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Neuropsychological Functioning and Family Environment of Children with Attention-Defecit/ Hyperactivity Disorder and Comorbid Oppositional Defiant Disorder/Conduct Disorder

M. Catherine Yeager

NEUROPSYCHOLOGICAL FUNCTIONING AND FAMILY ENVIRONMENT OF CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER AND COMORBID OPPOSITIONAL DEFIANT DISORDER/CONDUCT DISORDER

by

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This dissertation, submitted by M. Catherine Yeager in partial fulfillment of the requirements for the Degree of Doctor of Philosophy from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work had been done and is hereby approved.

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This dissertation meets the standards for appearance, conforms to the style and format requirements of the Graduate School of the University of North Dakota, and is hereby approved.

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10-25-00
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PERMISSION

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Signature M. Catherine Feagin

Date October 14, 2000

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ABSTRACT

Attention-Deficit/Hyperactivity Disorder (ADHD) is hypothesized to be a disorder of executive functioning; however, results of studies comparing ADHD with control children using executive functioning measures are inconsistent, with some studies showing group differences while others do not. One limitation of these studies has been the failure to control for frequently occurring comorbid psychiatric conditions, such as Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD), in the ADHD groups. Previous studies have demonstrated that children with ADHD and comorbid CD or severe ODD perform significantly better on tests of cognitive/executive functioning when compared to children with ADHD only. Based on these studies, this study tested the hypothesis that children with a single diagnosis of ADHD (ADHD-only) would show deficits on executive functioning measures relative to controls, but that children with a comorbid diagnosis of ADHD and CD or severe ODD (ADHD+SOD/CD) would not show such deficits relative to controls. Also, because ODD and CD are presumed to be caused by negative family environment factors, the family environments of the children in the current study were also examined, and it was hypothesized that children with ADHD+SOD/CD would come from more negative environments than would children with ADHD-only or controls. Evidence of more negative family environments coupled with a lack of neuropsychological deficits was presumed to provide evidence that the ADHD symptoms in children with

ADHD+SOD/CD may have environmental rather than neurobiological causes. A total of 56 male and female children participated in this study. One-way ANOVAs were used to compare groups on the executive functioning and family environment measures. Results indicated that children with ADHD-only did more poorly on executive functioning measures when compared with controls; however, children with ADHD+SOD/CD were not found to be significantly different from controls on these measures. In addition, the family environments of children with ADHD+SOD/CD were found to be more negative (i.e., higher parental stress, more ineffective discipline strategies, more family hassles) than those of controls. These results suggest that the ADHD symptoms that occur with OOD/CD are not associated with deficits in executive functioning and that these symptoms may have environmental rather than neurobiological causes.

CHAPTER I

Introduction

The American Psychiatric Association (1994) currently defines Attention-Deficit/Hyperactivity Disorder (ADHD) as a persistent pattern of excessive activity, impulsivity and inattention that is present to a degree that is more frequent and severe than is observed in others of the same age and developmental level. ADHD is the most frequent psychiatric diagnosis given to children in the United States (Olson, 1992) and is estimated to occur in 3%-5% of school-age children (American Psychiatric Association, 1994). This disorder is diagnosed more frequently in males than in females, with boys being three to five times more likely than girls to be diagnosed with ADHD (Szatmari, 1992).

Although they are frequently diagnosed later in development, children with ADHD have behavioral and/or attentional problems that present themselves before the age of seven years. These problems persist throughout childhood (and sometimes into adolescence and adulthood), are present in at least two settings (e.g., at home and at school), and are severe and/or frequent enough to cause clinically significant impairment in the child's social, academic, or occupational functioning. The diagnosis of ADHD is dependent on specific observed behaviors and is comprised of two primary behavioral dimensions: inattention and hyperactivity/impulsivity. In order to meet the Diagnostic

and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 1994) criteria for a diagnosis of ADHD, children must display at least six symptoms of inattention and/or six symptoms of hyperactivity/impulsivity. These symptoms must have persisted for at least six months and be inconsistent with the child's developmental level (American Psychiatric Association, 1994).

According to the DSM-IV, the inattentive symptoms displayed in ADHD may be manifested in social, academic, and/or occupational situations. Inattention in children with ADHD is usually reflected in a diminished ability to engage in tasks as long as other children of the same age. These children may have difficulty sustaining attention on school-related tasks or play activities and they are generally found to be more "off-task" in classroom situations than non-ADHD children. Along with their inability to sustain attention, children with ADHD may fail to give close attention to details, and therefore make careless mistakes in their schoolwork or other activities. The parents and teachers of children with ADHD often report that children with ADHD do not appear to be listening when they are spoken to directly and often fail to follow through on instructions. They also frequently have difficulty organizing tasks and activities, and therefore often fail to finish their schoolwork and/or chores. Children with ADHD frequently lose things that are necessary for tasks (e.g., school assignments, toys) and avoid tasks that require sustained mental effort (e.g., homework). Children with ADHD are typically easily distracted by extraneous stimuli and forgetful in daily activities (American Psychiatric Association, 1994).

Hyperactivity/Impulsivity, the second behavioral dimension of ADHD, may be manifested in many different ways and settings. Hyperactive children often have difficulty sitting still. They may also fidget with their hands or feet and may have difficulty remaining seated in situations where this is expected. Hyperactive children often run about or climb excessively in situations where this behavior is inappropriate. They may have difficulty playing quietly and they are often described as talking excessively. Finally, hyperactive children often are described by their parents and teachers as "always on the go" or acting as if they are "driven by a motor" (American Psychiatric Association, 1994).

Impulsivity in children with ADHD is often manifested as impatience. Children with this disorder often have difficulty waiting their turn, and will often blurt out answers before questions have been completed. Impulsivity may also manifest itself as difficulty in delaying responses, and impulsive children may interrupt or intrude on others by "butting in" to conversations or other activities. Parents and teachers of children with ADHD often report that children with ADHD initiate conversations at inappropriate times, touch things that they are not supposed to touch, and "clown around" more often than do children without this disorder (American Psychiatric Association, 1994). Their impulsive behavior may lead to accidents, and because they fail to consider the consequences of their actions, they may engage in activities that are potentially dangerous (e.g., running in front of cars).

Children with this disorder typically have problems with academic functioning. They tend to score lower than their peers or control groups on standardized tests of achievement and they are more likely to receive special education services and to be retained in grade (Fischer, Barkley, Edelbrock, & Smallish, 1990). Between 19% and

26% of children with ADHD also meet criteria for at least one type of learning disability (i.e., reading, written expression, or mathematics), and children with ADHD also have a higher prevalence of speech and language disorders than do children without ADHD (Taylor, Sandberg, Thorley, & Giles, 1991).

Children with ADHD also typically have difficulties in social adjustment. They tend to have negative interactions with their families (Mash & Johnston, 1983), teachers (Whalen, Henker, & Dotemoto, 1980), and peers (Clark, Cheyne, Cunningham, & Seigel, 1988). On average, children with ADHD are rated as less likable than are children who do not have ADHD and generally have fewer friends than their peers (Pelham & Binder, 1982).

Proposed Etiologies of Attention-Deficit/Hyperactivity Disorder

Environmental Factors

Children with ADHD are often hyperactive or inattentive only in specific situations (e.g., at home but not at school, at home and school but not in a third situation) or while performing specific tasks (e.g., school work). This situational variability has been cited as evidence for an environmental cause of this disorder (Altepeter & Breen, 1992; Conrad, 1976). The environments of children with ADHD have been widely studied and while there is evidence that factors such as social class (Velez, Johnson, & Cohen, 1989), family instability (Hartsough & Lambert, 1982), marital discord (Marshall, Longwell, Goldstein, & Swanson, 1990), and maternal depression (Barkley, Anastopoulos, Guevremont, & Fletcher, 1992) may play a role in maintaining hyperactive/inattentive behavior, the idea that environmental factors actually cause ADHD symptoms is not widely accepted by

clinicians and researchers. Also, although negative parent-child interactions have been consistently observed in families with children with ADHD, these interactions are usually believed to result from having a child with ADHD in the family, not cause the disorder (Fischer, 1990). In an effort to explain the variability in the manifestation of the symptoms of ADHD across settings, Lambert, Sandoval, and Sassone (1978) theorized that the inconsistent behavior is the result of "interactive systems." This theory asserts that a child with a given physical constitution may become hyperactive under certain environmental conditions, but that a child with the same physical make-up in a different environment may not display hyperactivity. This model essentially suggests that although a child's ADHD symptoms are affected by his or her surroundings, the environment alone does not cause the symptoms.

Genetic and Biological Factors

While there is no evidence that ADHD is caused by abnormal genes or chromosomes, research has consistently indicated that ADHD is highly hereditary. Higher rates of psychopathology in general (e.g., depression, substance abuse) have been noted in families of children with ADHD, and between 10% and 35% of the immediate family members of children with the disorder have ADHD themselves (Biederman et al., 1992). Studies of twins have also provided evidence for a genetic component to ADHD. These studies have consistently found monozygotic (MZ) twins to be more concordant for the disorder than dizygotic (DZ) twins (e.g., Hefron, Martin, & Welsh, 1984; Willerman, 1973). Based on such twin studies, Stevenson (as cited in Barkley, 1996) has estimated that the average heritability of the symptoms of ADHD at approximately .80. Another

line of research investigating the heritability of ADHD is the study of adopted children with the disorder. These studies have generally found that children who have been adopted are more likely to resemble their biological parents than their adoptive parents in terms of hyperactivity (Cadoret & Stewart, 1991; Morrison & Stewart, 1973).

Until recently, disorders such as ADHD have been believed to be the result of some type of minimal brain damage caused by brain infections, trauma, or injuries that occurred during pregnancy or delivery. This theory was based on the fact that persons with minor brain damage (without overt lesions) occasionally display symptoms that are similar to those displayed by individuals with ADHD. However, it has been shown that brain damage is associated with a wide range of disorders, of which attention deficit disorders are not most prominent (Rutter, 1981). Also, a study by Taylor, Sandberg, Thorley, and Giles (1991) found that children with ADHD were no more likely than non-ADHD control participants to have suffered brain injury early in life.

Although ADHD is no longer believed to be caused by brain damage, it is still widely accepted that ADHD has an organic origin. Since the first descriptions of children with ADHD by Still in 1902, it has been argued that this disorder is caused by hereditary factors and impairments in the brain. This hypothesis has led many researchers to investigate the structure and function of the brain in individuals with ADHD in an effort to find the causes of this disorder.

Many studies of individuals with ADHD have examined the structure of the brain to determine if morphological abnormalities exist in the brains of those with this disorder. In one such study that utilized computerized axial tomography (CT) to examine the brains

of 14 children with ADHD and severe learning disabilities, Caparulo et al. (1981) found that the lateral ventricles were enlarged in two of the children with ADHD in the study but no other structural abnormalities were present. In another study utilizing CT to examine brain structure in 15 children with ADHD, Voeller (1986) found four types of abnormalities in the brains of participants: large parietal lesions (in one child), mild focal atrophy (in two children), a dilated right lateral ventricle (in three children), and asymmetry in the size of the two hemispheres of the brain with the right hemisphere being smaller than the left (in three children).

Using magnetic resonance imaging (MRI), Hynd et al. (1993) found that over 70% of control children evidenced a left-larger-than-right pattern of asymmetry in the caudate nucleus, whereas approximately 63% of the children with ADHD had the reverse pattern (right-larger-than-left). This suggests that children with ADHD may also have structural differences from normal children in the caudate region of the brain, a part of the basal ganglia, which is responsible for the control of movement.

Although there is some evidence that suggests that brain structure of children with ADHD may differ from that of children without ADHD, the differences that have been demonstrated are inconsistent across children with ADHD and several studies using CT and MRI were unable to find any differences between the brains of children with ADHD and controls (Harcherik et al., 1985; Shaywitz, Shaywitz, Byrne, Cohen, and Rothman, 1983). More research is needed to determine whether ADHD symptoms are associated with abnormalities in brain structure.

Although studies that have sought to determine whether there are structural differences in the brains of children with ADHD have been inconclusive, even if no structural differences are present it is possible that there are functional problems in the brains of children with ADHD. Many studies have compared the functioning of the nervous system in children with ADHD with those of children who do not display symptoms of the disorder. Although these studies have also been generally inconsistent in demonstrating differences between children with ADHD and control children, several studies have demonstrated that children with ADHD display diminished arousal or arousability when measuring electrical activity in the body using galvanic skin response or electroencephalograms (Rosenthal & Allen, 1978; Ross & Ross, 1982). It has also been shown that high percentages of children with ADHD display right-hemisphere deficits (Voeller, 1986). Because studies have shown that attention and vigilance are functions of the right-hemisphere (Heilman & Van Den Abell, 1980), it has been hypothesized that there may be an association between right-hemisphere deficits and inattentive symptoms.

Neurotransmitter deficiencies or imbalances have also been proposed to cause ADHD and some evidence points to a deficiency in dopamine and norepinephrine in children with ADHD (Raskin, Shaywitz, Shaywitz, Anderson, & Cohen, 1984). Altered dopaminergic function in the prefrontal cortex and nucleus accumbens has been demonstrated in animal models of ADHD (Russell, deVilliers, & Sagvolden, 1995). Further evidence for the possibility that ADHD symptoms are caused by a dopamine and/or norepinephrine deficiency lies in the fact that methylphenidate, a drug that has been found to be effective in treating ADHD, inhibits the reuptake of dopamine and causes the

release of dopamine and norepinephrine into the synaptic cleft. However, although there is some evidence that ADHD is caused by neurotransmitter deficiencies, it is important to note that other studies have not found such deficiencies in children with ADHD (Shaywitz, Shaywitz, Cohen, & Young, 1983). More research is needed before conclusions can be drawn about the role of neurotransmitters in the development of ADHD.

Frontal Lobe Dysfunction

While the precise etiology of ADHD is obviously unknown, research has pointed to dysfunction in the frontal lobe of the brain as a causal factor in this disorder. Mattes (1990) proposed that frontal lobe dysfunction might be responsible for many of the deficits observed in children with ADHD after he noted the similarities between the behavior of children with ADHD and that of animals and adults with lesions on the frontal lobes. Also, the behavior of patients who suffer frontal lobe brain damage or have surgical lobotomies is notably similar to that of children with ADHD (Stuss & Benson, 1984). More recent empirical studies have demonstrated that when compared with controls, children with ADHD have excess beta activity and more slow wave activity in the frontal lobes (Chabot & Serfontein, 1996), and less cerebral blood flow to the prefrontal regions of the brain (Sieg, Gaffney, Preston, & Hellings, 1995). Furthermore, when compared with control children, children with ADHD have been found to have smaller amplitudes in the late positive components of their responses on measures of evoked potentials taken during their performance on vigilance tests. These late positive components are hypothesized to be a function of the frontal lobes of the brain (Frank, Lazar, & Seiden, 1992).

These studies and observations have led to the hypothesis that dysfunction in the frontal lobes of the brain or pathways connected to the frontal lobes is causal in the development of ADHD (Gorenstein, Mammato, & Sandy, 1989; Shue & Douglas, 1992). The frontal lobes are believed to be the area responsible for attention, or the ability to direct effort and concentration for periods of time to specific tasks, and for higher-order or executive functions (Luria, 1973). Executive functions are those cognitive abilities that include self-regulation, inhibition of responding, planning, and mental flexibility.

Given the fact that research has shown the frontal lobes of the brain in children with ADHD to be functionally different from those of children who do not have the disorder and the fact that frontal lobe processing appears to be deficient in individuals with ADHD, many researchers and clinicians consider ADHD to be a disorder of executive functioning stemming from dysfunction of cognitive abilities localized in the frontal lobes of the brain (Barkley, Grodzinski, & DuPaul, 1992; Reader, Harris, Schuerholz, & Denckla, 1994). In attempts to test this hypothesis, many studies have investigated the role of executive functioning in ADHD. These studies typically measure several areas of executive functioning using neuropsychological tests that are thought to be sensitive to frontal lobe dysfunction. These tests typically measure functions such as sustained attention, mental flexibility and perseveration, planning ability, and verbal fluency.

One area of functioning that has been frequently studied in children with ADHD is sustained attention. This ability is generally measured by continuous performance tests (CPT), which typically require the child to monitor a computer screen for the presence of a particular stimulus or sequence of stimuli. In one study of frontal lobe functioning that

compared sustained attention in male and female adolescents with ADHD and community controls matched for age and socioeconomic status (SES), Fischer et al. (1990) utilized a vigilance task developed by Gordon (1987). In this CPT, the participants were asked to monitor a computer screen for the presence of a certain sequence of numbers (a one followed by a nine) and told to press a button when this sequence appeared on the screen. This task, which usually lasts for nine minutes, was lengthened to 12 minutes in the Fischer et al. (1990) study in order to make the task more difficult. Target pairs were presented on approximately 20% of the trials, with a total of 60 target pairs presented throughout the task. This study found significant differences between a group of adolescents with ADHD and community controls on errors of omission (failing to respond to the presentation of the stimulus) and commission (responding when the correct stimulus has not been presented), indicating significantly poorer sustained attention and impulse control in the ADHD group. In a similar study by Breen (1989), Gordon's (1987) CPT was administered to 26 boys and girls with ADHD between the ages of six and 11 years and 13 control children matched for age and SES. This study revealed that the children with ADHD were similar to controls in the number of errors of commission; however, the ADHD group had fewer total correct, indicating that they had a more difficult time sustaining attention during this task. Loge, Staton, and Beatty (1990) also utilized Gordon's (1987) CPT in their study of executive functioning in ADHD. This study compared 20 boys and girls between the ages of six and 12 years who met DSM-III-R (APA, 1987) criteria for ADHD and 20 controls matched for age and SES. This study found that the children with ADHD made more errors of commission on the vigilance task

than controls, but they did not differ from controls in the total number correct on this task. Similar results were found by Mariani (as cited in Barkley, Grodzinski, and DuPaul, 1992) in another study using a continuous performance task to test the frontal lobe functioning of ADHD children. This study compared 34 four and five-year-old children with ADHD and 30 matched normal controls using Gordon's (1987) CPT and also found that children with ADHD made more errors of commission, but did not differ from controls in the total number of errors made on the task.

