.79_{a,b,c}$	1.25
Cog./Exp.	7.97_{a}	3.26	7.44_{b}	2.38	7.42_{c}	1.50	$12.54_{a,b,c}$	2.68
Assoc. Think.	7.93_{a}	2.32	7.21_{b}	2.10	8.42_{c}	1.38	$12.50_{a,b,c}$	3.03

Note. Means in row sharing subscripts are significantly different. Per. Int. = Perceptual Integration; Abst. Think. = Abstract Thinking; Cog./Exp. = Cognitive Experiential Integration; Assoc. Think. = Associative Thinking.

An ANOVA was run to determine if there were any group differences for the measures of ADHD (K-SADS, Child Behavior Checklist, Teacher Report Form, Conners' Parent and Teacher Rating Scales, and IVA) between the three referred groups. Because these variables were used to separate the clinical group from the sub-clinical and the ineligible groups differences between the groups were expected. There were indeed significant group differences noted for the CBCL Parent Attention Problems $F(2, 40) = 9.84$, $p < .01$, the TRF Attention Problems $F(2, 40) = 14.18$, $p < .01$, the CPRS-R Cognitive/Inattentive scale $F(2, 40) = 4.34$, $p < .05$, the CTRS-R Cognitive/Inattentive scale $F(2, 40) = 5.45$, $p < .01$, and the CTRS-R Hyperactive scale $F(2, 40) = 4.48$, $p < .05$ with the clinical group scoring higher than the other two groups on each of these scales.

There were no significant differences for the K-SADS Inattentive, the K-SADS Hyperactive, or the CPRS-R Hyperactive scales. The measures used to diagnose ADHD separated the groups on five out of eight of the scales identifying the clinical group as more impaired than the other two groups.

An ANOVA was run to determine if there were differences between the three referred groups on intelligence or achievement. Table 16 presents the descriptive statistics for IQ and achievement scores. There were no significant differences noted between groups on IQ or achievement (see table 17).

Follow-up.

At the completion of the present study and for exploratory purposes, 16 participants were retested to note any changes that might have occurred following intervention provided a sufficient number per intervention group. The TAT, the CPRS-R, the CTRS-R, and the IVA were readministered. Of these 16, 5 were placed on medication, behavior modification was used with 5 of them, and 5 participants received no intervention. One of the students was switched from public school to home schooling with no other intervention employed and was therefore not grouped with the others.

To explore possible differences due to intervention (despite small Ns) the three groups were compared with each other. Descriptive statistics for age, IQ, and the number of months between the first and second administrations are presented in table 18. An ANOVA indicated significant differences between the groups in age ($F_{2,12} = 4.194$, $p < .05$) but not in IQ or in the length of time between assessments. Tukey HSD post hoc analysis revealed that the behavioral group was significantly older than the no intervention group.

Table 16

IQ and achievement descriptive statistics by group

Variable	Group	N	M	SD
Full Scale IQ	Clinical	15	100.80	13.77
	Sub-clinical	18	97.83	11.60
	Ineligible	12	106.17	13.37
	Total	45	101.04	12.98
Verbal IQ	Clinical	15	101.73	14.72
	Sub-clinical	18	102.17	12.28
	Ineligible	12	106.67	12.97
	Total	45	103.22	13.18
Performance IQ	Clinical	15	99.93	14.80
	Sub-clinical	18	93.72	11.73
	Ineligible	12	104.92	13.17
	Total	45	98.78	13.69
MBA Reading	Clinical	14	103.21	13.99
	Sub-clinical	18	109.11	9.55
	Ineligible	11	111.36	10.43
	Total	43	107.77	11.60
MBA Writing	Clinical	14	96.36	8.10
	Sub-clinical	18	94.06	11.18
	Ineligible	11	93.82	14.50
	Total	43	94.74	11.06

(Table 16 continues)

(Table 16 continued)

IQ and achievement descriptive statistics by group (continued)

Variable	Group	N	M	SD
MBA Math	Clinical	14	104.64	15.31
	Sub-clinical	18	103.83	17.53
	Ineligible	11	108.91	16.18
	Total	43	105.40	16.24

Table 17

ANOVA of group IQ and achievement scores

Source	Variable	df	F	Sig.
Group	Full Scale IQ	2	1.532	.230
	Verbal IQ	2	.552	.580
	Performance IQ	2	2.677	.080
	MBA Reading	2	1.794	.179
	MBA Writing	2	.214	.808
	MBA Math	2	.345	.710

Note: Error df for IQ scores was 42. Error df for MBA scores was 40. MBA = Woodcock-McGrew-Werder Mini-Battery of Achievement.

Table 18

Age and IQ statistics for retested group

Variable	Group	Minimum	Maximum	Mean	S D
Age	Medication	7.75	13.33	9.216	2.32
	Behavior Mod	9.92	12.25	11.45_a	.99
	No Intervention	7.92	10.33	8.83_a	.90
IQ	Medication	94	127	109.2	13.05
	Behavior Mod	84	122	102.2	14.70
	No Intervention	80	113	96.20	13.20
Age Diff.	Medication	12	21	14.20	3.90
	Behavior Mod	13	22	17.80	3.83
	No Intervention	11	21	16.40	5.08

Note: Age Diff. = the number of months between the first and the second administration. Age and IQ are reported based on the initial evaluation. Means in the Mean column sharing subscript are significantly different.

The original assessments were compared with the re-test using paired samples *t* tests (see Table 19). Because the examiner conducted both the pre- and the post-test analysis there were stories for six TAT cards (1, 2, 3BM, 4, 5, and 8BM) for all but one of the participants; therefore, the results of all six TAT cards were compared. For the group as a whole, among the TAT variables there was a tendency towards a significant difference in Perceptual Integration. Group comparisons of paired samples *t* tests revealed a significant difference in Perceptual Integration for the medication group ($t_{(4)}$ = -3.411, p. < .05). The difference in the Cognitive-Experiential Integration score also

approached significance for the medication group ($t_{(4)} = -2.176$, $p = .095$). Other than Perceptual Integration, there was no significant change in cognitive processing over the intervening time period as measured by the TAT. However, because of limited group size these conclusions are only exploratory. TAT scores are not based on age comparisons, and therefore, are not corrected for maturation indicating that despite being older there was no difference in TAT score other than the group receiving medication, and then only for Perceptual Integration.

Comparison of the measures of ADHD indicated improvement on only two of the areas: a) The Full Scale Attention Quotient score of the IVA was higher for the group that received behavior modification; and b) the CPRS Hyperactivity score improved in the medication group. The lack of other improvements on the measures of ADHD indicates very little change relative to peers as reported by parents and teachers. Because these scores are based on age comparisons and are corrected for maturation, little change would be expected except for change that could be attributed to some type of intervention.