In another study examining executive functioning in ADHD children, Barkley and Grodzinski (1994) examined the positive predictive power (PPP), (i.e., the probability that an individual has the condition of interest given the fact that he/she receives an abnormal score on a diagnostic test), and negative predictive power (NPP), (i.e., the probability that an individual does not have the condition given the absence of an abnormal score on the test), of Gordon's (1983) CPT and several other measures of frontal lobe functioning. The study sought to determine the ability of these measures to classify children as having ADHD and utilized four groups of boys between the ages of six and 12 years matched for age, grade, IQ, and SES. The groups in this study included: 1) boys with ADHD, 2) boys with attention deficits but without hyperactivity (ADD-H), 3) boys with learning disabilities (LD), and 4) normal controls. The results of this study indicated that when the ADHD and ADD-H groups were combined, the CPT test used in the study had a PPP of over 90% (i.e., over 90% of children with ADHD were correctly classified by an abnormal score on the total correct, errors of commission, or errors of omission on the CPT). However, the NPP of the CPT was considerably lower with 41% of those children

diagnosed with ADHD scoring in the normal range on errors of commission, and 37% of children with ADHD scoring in the normal range on total number correct and number of errors of omission. This pattern of results indicates that while abnormal scores on the CPT are predictive of ADHD, children who meet the diagnostic criteria for ADHD often score in the normal range on this type of test. The results of Barkley and Grodzinski's (1994) study add to the inconsistent findings in studies of ADHD children's ability to sustain attention on CPT tasks.

Along with tasks that measure sustained attention, many researchers studying ADHD have focused on executive function tasks that measure mental flexibility and perseveration. One task that has frequently been used to study mental flexibility is the Wisconsin Card Sorting Test (WCST; Heaton, 1981). In this task, the participant must sort cards according to color, shape, and number or stimuli depicted on the card. The examiner initially verbally reinforces sorting in one category, but after the participant makes 10 consecutive correct responses in that category, the examiner begins reinforcing another category without alerting the participant to the change. The WCST yields scores on the total number of categories achieved and total number/percentage correct (measures of general mental flexibility and set shifting), and a score on perseverative errors/responses (responses that would have been correct on the previous category). Research has shown that patients with lesions in the most anterior region of the frontal lobe (pre-frontal) make more perseverative errors than patients with non-frontal lesions and normal controls (Milner, 1963). It has generally been predicted that individuals with ADHD would also commit more perseverative errors than normal control participants on this task.

In one study using the WCST to measure executive functioning in children with A ADHD, Boucagnani and Jones (1989) compared 28 children with a diagnosis of ADHD and 28 matched controls on their performance on this task. The children in this study were between the ages of seven and 10 years of age. Results indicated that children with ADHD performed worse than controls on the number of categories achieved and the percent correct, and made more perseverative errors on the WCST. Shue and Douglas (1989) found that their group of 24 children with ADHD made more perseverative and nonperseverative errors on the WCST than did control children. Gorenstein et al. (1989) compared 26 control children and 21 elementary school children between the ages of eight and 12 years who had been referred for disruptive behavior problems and inattention/overactivity. This study found that the ADHD group committed significantly more perseverative errors on the WCST than did the control group. Chelune, Ferguson, Koon, and Dickey (1986) administered the WCST to 24 children with ADHD and 24 control children between the ages of six and 12 years and also found the children with ADHD made more perseverative errors than the control group, but this study also found the ADHD group to have a significantly higher number of correct responses than controls.

Although the studies reviewed above show some evidence for impaired performance of children with ADHD on the WCST, other studies using this measure have revealed a different pattern of results. In their study comparing the executive functioning of children with ADHD with matched controls, Loge et al. (1990) found no differences between children with ADHD and controls on the WCST. Fischer et al. (1990) also failed to find significant differences between a group of adolescents with ADHD and

community controls on the WCST. Barkley and Grodzinski (1994) utilized the WCST in their study of the positive and negative predictive power of tests of frontal lobe functioning in ADHD and found that this task was not useful in distinguishing ADHD groups from learning disabled or control groups.

Another area of frontal lobe functioning that has been examined in individuals with ADHD is verbal fluency. Verbal fluency is typically measured with the Controlled Oral Word Association Test (COWAT; Benton & Hamsher, 1978). In this task participants are given letters (F-A-S) and asked to name all the words that they can think of that begin with that letter in a one-minute period. The task is then repeated with the participant being given a category instead of a letter and being asked to name all the words that he/she can think of that belong in that category (fruits-animals-vegatables) in a one-minute period. The COWAT is typically seen as a measure of the ability to suppress the habit of using words according to their meaning (i.e., the COWAT assesses ability to recall words according to a lexical property rather than according to their meaning) and it has been shown that performance on this type of test is deficient in adults with frontal lobe lesions (Benton, 1968). It is generally hypothesized that children with ADHD will do poorly on this type of test because they have difficulty sustaining behavior and inhibiting extraneous responses. Presuming that intelligence, knowledge of vocabulary, word retrieval capability, and speech are intact, verbal fluency tasks such as the COWAT are believed to tap the dimension of verbal fluency governed by executive functions in the frontal lobes.

Like studies that have measured sustained attention and mental flexibility/perseveration in children with ADHD, studies investigating verbal fluency in

children with this disorder have yielded inconsistent results. In one study investigating frontal lobe functioning in ADHD children, Koziol and Stout (1993) compared 19 children with ADHD with seven control children who had a mood disorder but not ADHD. The measure used was the Knight Verbal Fluency Test (Knight & Norwood, 1980), a shortened version of the COWAT that uses only the letters "C" and "L". The children in this study were boys between the ages of seven and 14. The results of this study indicated that the ADHD group and control group had similar Verbal, Performance, and Full Scale IQ scores as measured by the Wechsler Intelligence Scale-Revised (WISC-R); however, the ADHD group performed significantly worse than the non-ADHD group on the verbal fluency task. In a similar study, Felton, Wood, Brown, Campbell, and Harter (1987) administered a modification of the Controlled Oral Word Association Test to children diagnosed with either a reading disability and/or ADHD and controls. The children in all groups were matched for IQ and were between eight and 12 years of age. This study found that children with ADHD produced fewer correct exemplars on both the letter and category conditions of the Verbal Fluency Test than did normal control children or children with reading disabilities.

Although several studies have shown children with ADHD to perform worse than non-ADHD controls on tests of verbal fluency, other studies investigating verbal fluency have not shown children with ADHD to be deficient in this ability. In their study of frontal lobe functioning in children with ADHD, Loge et al. (1990) used the COWAT to investigate verbal fluency. The results of this study showed that although children with ADHD violated naming rules more often than controls (i.e., they gave words beginning

with the wrong letter or that were not in the correct category), the performance of children with ADHD was generally no different from that of normal control children. The ADHD group in Loge et al.'s (1990) study was also found to have significantly lower Full Scale IQs than the control group. In another study examining executive functioning in children with ADHD, Fischer et al. (1990) compared 100 children with ADHD of average intelligence with 60 community control children matched for IQ and did not find evidence that children with ADHD were less verbally fluent than control children. Reader et al. (1994) used the COWAT in their research with 48 children with ADHD between the ages of six and 13 years and did not find them to be impaired on verbal fluency when compared with control children matched for SES; however, it was noted that the ADHD group in this study had a mean Full Scale IQ that was significantly above average. McGee, Williams, Moffit, and Anderson (1989) also failed to find significant differences on the COWAT between boys with ADHD and control boys who were matched on IQ and age.

Adding to the discrepancies in the literature in this area, Barkley and Grodzinski (1994) utilized the COWAT in their study of frontal lobe functioning in ADHD children. This study found that the letters (F-A-S) condition had 90% PPP (i.e., 90% of children with abnormal scores on this measure were classified as ADHD); however, as in the case of the results of the CPT in this study (see above), the NPP of this measure was substantially lower (59%), indicating that 41% of children classified as ADHD scored in the normal range on the letters condition of this test.

The findings in the research on frontal lobe functioning in individuals with ADHD have yielded inconsistent results. It has been proposed that these inconsistent results are

due to methodological differences across studies (e.g., differences in the ages of subjects and the types of tests administered in the different studies) (Barkley & Grodzinski, 1994). It is also possible that the discrepant findings are due to the effects of comorbid disorders that were not controlled for in the statistical analysis. ADHD is known to have very high rates of comorbidity with other psychiatric disorders (Seidman et al., 1995). Certainly some of the most frequently observed comorbid disorders (i.e., learning disabilities, depression) impact performance on executive functioning tasks. The presence of comorbid disorders may result in a different pattern of responding on neuropsychological tests, thus clouding any frontal lobe dysfunction that may be present in ADHD alone.

Evidence of such differences in patterns of responding on neuropsychological tests when comorbid conditions are present is found in a study by Pennington, Grossier, and Welsh (1993). In this study four groups of boys between the ages of seven and 10 years were examined: 1) an ADHD-only group, 2) a reading disabled (RD-only) group, 3) a comorbid ADHD + RD group, and 4) a non-ADHD group. The ADHD group was comprised of boys who were rated at least one standard deviation above the mean on the Hyperactive scale of the Child Behavior Checklist (CBCL; Achenbach, 1991), were rated as pervasively hyperactive by their parents on the Home Situations Questionnaire (Barkley, 1981), and whose problematic behavior was reported to have begun before the age of six years. To be classified as RD, the child was required to meet DSM-III-R criteria for Specific Developmental Reading Disorder (i.e., a discrepancy between observed and expected reading ability).

The parents and children in the Pennington et al. (1990) study were administered a variety of measures. The parents of the children in the study were administered questionnaires that included items regarding the parents' religion, education, occupation, mental health history, income, and family composition. They were also asked to report any major family events or changes that had occurred over the last year. The children were administered the WISC-R (Wechsler, 1974) as a measure of overall intellectual functioning. The Word Attack subtest of the Woodcock-Johnson Psychoeducational Battery (Woodcock & Johnson, 1989) was used to measure the child's knowledge of letter-sound correspondences and a Pig-Latin test (Pennington, Van Orden, Smith, Green, & Haith, 1990) was used to assess the child's phonological awareness. Performance on the Word Attack subtest and on the Pig-Latin test were combined to produce a single measure of phonological processing skill.

The WCST (Heaton 1981), the Continuous Performance Test (Garfinkel & Klee, 1983), the Tower of Hanoi (Simon, 1975), and the Matching Familiar Figures Test (MFFT; Kagan, Rosman, Day, Albert, & Phillips, 1964) were used as measures of executive functioning in this study. The Continuous Performance Test was used to assess vigilance and sustained attention. In the first sequence of this task, the child is presented with letter sequences on a computer screen and told to press a key whenever a white "S" flashes on the screen. In the second sequence, the child is told to press the key only when a white "S" is followed by a blue "T." The test lasts approximately 15 minutes. The Tower of Hanoi was utilized in this study to assess planning ability. This task consists of two boards, each holding three pegs and three plastic rings of different sizes. The child is

presented with several rules (e.g., bigger rings cannot be placed on top of smaller rings, only one ring can be moved at a time) and then the rings on the examiner's board are placed in a specific configuration. The child is required to make the rings on his/her board match those on the examiner's board in a certain number of moves. The MFFT was included as a measure of impulsivity. In this task the child is asked to choose from among six pictures the one that is identical to a target picture. The incorrect pictures differ from the target picture in a single detail. The scores from the WCST, the Tower of Hanoi, the MFFT, and the CPT were combined to form a single measure of executive functioning.

The results of this study indicated that the ADHD-only group showed significant impairment in executive functioning when compared to the RD-only, ADHD+RD, and non-ADHD control groups, but the ADHD-only group was not impaired in phonological processing. In contrast, the RD-only group showed impairment in phonological processing but no impairment in executive functioning. The ADHD+RD group was found to be similar to the RD-only group in that this group was impaired on phonological processing, but it did not display the same executive functioning deficits that were seen in the ADHD-only group. These findings support the suggestion that the presence of a primary reading disability led to the symptoms of ADHD in the children with ADHD and RD. Interestingly, the ADHD+RD group was also found to have differences from the pure ADHD, the pure RD, and control groups in family environment. Specifically, the ADHD+RD group was found to have less maternal education, more mother-only households, and more family members with drug/alcohol abuse and mental health treatment as compared to the other three groups.

The results of Pennington et al. (1993) suggest that learning disabilities combined with ADHD affect performance on neuropsychological tests. It is also possible that the presence of comorbid psychiatric problems, such as mood disorders, anxiety disorders, and conduct disorders may also affect performance on such tests. Recognizing this possibility, Seidman et al. (1995) conducted a study that attempted to control for such comorbid disorders. This study included 65 children with ADHD and 45 normal comparison children of at least low average intelligence (WISC-R score greater than 80). The ADHD group was split into a group of 36 children with comorbid conduct disorders, depression, or anxiety disorders (ADHD+CM) and a group of 29 children with ADHD without any comorbid diagnoses (ADHD-CM).

Several measures of neuropsychological performance were included in this study. The Continuous Performance Test (CPT; Weintraub & Mesulam, 1985), which requires the participant to listen for and respond to a target tone rather than a visual stimulus, was utilized as a measure of sustained attention. The study also utilized the Stroop test (Golden, 1978). This test contains three sections, each of which has a card containing five columns of 20 items. The participant is first asked to read a list of color names (red, blue, green) printed in black ink as quickly as possible and is then asked to name colored patches of ink as quickly as possible. The participant is then required to name the color of ink in which a color word is printed as quickly as possible. This is an interference task as the color words are printed in ink of a different color. The participant is allowed 45 seconds for each of the sections and the score is the time needed to complete each portion and the number correct in each section. Low color-word scores are believed to be

associated with isolated pre-frontal injuries or dysfunction deficits (Golden, 1978). The children in this study were also administered the WCST, and the Wide Range Assessment of Memory and Learning (Adams & Sheslow, 1990).

Results of this study indicated that both the ADHD+CM and ADHD-CM groups were more impaired on the Stroop word task and interference task than controls. Also, the ADHD+CM group was more impaired than control children in terms of CPT omission errors, and the ADHD-CM group was significantly more impaired than controls on the Stroop color task and in terms of WCST perseverative errors. However, no significant differences were found between the ADHD+CM group and the ADHD-CM group on any of the measures.

Although this study did not find evidence of significant differences in executive functioning between children with ADHD with comorbid disorders and those with pure ADHD, this study is seriously flawed by the fact that the ADHD+CM group was comprised of children who met criteria for a diagnosis of one of several possible comorbid diagnoses (i.e., anxiety disorders, mood disorders, conduct disorders). Because the participants in this study were not divided by specific comorbid conditions, it is possible that any neuropsychological profile that might have emerged as a result of comorbidity may have been obscured by the heterogeneity of the comorbid group. Given the flaws of this study and the fact that the results of the Pennington et al. (1993) study demonstrated marked differences in executive functioning between the ADHD group and the comorbid ADHD+RD group, it is important that comorbid disorders be identified and controlled for when studying executive functioning in ADHD as it is possible that the inconsistent results

in the literature examining executive functioning in children with ADHD may be due to the failure to control for such comorbidity.

Oppositional Defiant Disorder and Conduct Disorder

Oppositional Defiant Disorder (ODD; American Psychiatric Association, 1994) has been found to be highly comorbid with ADHD. Between 35% and 60% of clinic-referred children with ADHD meet criteria for diagnosis of ODD (Biederman et al., 1992). Oppositional Defiant Disorder involves a recurrent pattern of negativistic, defiant, disobedient, and hostile behavior toward authority figures such as parents and teachers. These behaviors manifest as stubbornness, unwillingness to compromise or negotiate with adults or peers, and resistance to directions/instructions. Children with this disorder may also persistently test limits and rules. Children with ODD may frequently lose their tempers and they may argue with adults or actively defy or refuse to comply with rules or the requests of adults. Children with ODD may often blame others for their mistakes and misbehavior and they may be touchy or easily annoyed by others. They are often angry and resentful, and may also be spiteful and vindictive. Children with ODD are usually often oppositional and/or defiant in their interactions with adults or peers with whom they are very familiar. Children with this disorder usually do not realize that their behavior is problematic; rather, they view their actions as normal responses to unreasonable circumstances or demands.

In order for a child to be diagnosed with ODD, these behaviors must occur more frequently than is typical in children of comparable age and developmental level and they

must cause clinically significant impairment in the child's social, academic, or occupational functioning (American Psychiatric Association, 1994).

Conduct Disorder (CD; American Psychiatric Association, 1994) has also been found to be highly comorbid with ADHD, with approximately 30% to 50% of children diagnosed with ADHD also meeting criteria for CD (Biederman et al., 1992). Also, while studies have shown that ADHD frequently occurs without a concomitant conduct disorder, conduct disorder without ADHD is relatively rare (Taylor et al., 1991). Conduct Disorder is defined as a persistent pattern of violating the rights of others and/or of violating basic societal rules. The onset of CD is generally in late childhood or early adolescence. Children with this disorder often behave aggressively toward people and/or animals (e.g., they may be physically cruel to people or animals or initiate physical fights). They may engage in the deliberate destruction of property by fire-setting or other means. Conduct disordered children are often deceitful (i.e., they may lie to obtain goods or favors) and may engage in shoplifting or breaking into homes or cars to obtain goods. These children also often engage in serious rule violations, such as staying out all night despite parental prohibitions, running away from home, and being truant from school. In order to meet DSM-IV criteria for CD, children must have at least three symptoms present during the past year and must have at least one criterion present during the past six months. The behaviors must also cause clinically significant impairment in academic, social, or occupational functioning (American Psychiatric Association, 1994).

In contrast to the largely biological theories of the etiology of ADHD, nearly all theories of the etiology of ODD and CD (which are usually referred to as behavior or

conduct disorders) cite the role of the parents and general family functioning in the development of these disorders. Several familial risk factors have been cited as causal in the development of conduct disorders in children, including parental psychopathology, family adversity, and several aspects of ineffective parenting behavior.

Families of children with conduct disorders have been found to show higher rates of Antisocial Personality Disorder, parental depression, and parental substance abuse than the families of clinic-referred children without conduct problems (Griest, Wells, & McMahon, 1980). Parents of children with conduct disorders have also been found to have more marital discord than parents of children without conduct disorder (Loeber, 1990). Social variables such as single parenting and lower socioeconomic status have also been found to be linked to the development of conduct problems in children (Hinshaw, 1987). It is believed that such parental psychopathology and/or aversive family circumstances may decrease the parent's effectiveness, resulting in conduct problems in the child.

Parents of conduct disordered children have also been found to be less involved in their child's activities than parents of children without conduct problems, and poor parental supervision has been found to be correlated with conduct problems (Loeber & Stouthamer-Loeber, 1986). Parents of children with conduct disorders have also been found to be more harsh in their discipline of their children than parents of children who do not have conduct disorders (Patterson, 1982). Harsh discipline may create anger in children, reduce their levels of attachment to their parents, and provide a model of aggressive behavior (Frick et al., 1992). The parents of children with conduct disorder

also tend to use inconsistent discipline more often than do parents of children who do not have conduct disorder. Patterson's (1982) coercion theory describes how poor discipline practices may lead to the development of ODD or CD. Patterson's theory suggests that the behaviors displayed in children with ODD or CD emerge through a process of reciprocal, negative, and coercive exchanges between the parent and the child. This process begins with the child exhibiting distress behavior that may be developmentally normal or the result of stress, difficult temperament, or other factors. In normal parent-child interactions, the parent responds to the needs of the child; however, some parents see the child's behavior as irritating, leading the parent to avoid and/or harshly discipline the child. The child responds to this avoidance/harsh discipline with increasingly hostile behavior, leading to further avoidance and harsh discipline by the parent. As a means of gaining attention and forcing the parent to attend to his/her needs, the child's negative behavior continues to escalate. Eventually the parent attends to the child, unintentionally rewarding the child's coercive behavior. This type of interaction may also occur in the reverse manner, with the child unintentionally rewarding the parent's harsh discipline by occasionally giving in to parental requests (i.e., the act of yelling at the child is reinforced when the child complies with the parent's request). This combination of factors can lead to the development of "coercive cycles" of parent-child interactions in which both the parent and the child employ upper-limit control behaviors, with child aggressiveness being the end-product (Patterson, 1982).