Table 19

Paired samples test of pre-post test of TAT and ADHD diagnostic variables

Pair	Group(N)	M_1	M_2	M Diff	SD	df	*t*	Sig.
CPRS Cog/ Inattentive	Total (12)	74.42	70.75	3.67[a]	9.21	11	1.379	.195
	Med. (4)	71.00	58.75	12.25[a]	10.21	3	2.400	.096
	Beh. (4)	78.50	77.75	.75[a]	5.38	3	.279	.798
	No Int.(4)	73.75	75.75	-2.00[b]	5.03	3	-.795	.485
CPRS Hyper.	Total (12)	64.17	63.92	.25[a]	16.39	11	.053	.959
	Med. (4)	78.50	63.25	12.25[a]	7.93	3	3.845	.031*
	Beh. (4)	59.00	63.25	-4.25[b]	16.13	3	-.527	.635
	No Int.(4)	55.00	65.25	-10.25[b]	13.72	3	-1.494	.232
CTRS Cog/ Inattentive	Total (7)	64.71	71.14	-6.43[b]	9.91	6	-1.716	.137
	Med.	—[c]			—	—	—	—
	Beh. (4)	66.00	73.00	-7.00[b]	11.22	3	-1.247	.301
	No Int. (2)	68.50	80.00	-11.50[b]	2.12	1	-7.667	.083
CTRS Hyper.	Total (5)	66.14	69.00	-2.86[b]	13.40	6	-.564	.593
	Med.	—[c]			—	—	—	—
	Beh. (4)	63.50	63.25	.25[a]	14.71	3	.034	.975
	No Int. (2)	59.50	70.00	-10.50[b]	16.26	1	-.913	.529

(Table 19 continues)

(Table 19 continued)

Paired samples test of pre-post test of TAT and ADHD variables

Pair	Group (N)	M_1	M_2	M Diff	SD	df	*t*	Sig.
IVA Full Scale Resp.	Total (15)	90.87	94.20	-3.33[a]	20.32	14	-.635	.535
	Med. (5)	85.40	82.20	3.20[b]	28.17	4	.254	.812
	Beh. (5)	94.40	105.20	-10.80[a]	11.08	4	-2.180	.095
	No Int. (5)	92.80	95.20	-2.40[a]	20.12	4	-.267	.803
IVA Full Scale Att	Total (15)	75.20	78.73	-3.53[a]	17.91	14	-.764	.458
	Med. (5)	70.60	64.20	6.40[b]	13.89	4	1.031	.361
	Beh. (5)	76.60	97.80	-21.20[a]	12.79	4	-3.705	.021*
	No Int.(5)	78.40	74.20	4.20[b]	13.35	4	.704	.521
IVA Fine Motor Reg.	Total (15)	86.60	93.40	-6.80[a]	36.82	14	-.715	.486
	Med. (5)	94.20	78.40	15.80[b]	37.09	4	.953	.395
	Beh. (5)	81.00	108.80	-27.80[a]	38.13	4	-1.630	.178
	No Int.(5)	84.60	93.00	-8.40[a]	26.89	4	-.698	.523
Perc. Integ.	Total (13)	13.68	15.39	-1.71[a]	3.38	13	-1.896	.080
	Med. (5)	10.70	14.70	-4.00[a]	2.62	4	-3.411	.027*
	Beh. (4)	17.87	18.00	-.13[a]	4.48	3	-.056	.959
	No Int. (4)	13.37	14.75	-1.37[a]	1.89	3	-1.457	.241

(Table 19 continues)

(Table 19 continued)

Paired samples test of pre-post test of TAT and ADHD variables

Pair	Group (N)	M_1	M_2	M Diff	SD	df	*t*	Sig.
Level of Abst.	Total (14)	13.68	14.82	-1.14[a]	2.76	13	-1.548	.146
	Med. (5)	12.40	14.50	-2.10[a]	3.54	4	-1.326	.256
	Beh. (4)	16.00	16.62	-.62[a]	2.87	3	-.436	.692
	No Int.(4)	13.00	13.50	-.50[a]	2.38	3	-.420	.730
Cog/ Exp.	Total (14)	11.86	13.36	-1.50[a]	3.68	13	-1.523	.152
	Med. (5)	9.00	11.70	-2.70[a]	2.77	4	-2.176	.095
	Beh. (4)	15.62	17.50	-1.87[a]	6.28	3	-.597	.592
	No Int.(4)	11.62	11.50	.12[b]	1.65	3	.151	.889
Associative Thinking	Total (14)	11.96	13.36	-1.39[a]	3.21	13	-1.626	.128
	Med. (5)	10.70	12.40	-1.70[a]	4.09	4	-.930	.405
	Beh. (4)	13.75	15.62	-1.87[a]	4.13	3	-.908	.431
	No Int.(4)	12.00	12.37	-.37[a]	1.80	3	-.417	.704

Note: [a]Indicates improved score, [b]Indicates poorer performance, [c]Indicates only one participant in this cell making comparison impossible.

Table 20

Medication group pre- and post-test scores for each participant

	Participant 1		Participant 2		Participant 3		Participant 4		Participant 5	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Patt	59	61[b]	68	56[a]	75	57[a]	82	61[a]	75	--
Phyp	77	52[a]	78	72[a]	74	57[a]	85	72[a]	68	--
Tatt	48	--	52	46[a]	96	--	69	--	--	--
Thyp	79	--	90	90	73	--	78	--	--	--
FSR	92	46[b]	81	92[a]	73	102[a]	87	89[a]	94	82[b]
FSA	100	91[b]	71	56[b]	38	56[a]	54	39[b]	90	79[b]
FMR	112	68[b]	100	111[a]	85	112[a]	62	00[b]	112	101[b]
PI	5	13[a]	11	13[a]	7.5	9[a]	7	7	4	8.5[a]
AB	9	12[a]	11	10[b]	9	10[a]	9	7[b]	4	7.5[a]
CE	4	10[a]	9	10.5[a]	8	7[b]	6	4[b]	4	8[a]
AT	5	11[a]	11.5	10[b]	10	7[b]	7	7	4	8[a]

Note: [a] = improvement; [b] = deterioration; Patt = CPRS Cognitive/Inattentive; Phyp = CPRS Hyperactive; Tatt = CTRS Cognitive/Inattentive; Thyp = CTRS Hyperactive; FSR = IVA Full Scale Response; FSA = IVA Full Scale Attention; FMR = IVA Fine Motor Regulation; PI = Perceptual Integration; AB = Level of Abstraction; CE = Cognitive/ Experiential Integration; AT = Associative Thinking.

Table 21

Behavioral intervention pre- and post-test scores for each participant

	Participant 1		Participant 2		Participant 3		Participant 4		Participant 5	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Patt	88	--	65	71[b]	90	88[a]	90	83[a]	69	69
Phyp	45	--	45	49[b]	75	58[a]	64	86[b]	52	60[b]
Tatt	71	--	56	61[b]	90	83[a]	65	75[b]	53	73[b]
Thyp	46	--	44	44	78	57[a]	78	90[b]	54	62[b]
FSR	96	101[a]	106	100[b]	89	109[a]	87	104[a]	94	112[a]
FSA	87	95[a]	86	102[a]	57	99[a]	67	90[a]	86	103[a]
FMR	104	109[a]	90	108[a]	16	108[a]	85	114[a]	110	105[b]
PI	15	11[b]	11	12[a]	15	14[b]	12	14[a]	5	8[a]
AB	12	8.5[b]	10	11[a]	12	12	10	12[a]	7	8[a]
CE	15	9[b]	11	11	12.5	14[a]	11	13[a]	5	5
AT	10	8[b]	7	10[a]	9	9	10	12.5[a]	6	6.5[a]

Note: [a] = improvement; [b] = deterioration; Patt = CPRS Cognitive/Inattentive; Phyp = CPRS Hyperactive; Tatt = CTRS Cognitive/Inattentive; Thyp = CTRS Hyperactive; FSR = IVA Full Scale Response; FSA = IVA Full Scale Attention; FMR = IVA Fine Motor Regulation; PI = Perceptual Integration; AB = Level of Abstraction; CE = Cognitive/ Experiential Integration; AT = Associative Thinking.

Table 22

No intervention group pre- and post-test scores for each participant

	Participant 1		Participant 2		Participant 3		Participant 4		Participant 5	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Patt	77	78[b]	75	--	71	80[b]	79	80[b]	68	65[a]
Phyp	44	44	88	--	50	79[b]	60	60	66	78[b]
Tatt	77	87[b]	54	--	60	73[b]	65	--	66	--
Thyp	51	50[a]	66	--	68	90[b]	90	--	48	--
FSR	104	97[b]	84	122[a]	75	72[b]	95	90[b]	106	95[b]
FSA	74	81[a]	102	108[a]	50	44[b]	53	51[b]	113	87[b]
FMR	86	100[a]	105	110[a]	32	83[a]	93	75[b]	107	97[b]
PI	8	13[a]	9	10[a]	6	10[a]	6.5	10[a]	11	12[a]
AB	7	9[a]	10	9[b]	8	8	6	9[a]	10	10
CE	6	9[a]	8.5	8[b]	7	8[a]	6	7[a]	9	8[b]
AT	4	7[a]	8	8	8	8	6	8[a]	9	9.5[a]

Note: [a] = improvement; [b] = deterioration; Patt = CPRS Cognitive/Inattentive; Phyp = CPRS Hyperactive; Tatt = CTRS Cognitive/Inattentive; Thyp = CTRS Hyperactive; FSR = IVA Full Scale Response; FSA = IVA Full Scale Attention; FMR = IVA Fine Motor Regulation; PI = Perceptual Integration; AB = Level of Abstraction; CE = Cognitive/ Experiential Integration; AT = Associative Thinking.

Discussion

The main focus of this study was measuring the cognitive processing of children with ADHD using the TAT. The hypotheses were generally confirmed in that the children referred for ADHD evaluation had lower information processing scores as represented by four cognitive variables from the Teglasi scoring system for the TAT than did the control group. However, the clinical group did not differ from the other referred children on the TAT variables. A deficit in any one of the four areas could result in problems with social interactions, academic functioning, and problem solving. Deficits in all four areas may be responsible for the substantial difficulty that children with ADHD have in all these areas.

Perceptual Integration

As was hypothesized, children with ADHD in this study scored lower than normal-control children on Perceptual Integration which measures the ability to encode pertinent information from a TAT picture and integrate that information into a story. Encoding of pertinent information is crucial to functioning in a social environment. According to the model put forth by Crick and Dodge (1994) the first two steps in social information-processing are the encoding and interpretation of cues from the environment. Interpretations based on information encoded are likely to affect the processing at all subsequent steps. When viewing videotaped vignettes of social situations, boys with ADHD encoded fewer social cues than did control group boys in situations depicting the following three problem domains; Being Disadvantaged, Coping with Competition, and Social Expectations (Matthys et al., 1999). Other studies have similarly found that fewer cues were encoded by children with disruptive behavior disorders but they did not

specifically identify children with ADHD (Dodge and Newman, 1981; Milich and Dodge, 1984). Costantino et al. (1991) found that children with ADHD omitted significant information at a higher rate than normal-controls when telling stories on a thematic apperception test. Singh et al (1998) and Cadesky et al (2000) found that children with ADHD incorrectly encoded emotional expressions. Without the ability to recognize and encode social cues the child with ADHD will interpret situations based on insufficient information. Hasty or inaccurate interpretations may result in behavior that is impulsive.

It is possible that children with ADHD are not able to inhibit responding long enough to engage the executive processing mechanisms. Future research may address this issue by measuring the length of time it takes children with ADHD to respond to TAT stimuli compared to normal-control children.

Level of Abstraction

The second hypothesis was also confirmed that children with ADHD would score lower on the Level of Abstraction than normal control children. A deficit in this area is indicative of an individual who is unable to go beyond what is provided in the stimulus. Ordinarily, the story would be generated from the narrator's internal representation of the scene, rather than from just the picture itself. The individual with such a deficit would not have engaged the executive functions of cognition identified by Barkley (1997a) possibly due to the lack of behavioral inhibition. In a sense, the stimulus is exerting control over the individual rather than the individual self-regulating his/her response. The story would contain little planning, cause-effect reasoning, or sense of what has come before to contribute to the present situation. Bellak and Abrams (1997) indicate that

children with ADHD tell stories that are concrete and merely descriptive of the stimulus suggesting that the more severe the ADHD the more concrete the stories will be.

Cognitive-Experiential Integration

Children with ADHD also differed from normal-control children on Cognitive-Experiential Integration as was hypothesized. Encoding and interpretation of the stimulus is essential to the process of integration of the Cognitive-Experiential domain. Without accurate perception and interpretation of the stimulus it is not possible to adequately integrate cognitive and experiential aspects; therefore, lower scores on Cognitive-Experiential Integration were expected based on low scores on Perceptual Integration. Planning and monitoring of one's own behavior, planning and monitoring the progression of the story, integrating the inner and outer worlds, integrating within a time frame, and coordinating the perspectives of different individuals are all part of Cognitive-Experiential Integration. The average Cognitive-Experiential Integration score for the control group was 3.13, whereas, the average for the clinical group was 1.99 and the average for the three referred groups was 1.90. As noted above, there is a substantial difference between the Rudimentary category (score of 2) with simplified reasoning and minimal causal connections, and the Superficial category (score of 3) with a "socially appropriate" albeit naïve story (Teglasi, 1993, 2001). Children with ADHD and children referred for assessment for attention related school problems are less able to integrate inner thoughts, intentions, and desires with the external world, they have greater difficulty planning and monitoring their own behavior, integrating their thoughts into an appropriate time frame, and considering the perspectives of different people simultaneously. As noted previously, Schachar et al. (1995) found that children with

ADHD have difficulty shifting form one behavior to another. This may account for the inability to simultaneously complete all of the cognitive tasks required for Cognitive-Experiential Integration. Planning and organizational deficits were noted by Seidman et al. (1995) in children with ADHD and with LD supporting the conclusion that children with ADHD have greater difficulty with the integration of cognitive-experiential processes.