Comorbidity of ADHD and Other Behavior Disorders in Children

Children with comorbid ADHD and ODD or CD often present with a unique symptom pattern that includes earlier onset of conduct problems and a more severe and persistent clinical course than is typically seen in children with a single diagnosis (Hinshaw, 1987). It has also been shown that children with both ADHD and ODD or CD have higher rates of peer rejection, have more severe academic impairments, and display more persistent antisocial activity and aggression than do children who have only one of the two diagnoses (Hinshaw, 1987). Children with ADHD and ODD or CD also tend to be less responsive to treatment than children with one disorder (Hinshaw, 1987). The unique presentation of children with comorbid ADHD and conduct disorders has led many researchers to examine the possibility that when combined, these two disorders may form a unique subcategory of childhood disorder in terms of psychosocial and cognitive correlates.

Kuhne, Schachar, & Tannock (1997) investigated whether the presence of ODD or CD and comorbid ADHD was associated with different psychosocial correlates that those typically associated with ADHD. Based on the etiology of the conduct disorders, it was predicted that children with ADHD and comorbid conduct problems would have more parental psychopathology than children with pure ADHD. It was also predicted that the comorbid group would have poorer social functioning than would children with ADHD alone. Three groups of children between the ages of five and 12 years were utilized in this study: 1) children with pure ADHD (N = 33), 2) children with ADHD and ODD (N = 46), and 3) children with ADHD and CD (N = 12). Parents of the study children were

interviewed using the Parent Interview for Child Symptoms (Schachar & Waschsmuth, 1989), a semi-structured interview designed to probe for symptoms of several disorders, including ADHD, ODD, and CD. During this interview the parents of the participants were also asked to report any symptoms of anxiety that were present in the child. The children's teachers were interviewed using the Teacher Telephone Interview (TTI; Schachar, Tannock, Marriot, & Logan, 1995) which also screens for symptoms of ADHD, ODD, and CD. Children were assigned to one of the three groups based on DSM-III-R criteria and parent/teacher report of behavior.

The parents and teachers of the study's participants were administered several questionnaires including the Ontario Child Health Study (Boyle et al., 1987), which provides information about home and school functioning, and the Family and Household Record (Boyle et al., 1987), which provides information about child and parent characteristics and general family functioning (e.g., level of emotional support, helping/sharing in the family, children's engagement in extracurricular activities). As a measure of their own psychiatric symptomatology, the mothers of the children in the study were also asked to complete the Symptom Checklist-90-R (SCL-90-R; Derogatis, 1983). The children in this study completed questionnaires measuring their anxiety levels and self-esteem. The Wide Range Achievement Test-Revised (WRAT-R; Jastak & Wilkinson, 1987) was administered to the study participants as a measure of academic achievement.

The results of this study indicated that the presence of comorbid ADHD and ODD or CD was associated with different correlates than those typically associated with ADHD. Children with comorbid ODD or CD were found to have more severe and

pervasive symptoms and social dysfunction than children with ADHD alone. Some ADHD correlates, such as higher aggression, higher anxiety, lower self-esteem, and maternal psychopathology were more closely linked to the presence of CD with ADHD, while social withdrawal was more closely linked to the presence of comorbid ODD. This study indicated that when compared to children with pure ADHD, children with ADHD and comorbid behavior disorders have a separate profile of symptoms and family circumstances.

In another study of psychosocial correlates of ADHD+CD, Reeves, Werry, Elkind, and Zametkin (1987) investigated family characteristics in four groups of children aged five to 12 years: 1) children with anxiety disorders, 2) children with ADHD, 3) children with ADHD+CD, and 4) control children with no psychiatric diagnosis. The participants in this study were obtained from a child psychiatric clinic and from advertisements asking for hyperactive children to take part in a study. In the clinic sample, diagnosis was based on the opinion of two psychiatrists who interviewed the child and his or her parents. In the community group, children were required to have ratings of at least two standard deviations above the mean on the Attention Problems factor of the Revised Behavior Problem Checklist (RBPC; Aman, Werry, & Fitzpatrick, 1983) and to be diagnosed by a psychiatrist with at least one of the three disorders in question.

The parents in this study were interviewed by a psychiatrist regarding common psychiatric symptoms of adults. When appropriate, diagnoses were made based on DSM-III criteria. Marital adjustment was assessed using the Short Marital Adjustment Test (SMAT; Locke & Wallace, 1959), and emotional distress was assessed using a recent life

events inventory designed for this study. Family adversity was measured with an index of overall psychosocial disadvantage (Shaffer et al., 1975).

The children in this study were administered a variety of tests of sensorimotor coordination, speech, and hearing. Achievement was measured by teacher report (described below), life stress was measured by the Life Events Record (Coddington, 1972), and social functioning in the children was measured by the Social Competence Profile from the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983).

The results of this study indicated that ADHD and ADHD+CD children resembled each other in psychosocial stress level, sensorimotor coordination, speech, and hearing. These groups were also found to be similar in school achievement; however, this construct was measured very crudely (i.e., the teacher was asked to rate the child's classroom performance against his/her best estimate of the child's ability) and other studies have found children with ADHD+CD to have more impaired academic achievement than children with pure ADHD (Hinshaw, 1987). The ADHD+CD group was found to have more pronounced social problems than the ADHD group, and the comorbid group was also found to have more adverse family backgrounds (including more alcoholic, antisocial fathers) than the pure ADHD group.

In another study investigating the differences in the families of children with comorbid ADHD and CD and those with a single disorder, Schachar and Wachsmuth (1990) compared five diagnostic groups of boys aged seven to 11 years [ADHD, CD, ADHD +CD, emotional disorder (ED), and controls] on parental psychopathology and parental history of hyperactivity. The children in this study were diagnosed based on a

semi-structured interview with the parents and behavior ratings completed by the child's classroom teacher. The children were required to meet DSM-III criteria for ADHD, CD, or both disorders in order to participate in the study. Children with a diagnosis of ODD were included in the CD group if they had severe and pervasive symptoms involving oppositionality toward their parents and other adults.

The parents in this study were assessed using several measures, including the Diagnostic Interview Schedule (DIS; Robbins, Helzer, Croughan, & Ratcliff, 1981), a fully structured interview designed to generate lifetime and current DSM-III diagnoses. An interview was attempted with both biological parents; however, if one parent was unable or unwilling to be interviewed, information about that parent was gathered from the available parent. Parents of the study children were also asked to report the presence of overactivity, inattentiveness, and impulsivity in their history; however, no attempt was made to retrospectively diagnose childhood hyperactivity in absent parents.

The results of this study indicated that while the rates of parental childhood hyperactivity were similar in the ADHD, ADHD+CD, and CD groups, children in the ADHD+CD, CD, and ED groups had significantly higher rates of maternal psychopathology (i.e., substance abuse, mood, and anxiety disorders) than the ADHD or control groups. Children with a diagnosis of pure ADHD were similar to control children in rates of parental psychopathology. Similar results were found by Lahey et al. (1988); however, this study also found that along with more substance abuse, mood, and anxiety disorders in mothers, fathers of children with ADHD+CD were more likely to have a

history of aggression, arrest, and imprisonment than were fathers of children with CD only.

It is apparent that the psychosocial correlates of ADHD+CD are somewhat different than the correlates of pure ADHD or CD. Along with these differences in social and family functioning between groups with pure ADHD or CD and groups with ADHD+CD, several researchers have found differences in cognitive and executive functioning between children with pure ADHD and children with comorbid ADHD and CD.

In a series of studies examining cognitive functioning in children with ADHD, Chee, Logan, Schachar, Lindsay, and Wachsmuth (1989) compared groups of children with DSM-III diagnoses of ADHD, conduct disorder (CD), ADHD+CD, and learning disorders (LD) with normal control children on a CPT. The children in this study were 51 boys between the ages of five and 12 years who had been referred for psychiatric evaluation. The children were diagnosed with ADHD on the basis of an interview of each child's parents and three questionnaires that were completed by the child's teacher including the Rutter B Rating Scale (Rutter, 1967), the SNAP checklist (Pelham, Atkins, & Murphy, 1981), and the Conners Abbreviated Teacher's Questionnaire (Conners, 1973). Attention deficit hyperactivity disorder was diagnosed if the child met DSM-III criteria for the disorder based on the parental interview and the questionnaires completed by the teacher. Children were assigned to the CD group if they met DSM-III criteria for conduct disorder or severe and pervasive oppositional defiant disorder based on parent and teacher report. Learning disability was diagnosed if the child's scores on the Reading

and Spelling subtests of the WRAT-R (Jastak & Wilkinson, 1987) were both at least 15 standard score points below the Full Scale IQ in the absence of any physical, sensory, or emotional problems. Control children were nominated by their teachers and their lack of problems was confirmed from information from the same questionnaires that were administered to the teachers of the ADHD children. All children in the study had a Full Scale IQ of at least 80.

The CPT task in this study consisted of 10 upper-case letters including the letter "X", which was designated as the target stimulus. The stimuli were presented at several different rates in order to determine the effect of variable stimulus onset asynchrony (SOA) on sustained attention. The three SOAs were 1 second, 2 seconds, and 4 seconds. It was hypothesized that if the SOA was very short the participant would not be able to finish attending and responding to one stimulus before the next appeared, leading to more errors and slower reaction times. Performance was expected to improve as the SOA increased to 2 seconds; however, when the SOA increased to 4 seconds, it was expected that there would be time for the participant's attention to wander between trials, leading to poorer performance, especially in participants with attention problems.

The length of stimulus exposure, or display time (DT), was also varied throughout the task. The stimuli were exposed for either 0.2, 0.4, or 0.8 seconds. With brief DTs, it was predicted that participants who had attention problems would make more errors, as failure to pay attention may lead to failure to detect stimuli.

The use of three SOAs and three DTs resulted in nine possible conditions on the CPT. All participants were tested on all conditions. During the CPT task, participants

were seated in front of a computer screen and told to monitor the screen for the presence of an "X." They were told to press a button whenever they saw an "X" and not to respond when other letters were presented. Participants were given a short break between CPT conditions.

The results of this study revealed that the ADHD group performed less well overall, with a significantly lower hit rate (i.e., correct identification of a stimulus) than either the control, CD, or ADHD+CD groups. Also, the performance of the ADHD subjects was significantly more affected by variation in demand for attention imposed by different SOAs and DTs than was the performance of the control, CD, or ADHD+CD groups. Compared with the 2-second SOA, the rapid (1-second) and slow (4-second) SOAs were associated with significantly more errors in the ADHD groups, but not in the other experimental groups or the control group.

The children in this study also participated in a second study several weeks following the administration of the first CPT. Because SOA was confounded with time on task in the first study (i.e., because the same number of stimuli were presented in each condition, slower event rates were associated with longer task conditions), and because deterioration in performance across tasks such as the CPT is characteristic of ADHD children, the purpose of this study was to distinguish the effects of SOA in the first experiment while controlling for time on task. In this study, a different target letter (Z) was used to minimize practice effects. The three SOAs were used in this task; however, only one DT (0.4) was used and the number of stimuli presented varied with each condition.

The second study yielded results that were similar to those of the first experiment, indicating that the effect of SOA is significant even when task duration is controlled. In this study the ADHD group was still found to be the most impaired when compared to the other clinical groups and controls; however, in the second experiment the ADHD group showed deficits during only the slowest SOA. It was hypothesized that this poorer performance reflects a refractory effect from processing the preceding stimulus (i.e., the child is so occupied with the preceding stimulus that he/she misses the next one). The pure ADHD group continued to show a more marked deficit than the ADHD+CD group on the CPT task and the pattern of responding of the ADHD+CD group was more similar to response patterns in the pure CD and control groups than to the response patterns of the ADHD group. These findings provide evidence for different patterns of cognitive functioning in children with ADHD+CD and those with pure ADHD.

In a more recent study examining cognitive differences between children with pure ADHD and ADHD+CD, Schachar, Tannock, and Logan (1995) studied inhibitory control, or the ability to inhibit and alter strategies as they become inappropriate for performing a task, in children with behavior disorders. This study included four groups of children between the ages of seven and 11 years: 1) children with ADHD, 2) children with CD, 3) children with ADHD+CD, and 4) normal controls. Children with ODD were included in the CD group if they met criteria for ODD and displayed their symptoms in relationships with both parents or a variety of adults.

This study used a stop signal paradigm to measure inhibitory control. This paradigm is believed to be an analogue of common, everyday situations that require quick

execution of an action, and, on occasion, the inhibition of that action. In this task, participants are administered a computerized forced-choice reaction time task in which they are told to respond as quickly and accurately as possible. Occasionally and unpredictably throughout the reaction time task (on about 25% of the trials), the participants are presented with a stop-signal (a tone presented by the computer). The participants are instructed that when they hear the stop-signal they are to withhold their response to the reaction time task.

The results of this study indicated that the normal control, ADHD, ADHD+CD, and CD groups did not differ in the speed of their reactions on the primary reaction time task; however, the ADHD group was found to have longer stop signal reaction times (SSRT) than did normal control participants. The ADHD group also demonstrated poorer inhibitory control (lower probability of inhibiting a response) than normal controls. By comparison, neither the pure CD group nor the ADHD+CD group displayed evidence of deficient inhibitory control (in speed or accuracy) when compared to normal control participants.

The results of the Chee et al. (1989) and Schachar et al. (1995) studies suggest that when comorbid with CD, ADHD is not associated with the same cognitive deficits that are found in pure ADHD. This pattern of results is intriguing, for if these two disorders, when present in the same individual, represent only an interaction of the biological nature of ADHD and the adverse environmental nature of CD, then the comorbid group would be expected to exhibit the same cognitive deficits as the pure ADHD group. Since the comorbid group does not appear to display these deficits, the

etiology of ADHD symptoms in children with conduct disorders is called into question. It is possible that the ADHD symptoms in children with CD have a different etiology than they do in the case of pure ADHD and that the ADHD symptoms in children with ADHD and ODD/CD may actually be a "nonspecific epiphenomenon" (Schachar et al., 1995, p. 726) of CD.

The idea that ADHD symptomatology can develop secondary to another disorder is not new. Based on the finding that children with ADHD+RD did not show an executive functioning deficit like that seen in children with ADHD, and children with ADHD+RD had more aversive family environments (i.e., more mother-only households, more family psychopathology and drug/alcohol abuse) than did children with RD only, Pennington et al. (1993) hypothesized that it was the existence of the reading disability and an aversive family environment that led to secondary symptoms of ADHD. Pennington et al. (1993) present a hypothetical reconstruction of the development of the typical child with ADHD+RD. In this hypothetical scenario, the child has a congenital mild language disability and has problems with early language development. The child's mother is a single parent who is stressed by the demands of parenting and members of the extended family have psychiatric problems and are drug/alcohol abusers. The child's language problems interact with his environment, which does not provide consistent support or structure. As a result the child may begin to show ADHD symptoms, such as short attention span and problems in listening to adults before he starts school, but when he begins kindergarten and the demands for pre-reading skills begin, the child becomes frustrated, resulting in more ADHD symptoms (i.e., fidgeting, not following instructions).

His behavior and reading problems become evident to his teachers and he is placed in special classes; however, his mother does not have the time or money to intervene. The child begins to see himself as a troublemaker and forms relationships with other children with antisocial tendencies. By the age of nine, the child has the full-blown behavioral symptomatology of ADHD by both parent report and professional diagnosis; however, in cognitive testing he does not show deficits in executive functioning because his ADHD symptoms are not caused by a primary executive functioning deficit (Pennington et al., 1993).

The family environments of the children in the ADHD+RD group in the Pennington et al. (1993) study and those of the typical child with diagnoses of ADHD+CD are similar in that both have been found to be more aversive (i.e, more family psychopathology and alcohol/drug abuse, more mother-only households) than those of controls or children with pure ADHD. Studies have also shown that children with conduct disorder show an impairment in verbal skills (Hurschi & Hindelang, 1977; Moffit & Silva, 1988) that is similar to that seen in children with reading disabilities (McGee, Williams, Moffit, & Anderson, 1989). It is possible that the negative family environments of children with conduct disorder coupled with problems in school caused by verbal learning impairments may cause the development of ADHD symptomatology in children with conduct disorder in the manner described by Pennington et al. (1993). If the ADHD symptoms in children with CD develop as a result of negative family environment and/or school problems rather than as a result of biological/neurological problems, it is likely that children with comorbid ADHD and CD will not show the cognitive and executive

functioning deficits that are generally associated with pure ADHD. This would explain the lack of a cognitive deficit in children with ADHD+CD in the Chee et al. (1989) and Schachar et al. (1995) studies. Also, if such a cognitive deficit does not occur in children with certain comorbid disorders (as was shown to be the case in children with ADHD+RD in Pennington et al., 1993), it is possible that the failure to control for such comorbid conditions in the studies of executive functions reviewed above may have resulted in groups of children with ADHD with heterogeneous patterns of executive functioning. Such heterogeneity within groups of children with ADHD may have lead to the failure of these studies to reveal consistent patterns of executive functioning in children with ADHD.

Purpose of the Present Study and Major Hypotheses

The present study examined cognitive and environmental differences in children with ADHD only, ADHD comorbid with CD, and a control group. Also, because ODD is assumed to be less severe but qualitatively similar form of CD (Reeves et al., 1987), as in previous studies (Chee et al., 1989; Schachar et al., 1995), children who met criteria for ODD and had symptoms that occurred both in interactions with parents and other adults, were classified as Severe ODD (SODD) and were included in the CD group.

In an attempt to extend the findings of Chee et al. (1989), the present study compared children with ADHD+CD/SODD, ADHD-only, and controls on a visual and an auditory CPT. Based on the results of Chee et al. (1989), it was hypothesized that children with ADHD+CD/SODD would perform better than children with ADHD on the

continuous performance tests in terms of total correct, errors of omission, errors of commission, reaction time, and reaction time variability.