Level of Associative Thinking

The level of Associative Thinking of children with ADHD was also below that of normal-control children as was hypothesized. Planning and organization are once again implicated in Associative Thinking as the individual must be able to connect each thought. Higher scores on this variable are achieved when thoughts flow in such a way as to create a cohesive story that accounts for the passage of time. Children with ADHD told stories that were associative in that one thought triggered the next without planning or organization to the process. The average Associative Thinking score for the clinical as well as all of the referred groups was in the range of Linear Associations, while the average score for the normal-control group was in the range of Patterned Associations. The Barkley model (1997a) includes retrospective function (hindsight) and prospective function (forethought) within working memory which would be essential to higher levels of associative thinking. Bellak and Abrams (1997) also indicated that individuals with ADHD tend to omit the outcome for stories and do not follow the sequence of events to a conclusion.

The results of this study add to the cumulative body of research and knowledge regarding ADHD and information processing. Prior research has explored specific

deficits such as a deficit in the regulation of inhibition (Bayliss and Roodenrys, 2000; Purvis and Tannock, 2000; Schachar et al., 1995; Schachar and Logan, 1990) or the encoding and interpretation of emotional expressions (Singh et al., 1998; Cadesky et al., 2000). In telling stories to the TAT, a more global behavior is required tapping into multiple cognitive skills simultaneously. Therefore, this task is more similar to the complex social situations that children are engaged in daily. In addition to research on specific cognitive deficits, it is also important to understand how individuals are likely to respond in real-life situations. This research has shown how cognitive deficits such as poor regulation of inhibition, poor rule-governed behavior, and difficulty encoding and interpreting emotions may be manifested in more complex behavior.

Diagnosis of ADHD

As was stated at the beginning of this study, the diagnosis of ADHD has been problematic. The results of this study are consistent with that conclusion. There was considerable agreement within parents across instruments and within teachers across instruments; however, as would be expected on the basis of the literature, the agreement between parent and teacher was weak. In addition, the IVA generally did not correlate with either parent or teacher report. The low correlations between respondents and between instruments bring into question the diagnostic process. One of the reasons diagnosis of ADHD becomes so difficult is that there is no standard measure with which to compare other measures. Biedermann et al. (1993) assumed the diagnosis from the K-SADS was accurate in order to compare with the CBCL. Carlson et al. (1987) used the best estimate diagnosis based on hospital records to compare with the K-SADS. Halperin et al. (1992) claim that the CPT did not differentiate individuals with ADHD from

individuals with other psychiatric diagnoses. DuPaul et al. (1992) reported no correlation between the VT (a continuous performance test) and the Matching Familiar Figures Test, the TRF, and the CBCL. Validating the diagnosis of ADHD has taken a circuitous route with each study using a different measure as the basis for diagnosis. The difficulty in this study to establish a diagnosis of ADHD across multiple measures and the poor correlation between respondents are reflections of this problem.

It is interesting to note that 8 of the participants from the clinical group were girls and 7 were boys. Typically, boys outnumber girls in studies of ADHD. For instance, the MTA sample of 579 consisted of 80% boys and 20% girls (MTA, 1999). One possible explanation for the higher ratio of girls to boys is that a higher percentage of the clinical group was Primarily Inattentive than is often found in studies of ADHD. Girls are more evenly represented in groups of children with Primarily Inattentive ADHD and 9 of the 15 clinical children met the criteria for ADHD Primarily Inattentive. Therefore, there is a likely connection between the number of girls in the present study and the number of children with ADHD Primarily Inattentive. The present study evaluated children from 7 and one-half to 13 years old. It is likely that children with ADHD Primarily Hyperactive have already been identified by this age, especially the boys, because of disruptive behaviors leaving more children with Primarily Inattentive ADHD. It is also possible that the size of the sample was too small to accurately represent the gender ratio of the population of children with ADHD.

One of the students was eliminated from this study because of the drastic change between the first and second evaluation. There were no interventions involved during the six months between the evaluations, but the child advanced from the second to the third

grade. The difference in the child's behavior was attributed to either maturation or the difference in the classroom environment. His mother reports that he was so much more comfortable with the new teacher that there were no more behavioral problems. It was determined that if the new classroom and new teacher impacted this child enough that he no longer met the criteria for ADHD, then he probably did not have ADHD to begin with. It is likely that the match between the teacher and the child at the time of the first evaluation was poor and the match between the child and the new teacher was good. This also brings into question the perspective of the individual rating the child's behavior. Some teachers have a greater tolerance for differences among students and allow for a greater range of acceptable behaviors than other teachers. In order to correctly diagnose children as having ADHD, it may also be important to confirm the initial diagnosis at a later date to insure that the problem persists and is not linked to the environment.

Clinical Judgment

Because the participants of this study were referred for evaluation for ADHD, a diagnosis was necessary for intervention purposes. Based on the above discussion, each measure of ADHD has its strengths and weaknesses, and no instrument provides a standard from which to operate. At times, the person rating the child may contradict him/herself. For instance, one parent describes behavior consistent with ADHD during the K-SADS interview, but rates the child as not having attention or hyperactivity problems on the CTRS-R. It is at this point that the clinician is forced to use clinical judgment as to which measure is the best reflection of the child's behavior. The clinician needs to be able to compile information from several measures into an understanding of the child in question to generate the best possible diagnosis. Factors that make this

process difficult outside of the research environment include time, cost, and availability of parent, teacher, child, and clinician.

Despite all of the measures used to diagnose ADHD in the present study, when making recommendations to the parents of the children evaluated clinical judgment was the final criterion. For intervention purposes, all of the 15 children from the clinical group were identified as having ADHD and recommendations were made accordingly. Referral to a physician for medical evaluation for ADHD was recommended for all 15 (see table 23). While the symptoms of the children in the sub-clinical group did not reach the threshold to be placed in the clinical group, many of them had enough symptoms of ADHD to warrant referral to a physician. Given the difficulty with diagnosis of ADHD and with diagnostic instruments as described above the clinician is forced to use a degree of judgment in drawing conclusions about such children. In some cases from the sub-clinical and ineligible groups, data were missing from the teacher; therefore, the child was not included in the clinical group despite meeting the criteria based on parent feedback. In other cases, the child was just below the significance level to be included in the clinical group. From the sub-clinical group, 12 of the 18 children were believed to have sufficient ADHD symptomatology to warrant a diagnosis of ADHD and were therefore referred to a physician. Only one child from the ineligible group was referred to a physician because of the diagnosis of ADHD, and data for this child were missing from the teacher.

In light of the similarities between the groups in reasons for referral, it is understandable that the TAT scores of the clinical group did not differ from the sub-clinical or ineligible groups, and that these two latter groups did score significantly worse

Table 23

Recommendations for interventions given to parents by the examiner separated by group

Group	Medical Evaluation	Reinforce	Additional Structure	Problem Solving	Therapy	Social Skills
Clinical	15	7	6	5	5	3
Sub-clin.	12	8	5	4	0	1
Ineligible	1	2	1	4	3	2

Note: Reinforce = frequent and varied reinforcement.

than the control group on TAT variables. The children from the referred group who did not meet clinical criteria for inclusion as ADHD were referred for academic or behavioral problems that were related to inattention or hyperactivity. They are similar in behavior and academic performance to the clinical group, and therefore, would be expected to perform similarly on the TAT. Studies have shown that students with learning difficulties have similar problems with cognitive processing as children with ADHD (Purvis and Tannock, 2000; Swanson, Mink and Bocian, 1999; Cohen et al., 2000). Purvis and Tannock (2000) found that children with ADHD did not differ from children with reading disabilities on tasks of cognitive inhibition. Children with ADHD did not differ from children with language impairment on tasks measuring motor inhibition, motor control and working memory (Cohen et al., 2000).

In a review of the literature, Swanson et al. (1999) indicates that studies have shown that children with ADHD and children with reading disability (RD) may score low on intelligence, general achievement, problem solving, and memory. The children with ADHD score low in these areas because of inattention, distractibility, impulsivity, or inefficient cognitive processing. The deficits in children with RD are assumed to

generate from deficits in phonological processing. In their study (Swanson et al., 1999) slow readers with ADHD did not differ from children with RD on measures of phonological processing suggesting that children with ADHD who are also slow readers and children with RD have a similar core phonological deficit.

Factor Analysis

Four factors emerged as a result of the factor analysis, inattention, hyperactivity, continuous performance, and cognitive processing. Inattention emerged as the result of parent reports of attention problems on the K-SADS, the CPRS-R, and the CBCL. In contrast, the teacher reports of attention problems from the CTRS-R and the TRF loaded with the IVA variables. For the most part, parental perception of attention problems was unrelated to teacher perception of attention problems in this study. Teacher perception of inattention was related to all three of the IVA measures. Teachers have the opportunity to observe children in tasks that are repetitive at times and may require similar attentional capabilities as the IVA task. Parents rarely have the opportunity to watch their children in repetitive tasks requiring sustained attention such as are required for the IVA. This would suggest that the way that parents rate their children's attentional behavior is different from the way in which teachers rate the same children on questions that are either identical or very similar. Developers of these instruments, the CBCL (Achenbach, 1991a), the TRF (Achenbach, 1991b), the CPRS-R (Conners', 1997), and the CTRS-R (Conners', 1997), claim that the parent and teacher versions are measuring the same construct. These results suggest that separate constructs are being measured. Other factor analytic studies have found that CPTs do not load on the same factor as other

measures of ADHD (Lovejoy and Rasmussen, 1990; for a review of CPTs see Riccio, Reynolds and Lowe, 2001).

The hyperactivity measures all loaded on one factor so clearly one of the factors that emerged from this study is hyperactivity. The four TAT variables loaded separately from the other measures yielding the cognitive processing factor. As has been previously discussed the TAT variables are measuring such aspects of information processing as encoding, interpretation, cause and effect reasoning, associative thinking, abstract thinking, integration of inner and outer realities, and the integration of all of these into a cohesive story. These aspects of cognitive processing are more complex than response inhibition or encoding of emotional stimuli from pictures or videotaped vignettes as have been used to measure processing deficits in children with ADHD (Cadesky et al., 2000; Constantino et al., 1991; Matthys et al., 1999; Schachar et al., 1995; Siedman et al., 1995; and Singh et al., 1998). Traditional measures of attention and the inhibition of impulses do not account for these more complex cognitive processing variables. Different aspects of information processing are being measured by the TAT, the IVA, and behavior rating scales. The modest correlation between the IVA Full Scale Attention score and Perceptual Integration, Level of Abstraction, and Cognitive-Experiential Integration from the TAT coupled with loading on different factors in the factor analysis indicate the likelihood that different aspects of cognitive processing are being measured by the IVA and TAT.

Cognitive Processing

Knowing that there are various ways in which ADHD manifests itself in the lives of children will help to provide a greater understanding of the disorder as well as guide

treatment. The unique contribution of this study comes from the information that the TAT provides regarding cognitive processing. It is possible to take the variables measured by the TAT and evaluate them based on the Crick and Dodge (1994) model of cognitive processing.

According to the model by Crick and Dodge (1994) an individual telling a TAT story first needs to encode what they see in the picture. Encoding activates long term memory and schemas. The memories and schemas that are activated then influence the additional encoding that occurs. The child with ADHD will impulsively encode limited detail at first. Then through activated memories and schema chooses the "path of least resistance". This will result in a stereotypical story with an ending such as "they lived happily ever after". The following is a story told by a member of the clinical group to card #4 which portrays a man and a lady in a conflict situation;

> I Love Lucy picture (make up a story) okay she's doing something
> and the man's really happy and she's really happy that she found her
> man uh ... well that's all I can think of (what happens) they get
> married and have children

The clinical group child who told this story saw a couple and responded with "I Love Lucy picture." The "I Love Lucy" schema that was activated would evoke images of a happily married couple. This reaction may have prevented her from seeing the conflict that is obviously portrayed in this picture. Stories like the one above are based on minimal encoding, enactment of schema, and rapid interpretation of limited information. From this point, the individual is able to avoid steps three and four (clarification of goals and response access or construction) of the Crick and Dodge (1994) model and move

right to response decision and behavioral enactment, steps five and six. This process of skipping the intermediate steps is represented in the Teglasi (1993, 2001) system as a borrowed or stereotypical story line. There is no need to think in terms of timelines or even cause and effect because the plot is provided by the schema activated. Barkley (1997a) would suggest that the teller of this story was unable to inhibit responding to the first impression, and therefore, the executive functions were never activated; however, the narrator did encode some information and made an interpretation based on that encoding. Barkley's conclusion might result in not identifying the processing that has occurred in a situation such as this one.