The second purpose of the present study was to determine whether any differences exist in executive functioning between children with ADHD-only, comorbid ADHD and CD/SODD, and controls. The present study compared these three groups on measures of planning, mental flexibility, and verbal fluency. Based on the results of Pennington et al. (1993), it was expected that when comorbid conduct disorders are controlled for, children with a diagnosis of pure ADHD would show deficits in executive functioning relative to normal controls; however, based on the results of Chee et al. (1989) and Schachar et al. (1995), it was hypothesized that children with a comorbid diagnosis of ADHD and SODD/CD would not show these executive functioning deficits.

The present study also attempted to investigate the possibility that the ADHD symptomatology that occurs in children with a diagnosis of CD or SODD may be associated with aversive family environments. Because it has been shown that the presence of CD/SODD is associated with high rates of parental psychopathology (Schachar & Wachsmuth, 1990; Reeves et al., 1987), the parents of the children in the present study were asked to report any history of personal psychopathology and were given a questionnaire that assessed their level of depression. Based on previous studies, it was hypothesized that the parents of children with comorbid disorders would have higher rates of psychopathology than the parents of pure ADHD children (Fischer, 1990). Also, because it has been shown that ineffective discipline is associated with parental psychopathology and because lack of effective discipline may result in the development of

conduct problems, the present study compared the discipline strategies of the parents of children with ADHD with those of children with ADHD+CD/SODD. It was hypothesized that parents of children with comorbid diagnoses would use more ineffective discipline strategies than would parents of children with ADHD or control parents. It was also hypothesized based on previous research (Fischer, 1990) that the parents of the ADHD-only group would also report more ineffective discipline strategies when compared with the control group, but would report fewer ineffective strategies than the ADHD+SODD/CD group.

Along with having higher rates of parental psychopathology, it has also been shown that children with comorbid diagnoses generally live in more negative and dysfunctional family environments than do children with ADHD-only. In order to compare several aspects of the environments of children with ADHD, those with ADHD+CD/SODD, and those with no diagnosis, the parents of the participants were administered several measures of parenting and family stress and a measure of parent opinions about proper child behavior. They were also asked to report the coping strategies that they generally used in dealing with stresses. It was hypothesized that the parents of children with comorbid diagnoses of ADHD+CD/SODD would report more parenting stress, more daily hassles, and more inappropriate opinions of proper child behaviors than would the parents of children with pure ADHD and parents of controls. It was also hypothesized that parents of children with ADHD+CD/SODD would utilize more ineffective coping strategies in dealing with such stresses than parents of children with pure ADHD and control children. It was further hypothesized that the ADHD-only group

would also report more parenting stress, more daily hassles, more inappropriate opinions about proper child behaviors, and more ineffective coping strategies when compared with the control group, but would report fewer stresses, hassles, and ineffective coping strategies than the ADHD+SODD/CD group. More specific hypotheses are made following the description of the measures.

CHAPTER II

Method

Participants

The participants in the present study were three groups of children between seven and 12 years of age. One of these groups consisted of 19 children (eight female, 11 male) who met diagnostic criteria for ADHD with no differentiation for DSM-IV subtype. The ADHD-only group included one American Indian, 16 Caucasian, and two African-American children. The second group consisted of 21 children (four female, 17 male) who met the diagnostic criteria for ADHD with no differentiation for subtype and who also met diagnostic criteria for CD or severe ODD (SODD). In order to qualify for a diagnosis of SODD, children were required to meet DSM-IV criteria for the disorder and their oppositional defiant behavior must have occurred both in interactions with their parents and with other adults. The ADHD+SODD/CD group included 16 Caucasian, two African-American, and three Hispanic children. The third group of children served as a control group and consisted of 18 children (eight female, ten male) who did not meet criteria for any psychiatric diagnosis. The control group included 14 Caucasian, one African-American, one American Indian, and two Hispanic children. All participants in the study were required to have a Full Scale IQ (as measured by the WISC-III) of 80 or

above, no additional DSM-IV diagnoses, no significant medical conditions, and no history of a head injury that resulted in loss of consciousness. A total of 71 children were assessed in the current study; however, 13 of these children were not included in the analyses because their ADHD symptoms were not significant enough for a diagnosis (12 children) or because they had FSIQs of less than 80 (3 children).

The children in the two psychiatric groups were recruited from two local psychological clinics (the University of North Dakota's Family Practice Center and Altru Clinic) who brought the study to the attention of the child's parents when they made an appointment to have their child evaluated for ADHD. Regardless of the source of the referral and of previous diagnosis, the mother of each participant was interviewed at the time of testing to determine whether or not her child met criteria for inclusion in the study. Although families were told that either parent could accompany their child to the testing session, all participants were accompanied by their mothers, and therefore mothers were administered the interview and questionnaires.

An attempt was made to test all children who participated in the study before they began behavioral or psychopharmacological treatment for their diagnosed disorder; however, six children (32%) in the ADHD-only group and eight children (42%) in the ADHD+SODD/CD group were on stimulant medications (e.g., Ritalin, Adderall, Dexadrine, or Cylert) for their diagnosed disorder(s) at the time of testing. These children were required to be medication-free for at least 48 hours prior to testing.

Control participants in the present study were recruited through advertisements in the local area. Prior to their participation parents were interviewed to determine that their child had no current or previous psychiatric diagnosis.

Materials

Criterion Measures

Several measures were used in the current study to provide data to establish the diagnoses of ADHD and SODD/CD. These measures included a diagnostic interview conducted by a Master's level graduate student to determine whether or not participants met diagnostic criteria for ADHD, SODD, CD or co-morbid ADHD and CD/SODD and to determine that the participants did not meet criteria for any other psychiatric diagnosis. The diagnostic interview that was utilized in the present study was the Diagnostic Interview for Children and Adolescents (DICA; Herjanic, 1983). This is a structured psychiatric interview covering the general range of psychiatric diagnostic categories in the DSM-IV and it is intended to allow the interviewer to standardize and operationalize those diagnoses for research and/or clinical purposes. Only the parent section of the DICA was used in the present study. This section covers a wide range of psychiatric diagnoses that are possible in children (i.e., ADHD, ODD, Conduct Disorder, Major Depressive Disorder, Dysthymic Disorder, BiPolar Disorder, Separation Anxiety, Avoidant Disorder, Somatization Disorder, and Obsessive-Compulsive Disorder). The DICA section on ADHD includes questions for the parent on the child's impulsive, hyperactive, and inattentive symptoms. Endorsement of at least six symptoms of the possible 21, along with a report of onset before the age of seven years, establishes an operational definition

for the diagnosis of ADHD with or without hyperactivity. A diagnosis of ODD is established by parental endorsement of at least four symptoms of a possible eight and the presence of those symptoms in at least two environments (e.g., in home and at school). As mentioned above, in order to be included in the present study, participants with ODD were required to have symptoms that occurred in their interactions with their parents and with other adults (i.e., teachers). A diagnosis of Conduct Disorder is established by the presence of at least three of the possible 15 symptoms.

In order to provide additional information establishing the diagnosis of ADHD and/or SODD/CD, parents of potential participants were asked to complete the Child Behavior Checklist (CBCL; Achenbach, 1991). The CBCL is a widely used 118-item self-report measure designed to assess behavioral and emotional problems in children. The questionnaire provides a measure of type and severity of symptoms displayed by the child. Each of the 118 items is scored on a three-point scale. Syndromes that can be identified by the CBCL include the following categories: Withdrawn, Somatic Complaints, Anxious/Depressed, Social Problems, Thought Problems, Attention Problems, Sex Problems, Delinquent Behavior, and Aggressive Behavior (Achenbach, 1991). The reliability and validity of the CBCL are considered to be satisfactory (Achenbach & Edelbrock, 1983) and this measure considered to be valid as a rapid screening instrument to identify ADHD and comorbid psychiatric disorders (Steingard, Biederman, Doyle, & Sprich-Buckminster, 1992).

In order to determine family history of psychiatric disorders, the parents of the children in the current study were asked to report any history of psychiatric problems in

the child's biological parents. The parent(s) were asked if either of the child's parents had been diagnosed and/or treated for ADHD, learning disabilities, depression, or anxiety disorders.

The Wechsler Intelligence Scale for Children (WISC-III; Wechsler, 1991) was used in the present study in order to measure intelligence in the study participants. The WISC-III is a test of intellectual functioning for children ages six through 16. This test provides a Full Scale IQ score, a Verbal IQ score, and a Performance IQ score. The Verbal IQ score provides information about the subject's verbal processing, comprehension, reasoning, and memory skills. The Performance IQ score provides information about the subject's visual processing, planning, and nonverbal learning skills. The WISC-III consists of 12 subtests; six in the Verbal Scale and six in the Performance Scale. In order to screen out children who may have learning problems independent of any psychiatric diagnosis only children whose Full Scale IQ score is 80 or above were included in the present study.

Dependent Measures

The dependent measures in the current study were a measure of depression, a test of reading ability, a global measure of intellectual functioning, a measure of memory and learning, measures of executive functioning, measures of sustained attention, and measures of parental stress, discipline, expectations of child behavior, hassles, and coping.

Depression. Because depression in children may result in symptoms similar to those of ADHD (i.e., restlessness, inattention), in order to examine the possibility of depressive illness in the study's participants, the Children's Depression Rating Scale-

Revised (CDRS-R; Posnanski, Cook, & Carrol, 1979) was also utilized in the current study. The CDRS-R is a standard clinician-rated interview which is used to establish whether depressive symptoms are present in the child. This CDRS-R consists of questions about the child's mood, functioning in school and other social environments, appetite and sleeping habits, self-esteem, and morbid or suicidal ideation. The CDRS-R can be conducted in approximately 20 minutes and the interviewer then is able to make a rating of the child's level of depression based on his/her answers to the interview questions. A child with a CDRS-R T-score of 65 or more is likely to be diagnosed as clinically depressed with further evaluation (Posnanski et al., 1979). Because the parent was asked about depressive symptoms in the child during the administration of the DICA, the CDRS-R was administered to the child only.

Reading Ability. Because the presence of a reading disability may produce symptoms like those seen in ADHD (Pennington et al., 1993), the Word Attack subtest of the Woodcock-Johnson Psychoeducational Battery-Revised (WJ-R; Woodcock & Johnson, 1989) was administered in order to assess the child's phonological ability in terms of his/her implicit knowledge of letter-sound correspondences. This test consists of 30 nonsense words that the participant must pronounce (i.e., phigh, mafreatsun). A measure of phonological awareness/ability was included in the present study because it has been demonstrated that children with reading disabilities may display symptoms of ADHD although they do not display the executive functioning deficits often associated with the disorder (Pennington et al., 1992).

Intellectual functioning. While the WISC-III served as a screening measure in order to exclude children who had lower than average intelligence, the individual subtests of the WISC-III were analyzed for differential patterns of scores between groups. Significant differences have been found for some diagnostic groups of children on certain subtests and scales of this measure (Moffit & Silva, 1988). The variables of interest were scores on Full Scale IQ (FSIQ), Verbal Scale IQ (VIQ), Performance scale IQ (PIQ), Verbal Comprehension (VC), Perceptual Organization (PO), Freedom From Distractibility (FFD), and Processing Speed (PS). It was hypothesized that there would be no group differences in FSIQ, PIQ, PO, or PS; however, given research that has shown children with conduct disorders to have deficits in verbal skills (Hurschi & Hindelang, 1977; Moffit & Silva, 1988), it was predicted that children in the ADHD+SODD/CD group would receive lower VIQ and VC scores. In addition, based on previous research demonstrating lower scores on the FFD factor on the WISC-III in children with ADHD (Mealer, Morgan, & Luscomb, 1996), and the fact that the subtests included in the FFD factor score require the respondent to utilize verbal working memory, which has been shown to be deficient in children with ADHD (Barkley, 1998), it was hypothesized that children with ADHD-only would score lower than controls on this factor score. However, based on research that has failed to show cognitive deficits in children with ADHD and comorbid conduct disorders (Chee et al., 1989; Schachar et al. 1995), no differences were expected between the ADHD+SODD/CD and control groups on the FFD factor score.

Measures of executive functioning. Mental flexibility was assessed using the Wisconsin Card Sorting Task (WCST; Heaton, 1981). This task requires participants to

generate sorting rules when sorting a series of cards into piles by correctly identifying and implementing sorting rules. The participant must sort cards according to color, shape, and number or stimuli depicted on the card. The examiner initially verbally reinforces sorting the cards in one category, but after the participant makes 10 consecutive correct responses in that category, the examiner begins reinforcing another category without alerting the participant to the change. The participant is then required to shift to a new rule. The WCST variables of interest are the number of trials administered, trials to complete first category (the number of trials taken to make 10 consecutive correct responses), total number of categories achieved, total number/percentage correct, failure to maintain set (interruption of the correct sorting strategy after five consecutive correct responses had been made), perseverative errors/responses (responses that would have been correct on the previous sorting rule), and total errors.

Verbal fluency was measured using the Controlled Oral Word Association Test (COWAT; Benton & Hamsher, 1978). In this task participants are given a letter and asked to name in a one minute period as many words as possible that begin with that letter excluding proper nouns, numbers, and the same word with a different suffix. The letters used in this task were F, A, and S. The task was repeated with the participant being given a category instead of a letter. Participants were then asked to name all of the words that they could think of that belong in that category in a one-minute period. The categories used in the present study were fruits and animals. The variables of interest were the number of words produced in each condition.

Planning abilities were assessed with the Tower of London task (Krikorian, 1994). This test consists of three wooden pegs of varying lengths set on a strip of wood, three wooden balls of varying colors (red, green, blue) with holes the size of the pegs through their centers, and pictures of different arrangements of the balls on the pegs. The examiner arranges the balls on the pegs to a "start position" and then shows the examinee a picture of a different arrangement and tells the examinee to move the balls to match the picture. The examinee is also told that he/she is to try to match the picture in a certain number of moves, and that a move consists of taking a ball off of a peg and placing it on another peg. He/she is further instructed that he/she may only have one ball off of a peg at any time (i.e., that he/she cannot hold one ball in his/her hand while moving another or move two balls at once). The number of correct responses and the time taken to complete each problem are recorded by the examiner. Participants are allowed three trials on each problem and trials are discontinued on each problem after it was matched correctly to the picture. Participants are given a score ranging from 0 to 3 points on each problem. Three points are given if the picture is matched correctly on the first trial, two points are given if the picture is matched on the second trial, one point is given if the picture is matched on the third trial, and no points are given if the participant does not match the balls to the picture correctly on the third trial. Twelve trials are administered. The variable of interest was the total raw score.

It was predicted that children in the ADHD-only group would do more poorly than control children on the variables measured by the WCST, COWAT, and TOL. No

differences between the ADHD+SODD/CD and control groups were expected on these variables.

Sustained attention. Sustained attention was measured with the visual and auditory versions of the Test of Variables of Attention (TOVA; Greenberg & Waldman, 1993). The visual TOVA is a 23-minute fixed-interval visual CPT that is presented on a computer screen. Subjects are required to watch the computer screen continuously while monitoring the screen for the presence of a specified stimulus, a large square with a smaller square adjacent to the top in the larger square. A distracter stimulus, a large square with a smaller square adjacent to the bottom, is also presented. Subjects are required to hold a microswitch in their hand and to press a button a quickly as possible when the correct stimulus is presented. The stimuli are presented for 100 milliseconds every 2 seconds. The target to non-target ratio differs in the two halves of the task. The target is presented on 22.5% of the trials during the first half, whereas the target is presented on 77.5% of the trials during the second half. The 22.5% ratio (stimulus-infrequent condition) was selected as being similar to that of most CPTs and particularly effective at indexing inattention, whereas the 77.5% ratio (stimulus-infrequent condition) was selected to create a condition that places particular demands on response inhibition and impulse control by inducing a strong response set (i.e., very frequent presentation of the target stimulus). The varying target-non-target ratio allows users of the TOVA to examine the effects of differing response demands or response sets on inattention and impulsivity. In addition, scores on the TOVA indices are recorded for each quarter of the

test, thereby allowing users to examine the effects of practice or fatigue on inattention and impulsivity within each of the response conditions.

The auditory version of the TOVA was also administered to the individuals in the present study. This version of the TOVA requires the participant to hold the microswitch and press the button as quickly as possible when the correct tone (i.e., a tone of a high pitch) is presented. The distracter stimulus in the auditory task is a tone of a lower pitch. The auditory stimuli are presented at the same rate and the target stimuli are presented in the same varying concentration as in the visual version of the test. The variables of interest on both versions of the TOVA were errors of omission, errors of commission, reaction time, reaction time variability, D-Prime (a measure of signal detection accuracy), and the ADHD score.

It was predicted that children in the ADHD-only group would do more poorly than control children on the variables measured by the TOVA. No differences between the ADHD+SODD/CD and control groups were expected on these variables.

Parent Measures. The mothers of the children in the current study completed a Family History Questionnaire. This questionnaire assessed whether the parents of the children in the study had been diagnosed with or treated for a variety of psychiatric problems (i.e., ADHD, depression, anxiety, learning disabilities, schizophrenia).

The mothers of the children in the current study also completed the Parenting Stress Index (PSI; Abidin, 1986), a 101-item self-report measure of parenting stress. The PSI measures parenting stress due to child characteristics (Child Domain) and parent

characteristics (Parent Domain) and is one of the most frequently utilized measures of parenting stress in families of children with ADHD (Fischer, 1990). The Child Domain examines the contribution of child characteristics to parenting stress and is comprised of items that are designed to assess parental perceptions and appraisals of the impact that certain child characteristics have on them. The Child Domain is made up of several scales including Distractibility/Hyperactivity (symptoms of ADHD such as overactivity, restlessness, short attention span), Adaptability (the child's ability to adjust to changes in his/her physical or social environment), Reinforces Parent (the degree to which the parent experiences the child as a source of positive reinforcement), Demandingness (the degree to which the parent experiences the child as placing many demands on him/her), Mood (the degree to which the child displays dysfunctional affect), and Acceptance (the degree to which the child possesses characteristics that do not match the parent's expectations). The Parent Domain is comprised of scales that measure specific parent characteristics and family context variables which have been found to impact parenting. The Parent Domain includes several scales including Competence (the degree to which parents feel effective in the parenting role), Isolation (the degree to which parents are socially isolated from peers and relatives), Attachment (the degree to which the parent feels emotional attachment to the child), Health (the physical health of the parent), Role Restriction (the degree to which parents experience their role as restricting their freedom), Depression (the degree to which parents are experiencing symptoms consistent with clinically significant depression), and Spouse (the degree to which parents are lacking support from the other parent). The PSI has been shown to have adequate reliability and validity and can be used with a variety of

populations (Abidin, 1986). The variables of interest on the PSI were the Child Domain subscales and total score, the Parent Domain subscales and total score, the Total Stress score, and the Life Stress score. Based on research that has shown higher stress in families of children with ADHD (Breen & Barkley, 1988; Mash & Johnston, 1983), it was predicted that mothers of children with ADHD-only and ADHD+SODD/CD groups would score higher than controls on the subscales within the Child and Parent Domain of this measure. Given the broader range of symptoms of the comorbid group and research that has shown levels of aggressive and oppositional behavior in children to be associated with higher family stress than ADHD alone (Anastopoulos, Guevremont, Shelton, & DuPaul, 1992), it was also predicted that the mothers of children in the ADHD+SODD/CD group would generally score higher than those of children ADHD-only group on measures in the Child and Parent Domains. Also, based on previous research ADHD (Mash & Johnston, 1983), it was hypothesized that mothers of children in the ADHD-only group would report more parenting stress than the control group mothers on the PSI, but less stress than the mothers of the ADHD+SODD/CD group.