There were stories told by children from the clinical group in which they identified the conflict portrayed in the picture but were lacking in cause and effect reasoning. Reasons for the behaviors of the people in the story were not explained and outcomes were often not connected to the story. The following story, also told to card # 4, represents poor cause-effect reasoning;

> A hmm, a woman that doesn't want the man to go so before the man came in but the man has to leave now (okay, what's going to happen) she gonna probably run after him (what are they thinking and feeling) they're mad at each other (how does the story turn out) uh good I guess

This story reflects a low level of Abstract Thinking. The story is tied to the stimulus with little information about what occurred prior to the event and no real conclusion to the story. The story-teller is stuck in the present and unable to go beyond the stimulus. Steps three through six of the Crick and Dodge (1994) model are not

enacted in that there is no problem solving, generation of alternatives, selection of a course of behavior or enactment of that behavior.

There is some sense in which this individual has identified that there is a conflict between what the man is doing and what the woman desires to happen (encoding); however, the reasons for the man needing to go somewhere else or where he is going are not identified. Again, the story teller does not clarify goals or construct any real response, she just acts and "runs after him". In addition, the conclusion that the story turns out "good I guess" is not consistent with the fact that they are mad at each other and there is no attempt to resolve the anger. These deficits also are indicative of poor Cognitive-Experiential Integration. So there is evidence that children with ADHD may experience difficulties with encoding and interpreting, as well as clarifying goals and constructing responses.

Rule Governed Behavior

Problems with following directions and maintaining rule-governed behavior have been implicated as the core deficit of ADHD (Barkley, 1990; 1997a). Constantino et al (1991) found that children with ADHD need prompting three times more often than normal children indicating that they had more difficulty following the rules or directions that were established for this procedure. Children from the clinical group from this study required an average of 1.58 prompts per story while normal-control children required only 0.66 prompts per story. These children were less able to keep the instructions in working memory as they created stories.

Another example of possible problems with rule-governed behavior is provided by Schachar and Logan (1990). These researchers found that children with ADHD were

less able to inhibit responses to a stop-signal paradigm than were normal children. The stop-signal paradigm requires the respondent to not respond to the target stimuli if there was a stop-signal provided just before the target. Children with ADHD were not able to follow the "stop" rule as well as were normal children. The inability to inhibit responding could result in individuals who respond impulsively to the first or strongest impression of the stimulus. This is evident in the story related above where the child began with "I Love Lucy." The impulsive response led to a story that matched the response but did not accurately reflect the scene depicted. The ability to inhibit responses represents a "rule" that helps individuals to suspend responding until all important information can be processed about a situation.

Gender Differences

The results of this study indicated that girls who met the criteria for inclusion in the clinical group possibly had higher cognitive processing scores on Perceptual Integration, Cognitive/Experiential Integration and Level of Associative Thinking than did boys in this group. Because the multivariate difference between boys and girls was not significant but the univariate difference was significant, there is a greater possibility of committing a Type I error in assuming that the univariate difference represents a real difference between the genders. For the remaining groups, the scores were very similar between the boys and the girls. Taking into account the preceding caution regarding the possibility of a Type I error, it is possible that as the symptoms for ADHD become more severe, the impact on cognitive processing also becomes more severe for boys. The difference between the clinical, sub-clinical and ineligible groups was a matter of degree of severity of symptoms, and generally not a matter of alternate diagnoses as was

previously discussed. Gender difference in cognitive processing were evaluated by Bardos, Naglieri and Prewett (1992) and Naglieri and Rojahn (2001). Both studies found that girls scored higher than boys on tasks of planning but there were no differences in simultaneous, successive or attention tasks. Poor planning will result in TAT stories that do not include all aspects of the instructions, that do not include a beginning or ending, or that do not integrate the various elements. It is of interest to note that these possible differences were only found in the clinical group. There were no significant gender differences noted in the remaining three groups. Seidman, Biederman, Faroone, Weber, Mennin, and Jones (1997) measured the cognitive processing of girls. They then compared the girls from their study to the results from the literature of boys with ADHD and found that the girls were less impaired on measures of executive functioning. Seidman et al. did not include boys in the study, but made comparisons with results for boys from prior studies. The results in this study may be the product of sampling error given the small groups involved. Another possible explanation for girls with ADHD scoring better on TAT cognitive processing than boys with ADHD involves the discrepancy between the numbers of symptoms necessary for eligibility for ADHD for males versus females. In the 9 to 11 year-old age group, a score of 25 is necessary on the Cognitive Problems/ Inattentive scale of the CPRS for males to reach the cut-off point; however, for females a score of 17 is the cut-off. Similar differences exist for the CPRS Hyperactivity scale, the CTRS Cognitive Problems/Inattentive scale and the CTRS Hyperactivity scale. The cut-off scores on the CBCL and the TRF are similarly discrepant based on gender. These discrepancies would suggest that the level of disturbance must be greater for boys identified as ADHD by these instruments. One area

in which this level of disturbance may be manifested is in complex cognitive processing such as is being measured by the TAT. Further research should be done to explore the potential gender differences in cognitive processing especially in children who manifest significant ADHD symptoms.

Follow-up

In contrast to what was hypothesized, there was very little improvement in cognitive processing as a result of time and treatment. Of the four TAT variables, there was a significant improvement in Perceptual Integration for the medication group only. Encoding and interpretation of the stimulus are central to Perceptual Integration. Medication may have assisted the participants to attend better or to inhibit responding enhancing encoding and interpretation. Due to the small number in each of the retest groups, these conclusions are merely exploratory.

Given the time difference between the initial assessment and the re-evaluation, and in light of the correlation between the TAT and age, improvement in TAT scores was expected. It is not clear why the TAT scores did not improve significantly with age. If there were norms based on age for this scoring system, they might reveal that change would not be expected over the period of time represented in this study. Without norms for comparison and larger numbers of participants, it is not possible to generalize these results to children with ADHD. It may be consistent with Barkley's (1997a) conclusion regarding behavioral inhibition that little change would occur with age. If inhibition of behavior is not improved, then cognitive processing would be expected to also remain unchanged. Further research into the connection between behavioral inhibition, cognitive processing, maturation and treatment would assist in addressing this question.

On follow-up, there were two other significant differences. In the medication group there was improvement on the CPRS-R Hyperactivity scale and in the behavioral intervention group there was improvement on the IVA Full Scale Attention score. Again, the size of these groups makes it impossible to draw any firm conclusions regarding the follow-up data.

Limitations

There were several limitations to this study. The first limitation is the size of the groups. There were between 12 and 18 participants in each of the four groups. The size of these groups renders the interpretation somewhat questionable and the generalization to the population weak. In addition, trying to determine gender differences results in splitting the groups even further, thereby, making any conclusions about gender differences less credible. Another limitation involves the size of the retested groups. The data from the retesting must be considered exploratory with only five in each of the intervention groups. In addition to the small retested groups, the time between the initial and the follow-up assessments were not consistent for each participant. Conclusions about the impact of time and intervention may be affected by this variation in time between evaluations.