The mothers of the participants in the current study also completed the Parenting Scale (PS; Arnold, O'Leary, Wolff, and Acker, 1993). The PS is a 30-item self-report measure that measures dysfunctional discipline practices in parents. The PS can identify three main dysfunctional discipline styles including Laxness ("If my child gets upset, I back down and give in"), Overreactivity ("Things build up and I do things I don't mean to"), and Verbosity ("I threaten to do things that I won't actually do"). All ineffective discipline practices are paired with a more effective strategy to form the two ends of a

seven-point scale. The parent is asked to indicate where his or her regular discipline strategies fall on the scale between the effective and ineffective strategies. Subscale and overall scores were the variables of interest on this measure. It was hypothesized that mothers of children in the ADHD+SODD/CD group would report more dysfunctional discipline practices on the PS than the ADHD-only and control group mothers. Also, it was hypothesized that mothers of children in the ADHD-only group would report more dysfunctional discipline strategies than mothers of control children, but fewer dysfunctional strategies than the ADHD+SODD/CD group mothers.

The Parent Opinion Questionnaire (POQ; Azar, Robinson, Hekimian, & Twentyman, 1984) is a 80-item questionnaire self-report questionnaire that assesses parental opinions on appropriate child care and expectations of child behavior. Respondents are required to rate whether they agree or disagree with a variety of child behaviors. The POQ yields six subscales, including Self-Care, Family Responsibility and Care of Siblings, Help and Affection to Parents, Leaving Children Alone, Proper Behavior and Feelings, and Punishment. These scores are added together to provide an overall score on the POQ. The variables of interest on this measure were subscale scores and the overall score. It was hypothesized that mothers of children in the ADHD+SODD/CD group would report more inappropriate expectations and beliefs on the POQ than the ADHD-only and control group mothers. Also, it was hypothesized that mothers of children in the ADHD-only group would report more inappropriate expectations and beliefs than the mothers of control children, but fewer inappropriate expectations and beliefs than the ADHD+SODD/CD group mothers.

The Daily Hassles Scale (DHS; Kanner et al., 1981) was also administered to the mothers of the participants in the present study. The DHS assesses the severity of demands and irritants in the respondent's everyday environment. The respondent is asked to rate the severity of the hassles that have occurred in the past month. If a hassle listed on the scale has not occurred in the previous month, the respondent is asked to respond by circling "N/A." The respondent is asked to rate the severity of all hassles that have occurred on a severity scale of 1 (not severe at all) to 5 (extremely severe). The DHS assesses seven types of hassles/stressors using seven subscales: Inner Concerns (i.e., regrets over past decisions, being lonely), Financial Concerns (i.e., concerns about owing money), Time Pressures (too many things to do), Work Hassles (job dissatisfaction), Environmental Hassles (i.e., pollution), Family Hassles (i.e., problems with ones' children), and Health Hassles (i.e., concerns about bodily functions). Subscale scores were the variables of interest on this measure. It was hypothesized that mothers of children in the ADHD+SODD/CD group would report more hassles on the DHS than the ADHD-only and control group mothers. Also, it was hypothesized that mothers of children in the ADHD-only group would report more hassles than the mothers of control children, but fewer hassles than the ADHD+SODD/CD group mothers.

The Coping Strategies Inventory (CSI; Tobin, 1983) is a 72-item self-report questionnaire that assesses the frequency with which respondents use various coping strategies. Items consist of thoughts and behaviors related to coping and participants are asked to rate the items on a frequency scale of 1 (not at all) to 5 (very much). The CSI provides eight coping strategies subscales. The first four subscales, Problem Solving,

Cognitive Restructuring, Social Support, and Expressing Emotions, measure adaptive coping strategies, whereas the latter four subscales, Problem Avoidance, Wishful Thinking, Social Withdrawal, and Self-Criticism, measure maladaptive coping strategies. The reliability and validity of the CSI vary depending on the stressor that the respondent is imagining when rating the frequency with which he/she use the coping strategies. All mothers in the current study were asked to imagine a recent situation in dealing with a behavior problem in their child. The variables of interest on this measure were the subscale scores. It was hypothesized that mothers of children in the ADHD+SODD/CD group would report using more ineffective coping strategies on the CSI than the ADHD-only and control group mothers. Also, it was hypothesized that mothers of children in the ADHD-only group would report more ineffective coping strategies than the mothers of control children, but fewer ineffective coping strategies than the ADHD+SODD/CD group mothers.

Procedure

Potential participants' parents were informed of the opportunity to participate in the present study when they initially contacted a local clinic to have their child evaluated for ADHD. They were told that if they chose to have an assessment conducted, they could receive an extensive evaluation at no cost to them and that they would receive $25.00 for their participation.

Upon arrival at the testing center at the University of North Dakota the mother was asked to sign a consent form stating that she agreed to have her child participate in the study. The child's written assent to participate was also obtained. The mother was

also asked to sign a form stating that any and all information obtained during the evaluation could be released to the office from which he/she was referred. The child was then administered either the visual or auditory TOVA (counterbalanced across subjects). Following the administration of the TOVA, the child was administered the WISC-III by a clinical psychology graduate student trained in the administration of this test. During the administration of the TOVA and WISC-III, the child's mother was interviewed by a master's-level clinical psychology graduate student using the DICA. Following the interview, the mother was given the Child Behavior Checklist, the Family History Questionnaire, the Daily Hassles Scale, the Coping Strategies Inventory, the Parenting Stress Inventory, Parent Opinion Questionnaire, and the Parenting Scale to complete. The mother was told that he/she could complete the questionnaires at any time while their child was being tested.

After completing the WISC-III, the child was given a one-hour lunch break. When testing was resumed after lunch the child was given the version of the TOVA that was not administered in the morning session. He or she was then administered the Word Attack subtest from the WJ-R. Following the Word Attack subtest, the COWAT, the TOL, and the WCST was administered. The order in which these tasks were administered was counterbalanced across participants in order to control for fatigue effects. After testing was completed, the child was assessed for depressive symptomatology using the CDRS-R.

CHAPTER III

Results

An analysis of variance (ANOVA) was conducted to compare the ADHD, ADHD+SODD/CD, and control groups' mean age and grade. Means and standard deviations are reported in Table 1. No significant differences were found between the groups for age, $F(2,55) = 2.147$, $p = .127$, or grade $F(2,55) = 1.294$, $p = .282$.

Table 1. Demographic Information Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Age (in years)	8.32 (1.06)	9.19 (1.72)	9.06 (1.34)
Grade	3.05 (1.03)	3.76 (1.79)	3.28 (1.32)
Maternal Age	35.18 (3.30)	35.88 (5.76)	33.66 (3.29)
Paternal Age	38.18 (5.83)	38.15 (4.59)	36.93b (5.25)
Annual Income	56581.90 (49187.04)	43333.33 (36037.94)	42882.33 (23755.82)

Note. Standard deviations appear in parentheses.

A series of one-way ANOVAs were also conducted to compare the ADHD, ADHD+SODD/CD, and control groups on maternal/paternal age, and yearly income. Means and standard deviations as a function of group are reported in Table 1. No significant differences were found between the groups on any of these variables (all ps > .279). Chi-square analysis was performed comparing the groups on family composition. The families were separated into three groups: mother-only (i.e., child living with biological mother only), intact (i.e., child living with both biological parents), and other (e.g., child living with mother and stepfather) . The chi-square was significant, $\chi^2(4, N = 70) = 11.16$, $p < .05$. An examination of the proportion and number of mother-only intact, and other families presented in Table 2 suggests that the ADHD+SODD/CD group had significantly more single mothers than the ADHD-only and control groups.

Table 2. Proportion of Mother-Only, Intact, and Other Families as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Mother-only Families	5%	33%	11%
Intact Families	74%	57%	78%
Other Families	21%	10%	11%

The ADHD, ADHD+SODD/CD, and control groups were also compared on parental history of a variety of developmental and learning problems including ADHD, learning disabilities, depression, and anxiety. The number and percentage of parents who

Table 3. Percentage and Number of Parents with Psychiatric and Learning Problems as a Function of Group

	Mother		
	ADHD-only	ADHD+SODD/CD	Control
ADHD	12% (2)	15% (3)	0% (0)
Learning Disability	6% (1)	10% (2)	13% (2)
Depression	47% (8)	40% (8)	27% (4)
Anxiety	24% (4)	25% (5)	7% (1)
	Father		
	ADHD-only	ADHD+SODD/CD	Control
ADHD	6% (1)	5% (1)	14% (2)
Learning Disability	6% (1)	5% (1)	0% (0)
Depression	0% (0)	10% (2)	29% (4)
Anxiety	0% (0)	5% (1)	0% (0)

Note. The number of parents in each group with a history of each disorder appears in parentheses.

reported having each disorder are presented in Table 3. The ADHD, ADHD+SODD/CD, and control groups were also compared on the number of children in each group who participated in specialized classes at school. The number and corresponding percentage of children in each group participating in such classes are presented in Table 4. A one-way ANOVA conducted on these data revealed significant differences between groups on this variable, $F(2,55) = 4.687$, $p = .013$. Subsequent analyses using Tukey's procedure revealed that significantly more children in the ADHD+SODD/CD group had been referred for special classes at school when compared to control children. Pairwise comparisons revealed no other significant differences between groups on this variable.

Table 4. Number and Percentage of Children Referred for Specialized Classes as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Number	8	11	2
Percentage	42%	55%	11%

DICA and Child Behavior Checklist

The number of ADHD and SODD/CD symptoms reported by the mothers in each of the groups on the DICA were compared using a series of one-way ANOVAs. Means and standard deviations are reported in Table 5. Because children were required to have at least six symptoms of ADHD to be included in either clinical group and at least four symptoms of SODD/CD were required for inclusion in the ADHD+SODD/CD group, as

expected based on selection procedures, significant differences between groups were found between the number of ADHD symptoms reported on the DICA, $F(2, 53) = 138.73$, $p < .001$. Subsequent analyses using Tukey's procedure revealed that both the ADHD-only and ADHD+SODD/CD groups' mothers reported more ADHD symptoms in their children than did control group mothers, and that the mothers in the ADHD+SODD/CD group reported more ADHD symptoms in their children than did

Table 5. ADHD and SODD/CD Symptoms Reported by Mothers on the DICA as Function of Group

	ADHD-only	ADHD+SODD/CD	Control
ADHD Symptoms	8.32	11.74	.61
SODD/CD Symptoms	1.58	9.53	.39

Note. Standard deviations appear in parentheses.

mothers in the ADHD-only group. Also, significant differences were found between groups on the number of SODD/CD symptoms reported on the DICA, $F(2, 53) = 151.86$, $p < .001$. Subsequent analyses using Tukey's procedure revealed that, as expected, the ADHD+SODD/CD group mothers reported more SODD/CD symptoms in their children than did the ADHD-only or control group mothers.

During the DICA interview, the mothers of children in the clinical groups also reported the age when the child's symptoms of ADHD and/or SODD/CD became apparent. A series of one-way ANOVAs was then used to compare the clinical groups on

age of ADHD and SODD/CD symptom onset. Analyses revealed no differences between the ADHD-only and ADHD+SODD/CD groups on the age of ADHD symptom onset (4.47 years and 4.90 years respectively). The mean age of onset for the SODD/CD symptoms in the ADHD+SODD/CD group was 6.05. In the ADHD+SODD/CD group, eight mothers (42%) reported that their child's SODD/CD and ADHD symptoms had onset at the same time, nine (47%) reported that their child's ADHD symptoms developed prior to their SODD/CD symptoms, and two (11%) mothers reported that their child's SODD/CD symptoms developed prior to their ADHD symptoms.

The CBCL competed for each child was scored and T-scores were computed for each of the subscales. A series of one-way ANOVAs was conducted for each of these measures. Means and standard deviations for all subscales are reported in Table 6.

Because high scores (T-score > 65) on the Attention Problems subscale were used as inclusion criteria in the ADHD-only and ADHD+SODD/CD groups, as expected based on selection procedures, significant differences between groups were found on this subscale, $F(2,53) = 44.971$, $p < .001$. Subsequent analyses using Tukey's procedure revealed that the ADHD-only and ADHD+SODD/CD groups received significantly higher scores than the control group on this subscale. Pairwise comparisons also revealed that the ADHD+SODD/CD group received significantly higher scores than the ADHD-only group on the Attention Problems subscale. In addition, because high scores (T-score > 65) on the Delinquent Behavior and Aggressive Behavior subscales were used as inclusion

criteria in the ADHD+SODD/CD group, as expected based on selection procedures, significant differences between groups were found on these subscales (Delinquent

Table 6. Child Behavior Checklist T-Score Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Withdrawn	55.74 (8.89)	61.00 (8.94)	51.56 (3.31)
Somatic Complaints	55.11 (5.90)	57.52 (7.76)	52.38 (3.26)
Anxious/Depressed	55.68 (5.78)	62.23 (7.36)	52.44 (4.47)
Social Problems	56.79 (7.80)	64.24 (9.52)	51.56 (3.16)
Thought Problems	57.26 (6.27)	60.14 (8.65)	52.31 (4.48)
Attention Problems	66.58 (5.46)	71.81 (8.61)	51.93 (3.44)
Delinquent Behavior	52.84 (3.93)	63.62 (8.38)	50.25 (0.44)
Aggressive Behavior	52.16 (3.20)	68.81 (8.37)	50.63 (1.71)
Internalizing	53.84 (8.51)	62.71 (8.62)	44.94 (8.94)
Externalizing	49.26 (6.77)	67.29 (7.26)	40.29 (8.31)

Note. Standard deviations appear in parentheses.

Behavior, $F(2,53) = 30.463$, $p < .001$, Aggressive Behavior, $F(2,53) = 64.601$, $p < .001$). As expected, subsequent analyses revealed that the ADHD+SODD/CD group received significantly higher scores on these subscales when compared with the ADHD-only and control groups. No differences were found between the ADHD-only and control groups on either the Delinquent Behavior or Aggressive Behavior subscales.

Significant differences between groups were also found on all other subscale scores on the CBCL, including Withdrawn, $F(2,53) = 6.870$, $p = .002$, Somatic Complaints, $F(2,53) = 3.208$, $p = .048$, Anxious/Depressed, $F(2,53) = 12.538$, $p < .001$, Social Problems, $F(2,53) = 13.070$, $p < .001$, Thought Problems, $F(2,53) = 5.927$, $p = .005$, Internalizing, $F(2,50) = 17.784$, $p < .001$, and Externalizing, $F(2,50) = 58.126$, $p < .001$. Subsequent analyses using Tukey's procedure revealed that the ADHD+SODD/CD group scored significantly higher than the control group on all subscales, and the ADHD-only group scored significantly higher than the control group on the Attention Problems, Internalizing, and Externalizing subscales. analyses using Tukey's procedure also revealed that the ADHD+SODD/CD group scored significantly higher than the ADHD-only group on the Anxious/Depressed, Social Problems, Internalizing, and Externalizing subscales.

Word Attack Subtest

The Word Attack subtest standard scores based on age and grade were determined for each participant. The ADHD, ADHD+SODD/CD, and control groups' raw and standard scores on the Word Attack subtest were compared using a series of one-way

ANOVAs. Means and standard deviations are presented in Table 7. Significant differences were found between the groups on the Word Attack raw score, $F(2,51) = 4.914$, $p = .011$. Subsequent analyses using Tukey's procedure revealed that the ADHD-only group received significantly lower scores on this measure than the control group. No significant differences were found between the ADHD-only and ADHD+SODD/CD group or between the ADHD+SODD/CD and control groups on Word Attack raw scores. Significant differences were found between the groups on the Word Attack standard score based on age, $F(2,54) = 3.21$, $p = .048$. Subsequent analyses using Tukey's procedure revealed that the ADHD-only group received significantly lower scores on this measure than the control group. No significant differences were found between the ADHD-only

Table 7. Word Attack and CDRS-R Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Word Attack (raw score)	10.61 (6.10)	14.56 (8.45)	18.27 (7.28)
Word Attack (age standard score)	97.05 (11.02)	101.55 (14.66)	108.44 (15.23)
Word Attack (grade standard score)	99.16 (11.09)	102.55 (14.57)	110.12 (15.61)
CDRS-R (T-score)	51.91 (8.74)	57.95 (8.58)	44.29 (7.82)

Note. Standard deviations appear in parentheses.

and ADHD+SODD/CD groups or between the ADHD+SODD/CD and control groups on Word Attack standard scores based on age. Marginally significant differences were found between the groups on the Word Attack standard score based on grade, $F(2,53) = 2.92$, $p = .063$. Subsequent analyses using Tukey's procedure revealed that the ADHD-only group received significantly lower scores on this measure than the control group. No significant differences were found between the ADHD-only and ADHD+SODD/CD groups or between the ADHD+SODD/CD and control groups on Word Attack standard scores based on grade.

Child Depression Rating Scale- Revised

A T-score was computed for each participant on the CDRS-R. Means and standard deviations are presented in Table 7. A one-way ANOVA was conducted on these scores and a significant difference between groups was revealed, $F(2,52) = 10.832$, $p < .001$, and subsequent analyses using Tukey's procedure revealed that the both the ADHD-only and the ADHD+SODD/CD had significantly higher CDRS-R scores than the control group. No differences were found between the ADHD-only and ADHD+SODD/CD groups on this measure.