An even greater limitation is the difficulty with diagnosing ADHD. If different criteria were used in the identification of children with ADHD the groups would have divided differently. For instance, if data from the K-SADS were the sole criteria for inclusion in the clinical group, all 15 participants from the clinical group would have been included as well as all 18 participants from the sub-clinical group and 7 of the 10 ineligible participants. If data from the IVA were used, 10 from the clinical group, 7

from the sub-clinical group and 4 from the ineligible group would qualify as ADHD. More stringent criteria would result in underdiagnosis whereas less stringent criteria would result in identifying children who did not have ADHD. It seems that, at present, there is no single clear and definitive way in which to diagnose ADHD. In fact, even when using several methods, diagnosis is difficult. Clinician should utilize several procedures to diagnose ADHD including, interview and questionnaire data, behavioral samples such as CPTs, observation, clinical judgment, and cognitive processing assessments such as the TAT. The TAT can provide data about specific aspect of information processing to guide the planning of interventions.

Another limitation comes in the paucity of information regarding the control group. The only information available was age, the TAT, and that the IQ scores were in the average range. The school setting was known and all were from middle class families. It would have added weight to this study if there were data available on the behavior rating scales and the IVA.

Interventions

In this study there were too few participants who were retested to compare interventions in anything more than an exploratory way. There was an improvement in Perceptual Integration for the medication group; however, with such small groups the difference could be attributed to the change in the score of one or two participants.

Medication interventions have been found to be successful in improving performance on measures of ADHD such as CPTs and rating scales (MTA cooperative group, 1999). Berman, Douglas and Barr (1999) found that children treated with Methylphenidate (MPH) committed fewer errors on a letter recognition task. However,

when the number of letters was increased making the task more cognitively complex, error rates were not improved with MPH. Tannock, Martinussen, and Frijters (2000) demonstrated improvement in color-naming task reaction times as a result of MPH intervention. There was no improvement in response time for a letter-naming task. Medication appears to exert variable impact upon cognitive processing possibly due to differences in the task measured. The changes shown in most studies have been measured with tasks that do not involve complex cognitions. Future research should continue to assess the impact of medication on cognitive processing to further the understanding of which tasks are impacted and in what ways they are impacted. Research should also be conducted to measure the impact of the amount of time needed for improvement which may be greater for more complex tasks.

There were no improvements noted for the group that received behavioral intervention; however, behavioral interventions in this study were not standardized or consistent. The MTA group (1999) results indicated no significant improvement as a result of behavioral intervention alone, but when behavioral intervention was coupled with medication treatment there was significant improvement. Unfortunately, the improvement for the group that received both treatments was not significantly greater than the improvement seen in the medication only group.

There have been few studies to measure the treatment impact on complex cognitive processing such as was measured in this study. The cognitive processing improvements noted in other studies were based on CPT performance (MTA group, 1999), color naming (Tannock et al., 2000) and letter identification (Berman et al., 1999). These tasks do not measure the more complex cognitive processes required to complete

the TAT. Ronan, Date and Weisbrod (1995) were able to increase personal problem-solving scores on the TAT through specific training in generating alternatives and a utility model of decision making which includes weighing the impact of a decision, minimizing the negative and maximizing the positive impact. It is possible that with cognitive training such as was used by Ronan et al. (1995) the cognitive processing of children with ADHD could improve enough to impact the scores on the TAT. The subjects of the Ronan et al. (1995) study were normal college students, therefore, the results are not necessarily applicable to children with ADHD. Future research should explore the impact of such training on children with ADHD.

Future Directions

This study demonstrates children referred for evaluation for ADHD can be separated from normal-control children by their responses on the TAT. Several areas have been identified for future research. The amount of time that a child takes to begin and complete responding to each TAT card could be indicative of the ability to inhibit behavior. There are also children who tell long, rambling stories that demonstrate little response inhibition. Research into these areas, response times and rambling stories, would possibly add support to the model developed by Barkley (1997a) and discussed throughout this project.

Another area identified in this study is the instability of the diagnosis of ADHD over time. As shown, the symptoms of ADHD can be situational and change as the situation changes. Research into the nature of the stability of the diagnosis as well as what factors influence the presence or absence of symptoms would add to the

understanding of the diagnosis and treatment of ADHD; however, it may be difficult to study stability when the reliability of the diagnosing of ADHD is low.

The gender differences that emerged in this study deserve further exploration. Research should address whether there is indeed a gender difference in children diagnosed with ADHD, at what point does the difference become detectible, and what impact gender difference might have upon behavior. In any evaluation of gender differences in children with ADHD, it will be important to consider the difference in cut-off scores based on gender.

It is possible that there is a connection between behavioral inhibition, cognitive processing, maturation and treatment. Research should explore whether increased ability to inhibit impulsive responses correspond with changes in the type cognitive processing measured by the TAT. It would also be interesting to discover whether capacity of children with ADHD to inhibit behavior increases with maturation or remains constant. In addition, what types of treatment will impact behavioral inhibition and cognitive processing.

Finally, it would be beneficial to know which types of cognitive tasks are impacted by medication. As seen above, improvement was seen in simple cognitive tasks but not in more complex tasks (Berman et al., 1999; Tannock et al., 2000). The results of this study indicate that Perceptual Integration was improved but that the other cognitive variables, Level of Abstraction, Cognitive-Experiential Integration, and Level of Associative Thinking, were not improved after medication. Larger samples with a design to specifically measure the impact of medication, other interventions, and elapsed time without intervention upon cognitive processing may produce interesting results.

Appendix A: DSM IV criteria for diagnosis of ADHD

The diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD) has three subtypes in the DSM IV; Primarily Inattentive Type, Primarily Hyperactive-Impulsive Type, and Combined Type. To meet the criteria for Primarily Inattentive Type the individual must evidence at least six of the following symptoms for at least six months to a degree that is maladaptive:

(a) Often fails to give close attention to details or makes careless mistakes in school work, work or other activities
(b) Often has difficulty sustaining attention in tasks or play activities
(c) Often does not seem to listen when spoke to directly
(d) Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace
(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
(h) Is often easily distracted by extraneous stimuli
(i) Is often forgetful in daily activities

The diagnosis of ADHD/Predominantly Hyperactive-Impulsive Type requires that the individual meet the six criteria from the following two categories for at least six months to a degree that is maladaptive:

Hyperactivity
(a) Often fidgets with hands or feet or squirms in seat
(b) Often leaves seat in classroom or in other situations in which staying seated is expected
(c) Often runs about or climbs excessively in situations in which it is inappropriate
(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

Adapted from the DSM-IV (APA, 1994)

Appendix B: Letter to Physicians

Dear Dr. Sait:

I am currently conducting research, in conjunction with the University of Maryland, into the cognitive processing of children with ADHD. I am aware of the difficulty physicians face when attempting to address all of the diagnostic issues regarding ADHD. It is often not possible for you to allocate sufficient time to a child to complete a comprehensive evaluation.