Wechsler Intelligence Scale for Children-Third Edition

The WISC-III IQ and index scores (mean = 100, standard deviation = 15) were computed (Wechsler, 1991) and a series of one-way ANOVAs were conducted comparing the WISC-III index scores of the ADHD, ADHD+SODD/CD, and control group participants. Means and standard deviations are presented in Table 8. Significant

differences were found between the groups on Verbal IQ, $F(2,55) = 5.400$, $p = .007$, Verbal Comprehension, $F(2,55) = 4.451$, $p = .016$, and Freedom From Distractibility, $F(2,55) = 4.554$, $p = .015$. Subsequent analyses revealed that the ADHD-only group obtained significantly lower scores on Verbal IQ, Verbal Comprehension, and Freedom From Distractibility when compared with the control group. Analyses also revealed that the ADHD+SODD/CD group obtained significantly lower scores than the control

Table 8. WISC-III Index Scores Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Verbal Comprehension	97.63 (11.95)	100.00 (14.16)	109.11 (14.16)
Perceptual Organization	105.84 (11.52)	105.42 (13.38)	105.17 (11.83)
Freedom From Distractibility	91.37 (9.85)	94.38 (9.29)	102.39 (14.85)
Processing Speed	97.84 (9.81)	99.00 (10.51)	103.78 (9.34)
Verbal IQ	96.63 (10.99)	99.61 (12.45)	108.44 (10.31)
Performance IQ	103.79 (7.96)	105.05 (9.20)	103.56 (10.76)
Full Scale IQ	99.79 (8.57)	102.81 (9.79)	106.72 (9.47)

Note. Standard deviations appear in parentheses.

participants on Verbal IQ. Pairwise comparisons revealed no significant differences between the ADHD-only and ADHD+SODD/CD groups on Verbal IQ, Verbal Comprehension, or Freedom From Distractibility. No significant differences were found between groups on the Performance IQ, Full Scale IQ, Perceptual Organization, or Processing Speed indices.

Wisconsin Card Sorting Test

WCST raw scores on Number of Trials Administered, Total Correct, Number of Categories Completed, Failure to Maintain Set, Responses to Other, Trials to Complete First Category, Total Errors, Perseverative Responses, and Perseverative Errors were computed according to standard procedures described in Heaton (1981). Each of the raw scores was subjected to one-way ANOVAs comparing the mean raw scores of the ADHD, ADHD+SODD/CD, and control groups. Means and standard deviations are presented in Table 9. Significant differences were found between the groups on the Number of Trials Administered, $F(2,55) = 5.954$, $p = .005$, Total Correct, $F(2,55) = 3.202$, $p = .048$, Percent Correct, $F(2,55) = 8.486$, $p = .001$, Number of Categories Completed, $F(2,55) = 6.192$, $p = .004$, Trials to Complete First Category, $F(2,55) = 4.307$, $p = .018$, Total Errors, $F(2,55) = 8.807$, $p < .001$, Perseverative Responses, $F(2,55) = 5.680$, $p = .006$, and Perseverative Errors, $F(2,55) = 6.314$, $p = .003$. Subsequent analyses using Tukey's procedure revealed that the ADHD-only group did significantly worse than the control group on the Number of Trials Administered, Total Correct, Number of Categories Completed, Trials to Complete First Category, Total Errors, Perseverative Responses, and

Table 9. WCST Raw Score Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Total Trials Administered	123.47 (11.21)	116.38 (17.69)	105.56 (17.74)
Total Number Correct	61.53 (16.90)	69.35 (11.70)	71.72 (8.81)
Percent Correct	50.68 (15.92)	61.52 (13.77)	69.72 (12.40)
Total Errors	61.95 (21.88)	46.45 (20.73)	33.83 (18.38)
Perseverative Responses	44.74 (31.66)	30.90 (23.00)	18.61 (10.97)
Perseverative Errors	36.58 (24.46)	24.50 (14.32)	16.61 (9.41)
Categories Completed	3.68 (2.00)	4.48 (1.44)	5.50 (1.15)
Trials to Complete First Category	30.11 (35.16)	13.48 (5.13)	12.94 (5.22)
Failures to Maintain Set	.47 (.70)	.75 (.99)	.77 (1.31)

Note. Standard deviations appear in parentheses.

Perseverative Errors. Tukey's procedure also revealed that the ADHD-only group performed worse than the control group on Total Correct ($p = .051$). Analysis using Tukey's procedure also revealed that the ADHD-only group did significantly worse than the ADHD+SODD/CD group on Total Correct and Trials to Complete First Category.

Tukey's procedure also revealed marginal significance between the clinical groups on Total Errors ($p = .052$), with the ADHD-only group performing more poorly than the ADHD+SODD/CD group. No group differences were found on Failure to Maintain Set and no significant differences were revealed between the ADHD+SODD/CD groups and the control group on any WCST variables.

Controlled Oral Word Association Test

The number of words generated on the letters task and the category task were computed separately for each participant and the scores were subjected to a one-way ANOVA. The mean number of words produced and standard deviations are presented in Table 10. Significant differences were found between the groups on the letters condition, $F(2,55) = 4.494$, $p = .016$. Subsequent analyses using Tukey's procedure revealed that the ADHD-only group recalled significantly fewer words than the control group in this

Table 10. COWAT and TOL Raw Score Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
COWAT Letters	17.05 (6.09)	20.24 (6.40)	23.72 (7.78)
COWAT Categories	17.47 (4.43)	22.00 (16.02)	22.22 (5.11)
TOL Total Points	26.68 (3.23)	27.52 (2.97)	30.39 (3.90)

Note. Standard deviations appear in parentheses.

condition. Pairwise comparisons revealed no other significant group differences in the letters condition. Also, no significant differences were found between groups in the category condition of the COWAT.

Tower of London

The TOL was scored according to standard procedure (Krikorian, 1994) such that each participant received a score that ranged from 0-3 on each problem, and scores were summed across 12 problems to represent each subjects' performance. A one-way ANOVA was conducted comparing the raw total scores of the ADHD, ADHD+SODD/CD, and control group participants. The mean scores and standard deviations are presented in Table 10. Significant differences were found between the groups, $F(2,55) = 6.142$, $p = .004$ on this measure, and subsequent analyses revealed that both the ADHD-only and the ADHD+SODD/CD group obtained significantly poorer scores this measure when compared with the control group. No differences between the ADHD-only and ADHD+SODD/CD groups were revealed on this measure.

Test of Variables of Attention

The TOVA scoring program computed standard scores for each subject (mean = 100, standard deviation = 15) for the measures of errors of omission (failing to respond when the target was present), errors of commission (responding when the target was not presented), reaction time, reaction time variability, and D-Prime (a measure of signal detection accuracy).

Omission Errors. The standard score for errors of omission was calculated for each of the four quartiles and both modalities for each participant. Means and standard deviations for the three groups are presented in Table 11. A 3 (group) X 4 (quartiles) X 2 (modality) mixed ANOVA was conducted on these data. Analyses revealed a significant

Table 11. TOVA Omission Errors Means and Standard Deviations as a Function of Group

	Visual			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	94.69 (4.32)	83.56 (6.37)	90.13 (5.23)	88.38 (5.06)
ADHD+SODD/CD	92.07 (4.47)	84.40 (6.58)	83.00 (5.40)	84.60 (5.29)
Control	103.46 (5.21)	90.37 (7.68)	94.36 (6.30)	101.36 (6.11)

	Auditory			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	78.69 (4.92)	78.00 (6.07)	84.25 (3.53)	86.19 (4.58)
ADHD+SODD/CD	86.80 (5.08)	82.27 (6.22)	95.47 (3.65)	90.73 (4.73)
Control	100.27 (5.93)	95.09 (7.27)	100.55 (4.36)	94.00 (5.53)

Note. Standard deviations appear in parentheses.

main effect of quartile, $F(3,117) = 4.529$, $p = .005$. Subsequent analyses of this main effect using Tukey's procedure revealed that participants did significantly more poorly on quartile two (mean standard score = 85.61) when compared with quartiles one and three (mean standard scores = 92.67 and 91.29, respectively). A significant interaction between modality and quartile, $F(3,117) = 2.861$, $p = .040$ was also revealed. Means and standard deviations as a function of modality and quartile are presented in Table 12. Subsequent analyses of this interaction using Tukey's procedure revealed that participants made more omission errors on the Auditory TOVA than on the Visual TOVA in the first quartile. No differences were found between modalities for the second, third, or fourth quartiles. Post-hoc analyses of the modality and quartile interaction also revealed that participants made significantly more omission errors in quartile two than in quartile one on the Visual TOVA, and significantly more omission errors in quartile two than in quartile three on the Auditory TOVA. No significant differences between groups were revealed for omission errors on the TOVA.

Table 12. TOVA Omission Errors Means and Standard Deviations as a Function of Quartile and Modality

Modality	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Visual	96.74	86.11	89.16	91.45
	(2.70)	(3.98)	(3.27)	(3.17)
Auditory	88.59	85.12	93.42	90.31
	(3.08)	(3.77)	(2.21)	(2.87)

Note. Standard deviations appear in parentheses.

Commission Errors. The standard score for errors of commission was calculated for each of the four quartiles and both modalities for each participant. Means and standard deviations for the three groups are presented in Table 13. A 3 (group) X 4 (quartiles) X 2 (modality) mixed ANOVA was conducted on these data. Analyses revealed a significant main effect of modality F (1,39) = 20.151, $p < .001$, indicating that

Table 13. TOVA Commission Errors Standard Scores Means and Standard Deviations as Function of Group

	Visual			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	102.69 (3.50)	99.13 (3.11)	98.63 (4.17)	100.75 (4.36)
ADHD+SODD/CD	100.27 (3.61)	99.67 (3.22)	94.13 (4.31)	95.20 (4.51)
Control	98.36 (4.22)	96.73 (3.76)	101.18 (5.03)	101.09 (5.26)

	Auditory			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	78.56 (4.74)	85.88 (6.00)	76.13 (6.13)	81.63 (4.72)
ADHD+SODD/CD	94.40 (4.89)	84.53 (6.20)	83.47 (6.33)	81.53 (4.88)
Control	95.64 (5.71)	93.64 (7.24)	90.91 (7.39)	92.18 (5.70)

Note. Standard deviations appear in parentheses.

participants made significantly more commission errors on the Auditory TOVA (mean standard score = 86.54) than they did on the Visual TOVA (mean standard score = 99.00). No significant differences between groups were revealed for commission errors on the TOVA.

Reaction Time. The standard score for response latency was calculated for each of the four quartiles and both modalities for each participant. Means and standard deviations for the three groups are presented in Table 14. A 3 (group) X 4 (quartiles) X 2 (modality) mixed ANOVA was conducted on these data. Analyses revealed a significant main effect of group, $F(2,39) = 3.78$, $p = .032$. Subsequent analyses of this main effect revealed that response latencies for the ADHD-only group (mean standard score = 87.81) were significantly slower than those of the control group (103.68). No differences the ADHD+SODD/CD (mean standard score = 92.02) and ADHD-only or control groups were revealed.

Reaction Time Variability. The standard score for reaction time variability was calculated for each of the four quartiles and both modalities for each participant. Means and standard deviations for the three groups are presented in Table 15. A 3 (group) X 4 (quartiles) X 2 (modality) mixed ANOVA was conducted on these data. Analyses revealed a marginal main effect of modality, $F(1,38) = 3.821$, $p = .058$, indicating that the reaction times on the Auditory TOVA (mean standard score = 89.16) were slower than those on the Visual TOVA (mean standard score = 93.10). No significant differences between groups were revealed for reaction time variability on the TOVA.

Table 14. TOVA Reaction Time Means and Standard Deviations as a Function of Group

	Visual			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	87.13 (4.77)	83.44 (4.99)	89.81 (4.96)	87.25 (4.55)
ADHD+SODD/CD	92.40 (4.93)	92.47 (5.15)	95.60 (5.12)	95.67 (4.69)
Control	102.91 (5.76)	102.18 (6.02)	101.00 (5.98)	99.18 (5.48)

	Auditory			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	82.68 (6.08)	86.50 (5.76)	91.81 (4.44)	93.69 (4.52)
ADHD+SODD/CD	86.53 (6.28)	91.33 (5.95)	91.47 (4.58)	90.67 (4.67)
Control	107.91 (7.34)	103.27 (6.95)	108.63 (5.35)	104.36 (5.45)

Note. Standard deviations appear in parentheses.

D-Prime. The standard score for D-Prime was calculated for each of the four quartiles and both modalities for each participant. Means and standard deviations for the three groups are presented in Table 16. A 3 (group) X 4 (quartiles) X 2 (modality) mixed ANOVA was conducted on these data. Analyses revealed a significant main effect of modality $F(1,39) = 6.909$, $p = .012$, indicating that D-Prime standard scores were

Table 15. TOVA Reaction Time Variability Means and Standard Deviations as Function of Group

	Visual			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	88.38 (4.77)	86.88 (4.21)	89.63 (4.55)	91.69 (4.14)
ADHD+SODD/CD	91.87 (4.93)	91.80 (4.35)	92.80 (4.69)	95.27 (4.27)
Control	101.90 (6.04)	94.10 (5.33)	93.90 (5.75)	99.00 (5.24)

	Auditory			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	82.38 (4.86)	87.88 (4.02)	83.56 (4.01)	87.50 (3.57)
ADHD+SODD/CD	90.87 (5.02)	88.07 (4.15)	89.80 (4.14)	89.27 (3.68)
Control	96.30 (6.15)	90.40 (5.09)	90.00 (5.07)	93.90 (4.51)

Note. Standard deviations appear in parentheses.

significantly lower on the Auditory TOVA (mean standard score = 85.78) than on the Visual TOVA (mean standard score = 91.24). Analyses also revealed a significant main effect of group, $F(2,39) = 4.944$, $p = .012$. Subsequent analyses of this main effect revealed that signal detection accuracy (D-Prime) for the ADHD-only group (mean = 84.50) was significantly lower than that of the control group (mean = 103.68). No

Table 16. TOVA D-Prime Means and Standard Deviations as a Function of Group

	Visual			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	95.44 (3.36)	88.44 (4.13)	86.13 (3.75)	87.13 (3.09)
ADHD+SODD/CD	89.87 (3.47)	92.93 (4.27)	83.80 (3.88)	84.73 (3.19)
Control	100.36 (4.05)	92.36 (4.99)	95.36 (4.53)	98.36 (3.73)

	Auditory			
Group	Quartile 1	Quartile 2	Quartile 3	Quartile 4
ADHD	74.31 (4.43)	78.06 (4.85)	81.50 (2.95)	85.00 (3.19)
ADHD+SODD/CD	83.20 (4.57)	80.53 (5.01)	86.47 (3.05)	84.33 (3.30)
Control	91.73 (5.34)	89.46 (5.85)	98.55 (3.56)	96.18 (3.85)

Note. Standard deviations appear in parentheses.

pairwise differences involving the ADHD+SODD/CD group (mean standard score = 85.73) were revealed. Analyses also revealed a significant interaction of modality and quartile, $F(3, 117) = 4.664$, $p = .004$. Means and standard deviations as a function of modality and quartile are presented in Table 17. Subsequent analyses of this interaction using Tukey's procedure revealed that participants had lower D-Prime standard scores on

Table 17. TOVA D-Prime Means and Standard Deviations as a Function of Quartile and Modality

Modality	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Visual	95.22	91.25	88.43	90.07
	(2.10)	(2.59)	(2.35)	(1.93)
Auditory	83.80	82.68	88.84	88.51
	(2.77)	(3.04)	(1.84)	(2.00)

Note. Standard deviations appear in parentheses.

the Auditory TOVA than on the Visual TOVA in the first and second quartiles, while no differences were found between modalities for the third or fourth quartiles. Analyses also revealed that participants had significantly lower standard scores in quartile one than in quartiles three or four on the Visual TOVA. On the Auditory TOVA participants had significantly lower standard scores in quartile three than in quartiles two and one, and significantly lower standard scores in quartile four than in quartiles one and two.

ADHD Score. A one-way ANOVA was conducted comparing the mean scores of the ADHD, ADHD+SODD/CD, and control groups' ADHD scores from the TOVA. No significant differences were found between the groups on this variable, $p = .325$.

Parenting Stress Index

Child Domain. A series of one-way ANOVAs was conducted comparing the mean scores of the ADHD, ADHD+SODD/CD, and control group participants' parents on the Child Domain section of the Parenting Stress Index. Means and standard deviations are presented in Table 18. Significant differences were found between the groups on the

Child Domain composite score, $F(2,50) = 64.270$, $p < .001$, and on all Child Domain subscales, including Distractibility/Hyperactivity, $F(2,50) = 35.177$, $p < .001$, Adaptability, $F(2,50) = 10.391$, $p < .001$, Reinforces Parent, $F(2,50) = 25.177$, $p < .001$, Demandingness, $F(2,50) = 31.689$, $p < .001$, Mood, $F(2,50) = 48.475$, $p < .001$, and Acceptance, $F(2,50) = 33.726$, $p < .001$. Subsequent analyses using Tukey's procedure revealed that the ADHD-only group parents received significantly higher scores (indicating higher stress in these areas) on Distractibility/Hyperactivity, Adaptability, Demandingness, Mood, Acceptance, and the total Child Domain score when compared to the control group. Analyses also revealed that the ADHD+SODD/CD group received significantly higher scores on Distractibility/Hyperactivity, Adaptability, Reinforces Parent, Demandingness, Mood, Acceptance, and composite Child Domain when compared with the control group. Post-hoc analyses using Tukey's procedure also revealed significant differences between the ADHD-only and the ADHD+SODD/CD group on Distractibility, Reinforces Parent, Demandingness, Mood, Acceptance, and total Child Domain, with the ADHD+SODD/CD group receiving significantly higher scores on all variables as compared with the ADHD-only group.

Parent Domain. A series of one-way ANOVAs were conducted comparing the mean scores of the ADHD, ADHD+SODD/CD, and control group participants' parents on the Parent Domain section of the Parenting Stress Index. Means and standard deviations are presented in Table 19. Significant differences were found between the groups on the Parent Domain composite score, $F(2,50) = 11.500$, $p < .001$, Sense of

Table 18. Parenting Stress Index Child Domain Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Distractibility	28.16 (5.04)	32.24 (2.65)	19.85 (3.63)
Adaptability	26.79 (5.01)	30.71 (7.70)	20.46 (5.72)
Reinforces Parent	9.79 (2.59)	14.00 (1.52)	9.39 (2.50)
Demandingness	18.90 (5.78)	25.05 (2.73)	13.85 (2.55)
Mood	12.05 (3.03)	17.10 (2.02)	8.92 (2.10)
Acceptance	14.05 (3.29)	17.95 (2.38)	10.15 (2.27)
Total Child Domain	109.74 (17.90)	140.24 (12.61)	82.62 (12.12)

Note. Standard deviations appear in parentheses.

Competence, $F(2,50) = 12.284$, $p < .001$, Attachment, $F(2,50) = 22.158$, $p < .001$, Restriction of Role, $F(2,50) = 3.433$, $p = .040$, Depression, $F(2,50) = 6.101$, $p = .004$, and Relationship with Spouse, $F(2,50) = 5.131$, $p = .009$ subscales. Subsequent analyses using Tukey's procedure revealed that the ADHD-only group parents obtained significantly higher scores on Attachment, Restriction of Role, Relationship with Spouse, and composite Parent Domain when compared with the control group parents. Post-hoc

analyses also revealed that the ADHD+SODD/CD parents received significantly higher scores on Sense of Competence, Attachment, Depression, Relationship with Spouse, and total Parent Domain when compared with the control group parents. The analyses also revealed significant differences between the ADHD-only and the ADHD+SODD/CD group parents on Attachment, with the ADHD+SODD/CD group parents receiving significantly higher scores on this variable as compared to the ADHD-only group parents.

Parenting Stress and Life Stress. The mean total Parenting Stress and Life Stress scores on the Parenting Stress Index of the ADHD, ADHD+SODD/CD, and control group participants' parents were also compared using one-way ANOVAs. Means and standard deviations are presented in Table 19. Analyses revealed significant differences between groups on Parenting Stress, $F(2,50) = 36.229$, $p < .001$. A marginal difference was found between groups for total Life Stress, $F(2,50) = 2.954$, $p = .061$. Subsequent analyses using Tukey's procedure revealed that both the ADHD-only parents and the ADHD+SODD/CD parents reported more total Parenting Stress when compared to control group parents, and the ADHD+SODD/CD group parents reported significantly more Parenting Stress as compared with the ADHD-only group parents.

Parenting Scale

Four scores (Laxness, Overreactivity, Verbosity, and Overall) were computed for each participant on the Parenting Scale, and a series of one-way ANOVAs were conducted comparing the mean scores of the ADHD, ADHD+SODD/CD, and control group participants' parents. Means and standard deviations are presented in Table 20.

Table 19. Parenting Stress Index Parent Domain Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Sense of Competence	28.68 (6.77)	30.71 (7.34)	19.77 (3.79)
Sense of Isolation	13.90 (3.13)	12.91 (3.32)	11.54 (3.91)
Attachment	12.05 (2.93)	15.00 (2.15)	9.31 (2.14)
Health	12.16 (2.76)	12.10 (1.90)	10.31 (3.01)
Restriction of Role	18.26 (5.04)	17.00 (3.62)	14.31 (3.77)
Depression	17.84 (4.76)	20.24 (4.57)	14.77 (3.68)
Relationship with Spouse	17.68 (4.12)	17.14 (2.59)	13.69 (4.39)
Parent Domain	120.26 (24.61)	126.91 (16.59)	93.69 (17.84)
PSI Total	230.00 (37.53)	267.14 (25.66)	176.31 (24.56)
Total Life Stress	7.31 (3.03)	6.32 (4.99)	3.77 (3.83)

Note. Standard deviations appear in parentheses.

Significant differences were found between the groups on Laxness, $F(2,50) = 5.692$, $p = .006$, Overreactivity, $F(2,50) = 10.860$, $p < .001$, and Overall Score, $F(2,50) = 7.443$, $p =$

.001. Subsequent analyses using Tukey's procedure revealed that both the ADHD-only and ADHD+SODD/CD group parents had higher scores on Laxness, Overreactivity, and

Table 20. Parenting Scale Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Laxness	2.62	2.64	2.03
	(.60)	(.55)	(.53)
Overreactivity	2.86	3.31	2.19
	(.73)	(.77)	(.40)
Verbosity	3.95	3.82	3.64
	(.60)	(.75)	(.87)
Overall	3.07	3.20	2.54
	(.54)	(.51)	(.41)

Note. Standard deviations appear in parentheses.

Overall Score when compared to the control group parents. No significant differences were found between the ADHD-only and ADHD+SODD/CD groups on these variables, although there was a significant trend towards higher Overreactivity in the ADHD+SODD/CD group ($p = .10$). No differences were found between groups on Verbosity.

Parent Opinion Questionnaire

Scores for all six subscales (Self-Care, Family Responsibility and Care of Siblings, Help and Affection to Parents, Leaving Children Alone, Proper Behavior and Feelings, and Punishment) were derived for each participant on the POQ. An Overall score was

also computed from the subscale scores. Means and standard deviations are presented in Table 21. Higher scores indicate more problematic parent opinions of proper child

Table 21. Parent Opinion Questionnaire Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Self-Care	.62 (.53)	.83 (.53)	.15 (.38)
Family Responsibility	1.15 (.56)	1.41 (1.02)	.62 (.51)
Help/Affection to Parents	.69 (.70)	.83 (1.13)	.23 (.44)
Leaving Children Alone	.62 (.53)	.17 (.29)	.31 (.48)
Proper Behavior/Feelings	1.00 (.67)	1.67 (.80)	.85 (.69)
Punishment	.23 (.49)	.75 (1.31)	.00 (.00)
POQ Total	.23 (.36)	.25 (.34)	.54 (.52)

Note. Standard deviations appear in parentheses.

behavior in the area assessed by the subscale. A series of one-way ANOVAs was conducted comparing the mean scores of the ADHD, ADHD+SODD/CD, and control group participants' parents on the POQ. Significant differences were found between the groups on Self-Care, $F(2,50) = 7.469$, $p = .001$, Family Responsibility and Care of

Siblings, $F(2,50) = 4.331$, $p = .018$, Leaving Children Alone, $F(2,50) = 5.418$, $p = .007$, Proper Behavior/Feelings, $F(2,50) = 6.592$, $p = .003$, and Punishment, $F(2,50) = 3.356$, $p = .043$. Subsequent analyses using Tukey's procedure revealed that the ADHD+SODD/CD parents received higher scores on Self-Care, Family Responsibility and Care of Siblings, Proper Behavior/Feelings, and Punishment when compared to the control group. Analyses also revealed that the ADHD+SODD/CD group parents received significantly higher scores on the Leaving Children Alone and Proper Behavior/Feelings subscales compared to the ADHD-only group parents. Finally, analyses revealed that the ADHD-only group parents received significantly higher scores on the Self-Care subscale compared to the control group parents.

Hassles Scale

The Hassles Scale was scored resulting in seven subscales scores and a total score for each participant. Means and standard deviations are presented in Table 22. Higher scores indicate more hassles in the area assessed by the subscale. These scores were subjected to a series of one-way ANOVAs comparing the mean scores of the ADHD, ADHD+SODD/CD, and control group participants' parents on this measure. Significant differences were found between the groups on the Family Hassles subscale, $F(2,50) = 13.892$, $p < .001$. Subsequent analyses revealed that the ADHD+SODD/CD group parents reported more Family Hassles compared to both the ADHD-only and the control group parents. No differences were found between groups on Inner Concerns, Time Pressures, Health Hassles, Work Hassles, Environmental Hassles, or Total Hassles.

Table 22. Hassles Scale Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Inner Concerns	14.39 (8.40)	19.46 (10.39)	14.69 (11.75)
Time Pressures	12.62 (4.84)	15.27 (4.68)	10.92 (8.43)
Health Hassles	2.77 (1.95)	3.09 (2.69)	3.23 (3.27)
Work Hassles	4.15 (3.31)	2.73 (2.05)	3.92 (3.50)
Environmental Hassles	2.92 (2.07)	3.73 (1.76)	2.77 (3.54)
Financial Concerns	8.15 (5.31)	11.55 (6.21)	9.23 (7.99)
Family Hassles	6.77 (2.97)	12.27 (4.85)	6.15 (3.31)
Total Hassles	51.77 (21.22)	68.09 (23.08)	49.92 (37.35)

Note. Standard deviations appear in parentheses.

Coping Strategies Inventory

Eight subscales scores were derived for each participant on the CSI. Means and standard deviations are presented in Table 23. Higher scores indicate more frequent use of the coping strategies assessed by the subscale. These scores were subjected to a series of one-way ANOVAs comparing the mean scores of the ADHD, ADHD+SODD/CD, and

control group participants' parents on this measure. Significant differences were found between the groups on Problem Solving, $F(2,50) = 3.886$, $p = .027$, Cognitive Restructuring, $F(2,50) = 5.163$, $p = .009$, and Self-Criticism, $F(2,50) = 4.967$, $p = .011$. Subsequent analyses revealed that the ADHD-only and ADHD+SODD/CD group parents scored significantly lower than controls on Cognitive Restructuring. In addition, the

Table 23. Coping Strategies Inventory Means and Standard Deviations as a Function of Group

	ADHD-only	ADHD+SODD/CD	Control
Problem Solving	25.83 (4.65)	30.77 (7.04)	30.00 (5.31)
Cognitive Restructuring	25.92 (4.88)	24.25 (5.97)	29.92 (3.20)
Expressing Emotion	23.08 (4.29)	22.17 (4.38)	20.62 (4.89)
Social Support	27.92 (5.42)	26.50 (5.44)	26.54 (5.92)
Problem Avoidance	16.25 (3.39)	18.08 (3.43)	18.54 (3.95)
Wishful Thinking	17.75 (3.40)	21.08 (5.43)	20.31 (5.28)
Self-Criticism	15.92 (4.42)	18.00 (4.53)	22.00 (7.56)
Social Withdrawal	16.67 (4.66)	19.08 (5.62)	21.15 (8.36)

Note. Standard deviations appear in parentheses.

ADHD-only group parents scored lower on Self-Criticism than control group parents. Finally, analyses revealed that the ADHD-only group parents scored significantly lower on the Problem Solving subscale than the ADHD+SODD/CD group parents.

CHAPTER IV

Discussion

The present study examined differences on a variety of cognitive, neuropsychological, and parenting/family environment measures between children with ADHD-only, ADHD+SODD/CD, and controls. Based on previous research, two major hypotheses were made. First, it was hypothesized that the children with ADHD-only would display neuropsychological/cognitive deficits when compared to controls, but that the ADHD+SODD/CD group would not display such deficits. Second, it was hypothesized that children in the ADHD+SODD/CD group would come from more negative family environments, characterized by more parental stress, ineffective discipline techniques, unrealistic child expectations, hassles, and ineffective parental coping strategies, as compared to children in the ADHD-only and control groups. Evidence of a more negative family environment coupled with a lack of neuropsychological/cognitive deficits was presumed to provide evidence that the ADHD symptoms in children with ADHD+SODD/CD may have environmental rather than neurobiological causes.

Executive Functioning Measures

Three measures of executive functioning, the WCST, COWAT, and TOL, were administered to the children in the current study. The results of the first measure, the WCST, revealed that although previous studies utilizing this test to examine executive

functioning in children have yielded inconsistent results, (Barkley and Grodzinski,1994; Boucagnani and Jones, 1989; ; Chelune et al, 1986; Fischer et al., 1990; Gorenstein et al., 1989; Loge et al., 1990; Shue and Douglas, 1989) the present study demonstrated obvious deficits on the WCST in children with ADHD-only as compared to control children. Children in the ADHD-only group showed deficits on nearly all scores computed on the WCST, evidence that, when compared with control children, children with ADHD-only are less mentally flexible, have a tendency to perseverate, and have problems in generating and implementing sorting rules. As predicted based on previous research examining the neuropsychological/cognitive functioning of children with ADHD and comorbid conduct disorders (Chee et al., 1989; Schachar et al., 1995), when compared to control children, the children in the ADHD+SODD/CD group did not show deficits on the WCST. In fact, children in the ADHD+SODD/CD group performed significantly better than children with ADHD-only on a number of WCST measures, including the total number of correct responses and total trials taken to complete the first category, providing strong support for the hypothesis that children with ADHD-only have more severe neuropsychological impairment than children with ADHD+SODD/CD.

A pattern of results similar to those revealed on the WCST was displayed on the letters condition on the COWAT. On this task the ADHD-only group produced significantly fewer words in the letters condition when compared with controls, whereas the ADHD+SODD/CD group did not perform more poorly than control children. Previous studies have suggested that this pattern of results on the COWAT indicates that the participants who produce fewer words have deficits in the executive functions that

allow them to suppress the habit of using words according to their meaning rather than to a lexical property (Walsh, 1978) and to sustain behavior and stay "on-task" (Koziol & Stout, 1992).

The results of the third measure of executive functioning, the TOL, demonstrated partial support for the hypothesis of the present study. On this measure the ADHD-only group was found to be significantly more impaired than the control group; however, the ADHD+SODD/CD group was also found to be impaired on this measure when compared to controls, suggesting that deficits in planning ability as assessed by the TOL may be less specific to children with ADHD. However, although the ADHD+SODD/CD group did more poorly than controls on the TOL, an examination of mean scores revealed that, on average, the ADHD+SODD/CD group performed better on this measure than the ADHD-only group, suggesting that although an impairment may exist in this area of executive functioning in children with ADHD+SODD/CD, this impairment is less severe than that of children with ADHD-only. Thus, along with the results of the WCST and letters condition of the COWAT, the results of the TOL indicate support for the hypothesis that children with ADHD-only have more severe executive functioning deficits than do children with ADHD+SODD/CD or controls.

The results of the WCST, letters condition of the COWAT, and TOL indicate that children with ADHD+SODD/CD do not exhibit the same pattern of neuropsychological impairment seen in children with ADHD-only, demonstrating clear support the first hypothesis of the present study. This pattern of results suggests that previous studies of executive functioning in children with ADHD may have been flawed by the inclusion of

children with SODD/CD in the ADHD group (Barkley & Grodinski, 1994; Felton et al., 1987; Fischer et al., 1990; Gorenstein et al., 1989; Koziol & Stout, 1992; Loge et al., 1990; McGee et al, 1989; Reader et al., 1994). Because children with ADHD+SODD/CD may not demonstrate executive functioning deficits (as measured by the WCST or letters condition of the COWAT), including these children in ADHD groups may have led to heterogeneity in these groups, possibly leading to the subsequent failure to find consistent differences between ADHD and control children on these executive functioning measures. This pattern of results also indicates that children with ADHD-only indeed display deficits in their frontal lobe functioning, as this is the area of the brain responsible for regulating the abilities measured by these tests (Benton, 1968). No such deficits were indicated for children with ADHD+SODD/CD.

Although the results of the WCST, the letters condition of the COWAT, and the TOL provide support for the hypothesis that children with ADHD+SODD/CD do not have the same neuropsychological deficits as children with ADHD-only, differences in the expected direction were not found on several of the executive functioning measures utilized in the current study. For example, contrary to prediction, the present study did not find evidence that the ADHD-only group was significantly different from the control group on the failure to maintain set variable of the WCST. However, it should be noted that few studies, even those that have demonstrated differences on other variables on the WCST, have found significant differences between ADHD and controls on this variable. The consistent failure to demonstrate differences in performance between ADHD and control children on failure to maintain set variable of the WCST indicates that once a child

with ADHD has determined the correct sorting rule, he/she is no more easily distracted from his/her task than are control children. It is possible that the strong tendency toward perseveration demonstrated by children with ADHD-only decreased the likelihood that they would fail to maintain the set once they had determined the sorting rule in operation. The act of failing to maintain set may actually be the theoretical opposite of perseveration in that individuals with a tendency to perseverate do so even under conditions in which they are no longer receiving consistent reinforcement for their responses. Given their tendency to perseverate in conditions under which they are not reinforced, it would seem unlikely that children with ADHD would change their response sets when they are receiving consistent positive reinforcement for correct responses. In other words, their strong tendency to perseverate may override the possibility that children with ADHD will react to distraction by changing their response set while they are still receiving positive reinforcement for correct responses.

Along with the fact that no differences were revealed between groups on the failure to maintain set variable of the WCST, no differences were found between groups on the category condition of the COWAT. This result is similar to those of other studies that have shown children with ADHD to have deficits on the letters but not the categories condition of this measure (Barkley & Grodzinsky, 1994), suggesting the possibility that the deficit in verbal fluency in children with ADHD may be found specifically in children' s ability to produce words in the letters condition. This seems possible, as the categories condition allows the child to recall words based on meaning, requiring less mental flexibility.

Sustained Attention Measures

The visual and auditory versions of the TOVA were administered in the current study in order to examine participants' ability to sustain attention and inhibit impulses. Contrary to prediction, no differences were found between these groups on several of the measures included in this CPT, including reaction time variability. This result is somewhat surprising, as reaction time variability has been cited as the most sensitive measure of ADHD on the TOVA (Greenberg & Kindschi, 1996). In addition, no differences were found between groups on errors of omission or errors of commission on the TOVA. These results differ from those of previous studies examining the performance of children with ADHD on CPT tasks, which have demonstrated differences between ADHD and control groups on errors of omission (Breen, 1989; Fischer et al., 1990; Forbes, 1998) and errors of commission (Fischer et al., 1990; Loge et al., 1990; Mariani, 1992). The ADHD-only group in the current study did demonstrate significantly lower scores than the control group on the D-Prime measure on the TOVA, which combines errors of omission and errors of commission in order to form a composite measure of total signal detection.

The fact that no differences were found between the ADHD-only and control groups on errors of omission or errors of commission is interesting given the very strong evidence of an executive functioning deficit in children with ADHD-only demonstrated by the other measures used in the current study. It appears that children with ADHD-only who have obvious neuropsychological deficits do not show significant deficits in the separate abilities to detect and react to a target stimulus and to inhibit reaction to a nontarget stimulus. Only when these two abilities are combined, as they are in the D-

Prime measure computed by the TOVA, does a deficit in sustaining attention and inhibiting impulses become apparent in children with ADHD-only.

In addition to significant differences between groups on the D-Prime measure of the TOVA, significant differences were also found between the ADHD-only and control groups on reaction time on this CPT, with the ADHD-only children taking significantly more time to respond to a target stimulus than the control children. This result is consistent with the results of Schachar et al. (1993) and Chee et al. (1989) who found that children with ADHD were slower to respond to the tasks utilized in their studies, whereas children with ADHD+CD were not slower in their reaction times. Chee et al. (1989) hypothesized that increased reaction time was a result of failure to maintain attention on the task when stimuli are presented in rapid succession. The present study provides further evidence that ADHD-only, but not ADHD+SODD/CD, is associated with such a failure, as the TOVA also presents stimuli in rapid succession (i.e., stimuli are presented for 100 milliseconds every 2 seconds).

No differences were found between the ADHD+SODD/CD group and the control group on any of the variables measured by the TOVA. This pattern of results suggests that although children in the comorbid group were reported by their parents to display more severe attention and impulsivity problems than children with ADHD-only, children with ADHD+SODD/CD do not display attention deficits or impulsivity as measured by the TOVA. The pattern of results on the CPT administered in the current study again demonstrates support for the first major hypothesis of the current study in that differences were found between the ADHD-only and control groups on the TOVA; however, no

differences were found between the ADHD+SODD/CD group and controls on this measure.

Intellectual Testing

The results of the intellectual testing conducted in the current study demonstrated no differences between children with ADHD-only, ADHD+SODD/CD, and controls on FSIQ. This is significant as several of the studies in this area have found children with ADHD to show intellectual deficits when compared to control children (Reinecke, Beebe, & Stein, 1999; Seidman et al., 1995). This is also important as utilizing control children who score significantly higher than clinical children on FSIQ makes it difficult to determine whether significant effects revealed by these studies are due to deficits in the clinical children or higher intelligence in the control children.