I am offering to conduct a comprehensive psychological evaluation including intelligence testing, achievement testing, a continuous performance test, a semi-structured interview, parent and teacher questionnaires, and a projective story-telling task all under the supervision of a licensed psychologist. The family of children with ADHD will be provided with a review of the results, a psychological report, and assistance in following-up on referral and recommendations. I would welcome the opportunity to work with you in helping to serve children with ADHD and their families.

Enclosed please find a form that can be given to parents of children that you would like to refer for this evaluation. I look forward to working with you.

Sincerely,

William F. Young, MA, LCPC
Nationally Certified School Psychologist

Appendix C: Follow-up interview questions

Follow-Up Interview

We completed the testing for ADHD on _____ _____. Since then how has your child been doing?

What, if any, treatments have been utilized to help your child with ADHD?

Has your child taken medication for ADHD at any point since the evaluation?

- What dosage?
- Was the dosage modified?
- How long did you child take the medication?
- Is you child still taking the medication?
- What is the current dosage?

Have there been any behavioral interventions?

- Did your child's teacher alter his/her approach to teaching your child?
- Did the teacher use a reward system?
- Were the academic expectations of your child altered in any way?
- Have you implemented a behavior modification system in the home?
- If yes, what do you use for rewards and what rewards do you offer?
- How did you develop the list of rewards?
- What are the consequences if any for misbehavior, impulsive behavior or failure to perform?

Did you make any attempts to alter your child's behavior that were unsuccessful?

- What were they?
- How long did you implement the system?

Have you altered your child's diet or added any supplements to address the attention problems?

Appendix D

CONSENT FOR PARTICIPATION

I _____, parent/ guardian of _____ give
(parent/guardian) (name of child)
permission for my child to participate in the research study on ADHD being conducted by William F. Young of the University of Maryland.

1. I understand that the information gained from this study will be used for research purposes, but that no information that would lead to the identification of my child will be given to anyone or published without my express written consent.
2. I understand that I have the right to withdraw my child from this study for any reason at any time.
3. I understand that the results of the evaluation of my child will be reported to me, and that any treatment recommendations made will be my responsibility to pursue.
4. I understand that the evaluation will include;

    a. The Schedule for Affective Disorders and Schizophrenia for Children (a semi-structured clinical interview)
    b. The Child Behavior Checklist
    c. The Connors Parent Rating Scale and Teacher Rating Scale
    d. The Wechsler Intelligence Scale for Children-Third Edition
    e. The Woodcock-McGrew-Werder Mini-Battery of Achievement
    f. The Individual Visual and Auditory Continuous Performance Test (a computer based test to measure attention, distractibility and impulsivity)
    g. The Thematic Apperception Test (a story telling test)

5. These procedures have been explained to me so that I have a satisfactory level of understanding of each of them.
6. I understand that a follow-up evaluation will be conducted approximately 6 months after the initial evaluation to determine the effect of any treatment implemented. This follow-up evaluation will include some of the above named procedures.

_____ _____
(Signature of Parent/Guardian) (Date)

_____ _____
(Witness) (Date)

Appendix E: Sample letter to a private school to solicit referrals

September 8, 1998

St. Peter's School
St. Peter's School Road
Waldorf, MD 20601

Dear Mrs. DeLuca:

Thank you for the interest that you expressed to Dr. Mary Shaughnessy in the research study I am currently conducting. The topic of the study is the social cognitions of 8 to 12 year old children with Attention Deficit Disorder.

Teachers should refer children that they suspect may have Attention Deficit Disorder with or without hyperactivity who have not already been placed on medication for the disorder. If the child meets the criteria, a complete psychoeducational evaluation will be completed at no charge to the parents. This evaluation will include a WISC-III (IQ test), a test of achievement, a computerized attention test, an interview with the parents, behavior rating scales for the teacher and the parents, and a story telling task. In addition, the computerized test of attention and the story telling task will be repeated in six months to determine if any changes have occurred. The results of the evaluation will be shared with the parents and the school if the parents so indicate, and recommendations will be made for interventions. A report can also be generated.

To refer children for this study, parents should call Bill Young at 301-374-9377. Upon receiving their call I will contact the parents and arrange to meet with the student.

Sincerely,

William F. Young, MA
Psychology Associate

Appendix F: Sample of parent handout for private school referrals

September 8, 1998

Dear Parent:

I have informed Mrs. DeLuca at St. Peter's School that I am conducting a research study of children with Attention Deficit. She has agreed to assist me and the children by having her teachers refer students they feel may have an attentional problem in the classroom. The topic of the study is the social cognitions of 8 to 12 year old children with Attention Deficit Disorder.

Your child's teacher has referred your son or daughter as a potential candidate for this study. If the child meets the criteria, a complete psycho-educational evaluation will be completed at no charge to you. This evaluation will include a WISC-III (IQ test), a test of achievement, a computerized attention test, an interview with the parents, behavior rating scales for the teacher and the parents, and a story telling task. In addition, the computerized test of attention and the story telling task will be repeated in six months to determine if any changes have occurred. The results of the evaluation will be shared with you and with the school if you so indicate, and recommendations will be made for interventions

If you would like your child considered for this study, call Bill Young at 301-374-9377.
Sincerely,

William F. Young, MA
Psychology Associate

Appendix G: Sample of parent handout for physicians

ADHD: Attention Deficit Hyperactivity Disorder

Evaluation:

The evaluation of ADHD can be a time consuming and costly endeavor. The school system requires a diagnosis from a physician before they will recognize that your child had ADHD. Physicians often desire assistance in diagnosing ADHD because they may only be able to see the child for a brief time in the office which is drastically different from the environment in which AHDD is most problematic

Research:

A research study of ADHD children is currently being conducted at the Center for Children by Bill Young. The research study includes:

1. A clinical interview
2. Rating scales to be completed by parents and teachers
3. A Continuous Performance Test (a computer based test designed to measure attention, distractibility, and impulsivity)
4. Intelligence testing
5. Achievement testing
6. A story-telling task

Participants in this study will receive a complete evaluation for ADHD, screening for specific learning problems that often accompany ADHD, a review of the results of the evaluation, and recommendations and referrals for treatment alternatives. In addition, the progress of the treatment for ADHD will be monitored over a 6-month period to assist in discovering the most effective interventions. All of the information collected is designed to be helpful to the child and to the family, but will also be used as data for a research program.

Participation:

If your child is being referred for an evaluation for ADHD and you would like to have your child evaluated as a part of this study, then call **Bill Young** at **the Center for Children at 374-9442.**

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