As expected, no differences were found between groups on PIQ, or on the PO or PS factors of the WISC-III. However, the ADHD-only group did display deficits when compared to controls on the FFD factor. This difference was expected given that the subtests included in the FFD factor score require the respondent to utilize verbal working memory, an aspect of memory that has been shown to be deficient in children with ADHD (Barkley, 1998). However, research has been mixed on the ability of this factor score to discriminate between ADHD and non-ADHD children. Studies have shown that even when the FFD factor can be used to discriminate ADHD and control groups, individual children with ADHD may not show significant relative weaknesses on the FFD factor (Reinecke et al., 1999) and therefore these scores may not be suitable for identifying individual children with ADHD (Anastopoulos, Spisto, & Maher, 1994). Further analyses

of the data collected in the current study would be needed in order to determine the usefulness of the FFD factor score in identifying individual children with ADHD-only; however, present analyses of this data suggests support for the hypothesis that in general, children with ADHD-only as a group show deficits on the FFD factor of the WISC-III when compared to control children. As expected, the children with ADHD+SODD/CD in the current study did not show deficits on FFD when compared to the ADHD-only and control groups, supporting the hypothesis that children with comorbid disorders do not display the same pattern of cognitive deficits as do children with ADHD-only.

In addition, as predicted, the ADHD+SODD/CD group demonstrated deficits relative to controls on VIQ, providing additional support for the hypothesis that children with conduct disorders display verbal skills deficits relative to controls (Hurschi & Hindelang, 1977; Moffit & Silva, 1988); however, contrary to this hypothesis, no differences between the ADHD+SODD/CD and control groups were found on VC. Further complicating this result was an unexpected difference between children with ADHD-only and controls on VIQ and VC. Previous research has failed to show deficits in children with ADHD on either the VIQ or VC factor scores, even when differences are present between ADHD and control groups on the FFD factor (Mayes, Calhoun, & Crowell, 1998; Schachar et al., 1995), and it has been hypothesized that this is because children with ADHD are able to retain and recall information as well as control children once the material gets into long-term memory stores (Mealer et al., 1996). The fact that children in the ADHD-only group did more poorly on the VC factor score contradicts this hypothesis, as the majority of the subtests included in the VC factor scores (i.e.,

Information, Similarities, Vocabulary, and Comprehension) require the respondent to draw mainly from information in long-term memory. The subtests which comprise the remainder of the subscales included in the VIQ (Arithmetic and Digit Span) weigh heavily on verbal working memory, which has been hypothesized to be deficient in children with ADHD (Barkley, 1998). The pattern of results in the present study supports the hypothesis that children with ADHD-only have deficiencies in verbal working memory, and also suggests that they may be deficient in their ability to draw information from long-term memory stores. In addition, these results suggest that children with ADHD+SODD/CD may have generalized verbal skills deficits, but that these deficits are not related to their ability to draw on information from long-term memory. This pattern of results generally supports the hypothesis that children with ADHD-only display a different pattern of cognitive functioning than do children with ADHD+SODD/CD. It is possible that by removing children with comorbid conduct disorders from ADHD groups in future studies, a more consistent pattern of verbal deficits may be revealed in children with ADHD.

Phonological Processing

The results of the measure of phonological ability used in the current study revealed that the children with ADHD-only were significantly more impaired than controls on reading ability as measured by the Word Attack subtest of the Woodcock-Johnson Psychoeducational Battery-Revised. By comparison, the children in the ADHD+SODD/CD group did not show significant evidence of reading problems when compared to the control group, although the children in this group did receive consistently

lower scores than controls on this measure. Interestingly, a significantly greater number of the children from the ADHD+SODD/CD group than from the control group had been referred for specialized reading classes at school, even though the children with ADHD+SODD/CD did not show deficits on phonological ability when compared to control children. By contrast, although the ADHD-only group did display significantly more reading deficits than control children, no statistically significant differences were found between the ADHD-only and control groups in terms of the number of children who participated in specialized reading classes. This pattern of results implies that children with ADHD-only may be under-referred for specialized services in reading, whereas children with ADHD+SODD/CD may be over-referred for such services. It is possible that because children with ADHD+SODD/CD typically display a more disruptive and severe constellation of symptoms than children with ADHD-only, they may be more likely to be identified as needing special services at school, even if they do not have severe deficits. Children with ADHD-only, on the other hand, may be regarded as less severe, and their reading problems may be more likely to be overlooked.

The results of the executive functioning and cognitive measures provide very clear support for the hypothesis that children with ADHD-only display more impaired patterns of neuropsychological/cognitive functioning than do children with ADHD+SODD/CD. This pattern of results is especially significant in light of the fact that the ADHD symptoms in the ADHD-only group were reportedly less severe than those of children in the ADHD+SODD/CD group. It is evident that the impairments demonstrated by the ADHD-only group in the current study were not merely the result of more severe ADHD

symptoms and that a true pattern of neuropsychological impairments exists in children with ADHD-only.

Parenting/Family Environment Measures

Along with demonstrating that ADHD-only is a distinct diagnostic category, the pattern of results revealed by the current study also provides evidence that the ADHD symptoms in children with ADHD+SODD/CD are not associated with primary neuropsychological deficits. If the ADHD symptoms in children with ADHD+SODD/CD did not develop due to neuropsychological problems, these symptoms must have a different etiology than do the symptoms displayed by children with ADHD-only. Given the fact that SODD/CD symptoms are believed to be caused by problems in the family, it is possible that the ADHD symptoms displayed by the children in this group also developed as a result of family environment problems. The hypothesis that ADHD symptomatology may develop as a result of negative family environments was put forth by Pennington et al. (1993) in attempting to explain their study' s finding that children with ADHD and comorbid reading disabilities (ADHD+RD) did not demonstrate executive functioning deficits when compared with controls. As outlined above, Pennington et al. (1993) reconstructed the circumstances that may have contributed to the development of ADHD symptoms in ADHD+RD children, and this reconstruction emphasized the role of the family environment in the development of ADHD symptoms.

Because conduct problems are believed to originate from problems in the family environment (i.e., ineffective and harsh discipline, parental psychopathology), the possibility that negative characteristics of the family environments of the children with

ADHD+SODD/CD contributed to the development of their ADHD symptoms was examined in the current study. Based on previous literature examining the etiology of conduct disorders, it was hypothesized that, when compared with ADHD-only and control children, a greater number of children with ADHD+SODD/CD would come from negative family environments (e.g.., more single-parent families, more parental pathology, younger parental age, lower family income). It was also hypothesized that mothers of ADHD+SODD/CD would report more stress, use more ineffective discipline practices, have more unrealistic expectations of their children, and use fewer effective coping strategies than would mothers of children with ADHD-only and control children.

The present study found partial support for this hypothesis. While no differences were found between groups on parental age or family income, as expected, the ADHD+SODD/CD group was found to have significantly more single-parent households than the ADHD-only group. In addition, the mothers of the children with ADHD+SODD/CD were found to suffer from more depressive symptoms (as measured by the PSI) than were the mothers in the control group. Interestingly, although the mothers of ADHD+SODD/CD reported more depressive symptoms on the PSI, according to their report on the Family History questionnaire, these mothers were not significantly more likely than ADHD-only or control mothers to have been formally diagnosed with or treated for depression. This finding suggests the possibility that a subset of the mothers in the ADHD+SODD/CD group suffered from undiagnosed and untreated clinical or subclinical depression. This finding is important as research has shown that maternal depression is associated with the presence of behavior disorders in children (Mash &

Johnston, 1983). Maternal depression has also been found to increase controlling parental behaviors and commands, which may lead to and maintain negative child behaviors, such as those displayed by children with conduct disorders and/or ADHD (Fischer, 1990).

Along with differences in maternal depression, the present study also found differences in the expected direction on the other child and parent variables measured by the PSI. When compared with the mothers of control participants, mothers of children in the ADHD+SODD/CD group generally reported higher parenting stress. These parents rated their children as more distractible, hyperactive, and demanding than controls. They were also reported to be significantly less able to adjust to changes in the environment, less a source of positive reinforcement, and less acceptable in terms of physical, intellectual, and emotional characteristics than control children. When compared with control mothers, the mothers of children in the ADHD+SODD/CD group also reported that they received less emotional support from the child' s other parent (which is likely related to the fact that more of the mothers in this group were single parents) and that they felt less competent as parents and less attached to their child. The pattern of results on the PSI is consistent with the second major hypothesis of the current study and indicates that along with experiencing more stress than do mothers whose children do not have behavior disorders, mothers of children with ADHD+SODD/CD also generally have more negative perceptions of their children and are less happy in their roles as mothers. It is likely that that these characteristics in the mothers in the ADHD+SODD/CD group negatively influenced the family environments of their children, as such factors are associated with more negative parent-child interactions and more negative child behaviors (Fischer, 1990).

The results of the Parent Opinion Questionnaire (POQ) also provided support for the hypothesis that children with ADHD+SODD/CD are more likely to come from family environments characterized by dysfunction than are control children. The POQ revealed that, when compared to the control group, mothers of children with ADHD+SODD/CD had significantly more unrealistic expectations of their children with regard to child self-care, family responsibility and care of siblings, children' s ability to be left without supervision, proper child behavior and feelings, and proper punishment methods. High scores on the POQ have been found to predict child maltreatment (Azar et al., 1984), and, although there is no evidence that the mothers of the ADHD+SODD/CD group were mistreating their children, it is likely that such unrealistic expectations of child behavior may lead parents to use more ineffective and harsh discipline strategies. Further evidence that mothers of children in the ADHD+SODD/CD group use ineffective and harsh strategies in disciplining their children is provided by the results of the Parenting Scale (PS), which revealed significant differences between the ADHD+SODD/CD and control groups on Laxness, Overreactivity, and Overall ineffective discipline practices. These findings are significant, as harsh discipline and the tendency to overreact to negative child behavior behaviors have been shown to contribute to the development of behavior problems in children (Patterson, 1982).

Along with providing strong support for less adaptive opinions regarding child care and behavior in the ADHD+SODD/CD group, the pattern of results on the POQ is also interesting to consider in combination with the results of the PSI, on which mothers in the ADHD+SODD/CD group generally reported higher stress levels than those of mothers

in the control group. When viewed in combination, the pattern of results of these two measures suggest that it is possible that mothers of children with ADHD+SODD/CD experience more stress because their expectations for their children' s capabilities and behavior are unrealistically high. These unrealistic expectations may cause them to perceive their child in a more negative light than do mothers whose expectations of their child' s behavior is more appropriate, thereby leading to frustration and parental stress.

The results of the DHS also provided partial support for the second major hypothesis of the current study. On this measure, mothers of children in the ADHD+SODD/CD group reported more family hassles as compared to the ADHD-only or control groups. It is possible that the greater number of family hassles experienced by the mothers of the ADHD+SODD/CD group resulted in the negative family environment factors reported by this group (i.e., maternal depression, stress, poor discipline); however, it is also possible the family hassles reported by these mothers were result of stress caused by having a child with more severe behavior problems. The methodology of the present study does not allow for determination of whether greater family hassles preceded or resulted from the other negative family environment factors reported by the mothers in the ADHD+SODD/CD group. However, it is important to note that more family stressors have been found to intensify parent-child interaction problems and to increase problems in child compliance (Baldwin, Brown, & Milan, 1995). Higher levels of family hassles in the ADHD+SODD/CD group may in this way have caused some of the behavior problems displayed by children with comorbid disorders.

The results of the CSI indicated only partial support for the second major hypothesis of the current study. On this measure, the ADHD+SODD/CD mothers reported that using fewer cognitive restructuring strategies (e.g., trying to think about problems in a new way) in coping with stressors related to their child than control mothers. However, the parents of the ADHD+SODD/CD group otherwise reported coping strategies that were similar to those of parents of control children, indicating that, in general, these mothers utilized adequate coping strategies in dealing with problems with their child.

In addition to differences between the ADHD+SODD/CD and control parents on the parenting/family environment measures, significant differences between the ADHD-only and control group parents were also revealed in the current study. On the PSI, ADHD-only group mothers reported more stress than controls in the child (Distractibility/ Hyperactivity, Adaptability, Demandingness, Mood, Acceptance, and total Child Domain) and parent (Attachment, Restriction of Role, Relationship with Spouse, and total Parent Domain) domains. On the PS, ADHD-only mothers received higher scores on Laxness, Overreactivity, and Overall score, indicating that, like mothers of ADHD+SODD/CD children, mothers of children with ADHD-only tend to use more negative discipline practices than do the mothers of control children. The results of the POQ indicate that mothers of children with ADHD-only had more inappropriate expectations of their children with regard to child self-care when compared to control mothers, but were otherwise similar to control mothers in their expectations. Finally, like mothers in the ADHD+SODD/CD group, mothers in the ADHD-only group reported using fewer

cognitive restructuring strategies in coping with stressors than control mothers; however, the mothers of the ADHD-only group also reported less self-criticism (which is assumed to be a maladaptive coping strategy) than the mothers of control children.

The current study obviously revealed many significant differences in parenting/family environment factors between the clinical groups (ADHD+SODD/CD and ADHD-only) and controls. Several differences were also revealed between the two clinical groups utilized by this study. The greatest number of differences between these groups were found on the PSI. Results of this measure revealed that, as expected, mothers of children with ADHD+SODD/CD generally rated their child' s behavior as more problematic than did mothers of children with ADHD-only. The fact that children with ADHD+SODD/CD were rated as more distractible and hyperactive than children with ADHD-only on this measure is especially interesting given the fact that little evidence for neuropsychological impairment in this group was found in the current study, but is consistent with parent report of child behavior on the CBCL. Mothers of children in the ADHD+SODD/CD group also reported that they felt less attached to their children than did mothers of children with ADHD-only, indicating more severe parent-child relationship problems in the comorbid group.

Although, as expected, significant differences were revealed between the ADHD+SODD/CD and ADHD-only groups on the PSI, contrary to prediction, few differences in parenting/family environment were found between the ADHD-only and ADHD+SODD/CD groups on the other parenting/family environment measures. Previous research has revealed more negative parent-child interaction patterns (Marshall et al.,

1990), more family adversity (Johnston, 1996), and more harsh discipline (Loeber & Stouthamer-Loeber, 1986) in families of children who have ADHD and comorbid conduct disorders than in families of children with ADHD-only. Based on this research, it was expected that mothers of children with ADHD+SODD/CD would also report more problems on the other parenting/family environment measures than mothers of children with ADHD-only. This was found to be the case on only a few variables (i.e., the Leaving Children Alone and Proper Child Behavior and Feelings subscales on the POQ, and family hassles on the DHS). On one measure, the CSI, mothers of children with ADHD+SODD/CD were actually found to use more positive coping strategies (i.e., problem solving) than mothers of children with ADHD-only. The finding that mothers in the ADHD+SODD/CD group were not significantly different from mothers of children with ADHD-only on subscales on the PS is especially interesting given the literature citing the role of discipline styles in the development of conduct disorders in children (Patterson, 1986; Loeber & Stouthamer-Loeber, 1986). It was expected that the mothers in the ADHD+SODD/CD group would report more Laxness, Overreactivity, and Verbosity than the mothers in the ADHD-only group. Contrary to this prediction, no evidence for differences between these groups on Laxness or Verbosity were revealed, and only weak evidence that the ADHD+SODD/CD group mothers were more likely to overreact to their children' s negative behavior than ADHD-only group mothers was revealed.

Although the mothers in the ADHD-only and ADHD+SODD/CD groups reported similar discipline styles, it is possible that their discipline strategies of mothers in each group developed as a result of different factors. Research has shown that parents of

children with ADHD may actually develop poorer discipline strategies in attempting to regulate their child' s behavior (Bell & Harper, 1977). It is possible that mothers of children with ADHD-only began parenting with effective discipline strategies, but resorted to more ineffective strategies in their efforts to parent a difficult child. Conversely, it is possible that the mothers of children with ADHD+SODD/CD began parenting with more ineffective discipline strategies, which eventually resulted in child behavior and conduct problems. This explanation would account for the fact that the expected differences in discipline styles were not found between the two clinical groups. More research is needed to determine if such differences in the origin of discipline practices in these two groups exist, as the cross-sectional design of the current study does not allow for determination of directionality in the development of parental discipline styles and negative child behaviors.

There are a number of other possible explanations for the lack of differences between the ADHD+SODD/CD and ADHD-only groups on the PS and on the other parenting/family environment measures. It is possible that this lack of differences was due to relatively high levels of dysfunctional parenting in the ADHD-only group or to relatively low levels of dysfunctional parenting in the ADHD+SODD/CD group in the current study. However, because normative data for the questionnaires used in the current study is not available for these clinical groups, it is beyond the scope of this study to determine which, if either, possibility could account for the lack of differences. The finding that mothers in the ADHD+SODD/CD group were not significantly different from mothers of children with ADHD-only on the majority of the parenting/family environment measures utilized in the current study may also indicate a problem in the way these

variables were measured. Studies have shown that self-report of parenting and discipline strategies may not correlate well with actual discipline practices (Morgan, Gliner, & Harmon, 1999) and it is possible that the mothers in the current study were not accurate in reporting their parenting and discipline strategies. Such inaccurate reporting may be even more common in parents who are under substantial stress, and it is possible that the higher levels of stress reported by the mothers in the ADHD+SODD/CD and ADHD-only groups resulted in less accurate reporting by these groups.

The current study provided support for the hypothesis that children with ADHD+SODD/CD live in more negative family environments (characterized by more ineffective discipline, stress, hassles, etc.) than do control children; however, as discussed above, there is less evidence that the mothers of the ADHD+SODD/CD children were more deficient in their discipline practices than were mothers of children with ADHD-only. Because the ADHD+SODD/CD group cannot be statistically distinguished from the ADHD-only group on many of the crucial parenting variables, it is difficult to determine the significance of the parenting/family environment data. In addition, the measures used in the current study provide no direct evidence that the more negative parenting/family environment factors reported by the ADHD+SODD/CD group actually caused the ADHD symptoms in this group. However, the results of the parenting/family environment measures combined with the finding that neuropsychological deficits were revealed in the ADHD-only but not in the ADHD+SODD/CD group provide clear evidence that the ADHD symptoms in these two clinical groups have distinct etiologies. It remains possible

that the ADHD symptoms in children with ADHD+SODD/CD are caused by factors in the family environment, and further research is needed investigating this possibility.

Child Depression

Along with the major findings of the current study, another important finding was obtained with regard to the depressive symptoms reported in the clinical groups. The results of the CDRS-R indicated that children in the ADHD-only and ADHD+SODD/CD group experienced more depressive symptoms than the children in the control group, providing evidence that the presence of behavior disorders in general is associated with increased depressive symptoms. Although the methodology of the current study does not allow examination of the causes of the depressive symptomatology in these children, it is speculated that children with behavior disorders such as ADHD and SODD/CD experience more negative interactions in their environments. The children in the ADHD-only and ADHD+SODD/CD groups in the present study often reported on the CDRS-R that they failed at things more often than their peers, that other children did not like them, and that they frequently got into trouble with parents and teachers. Research has shown that negative interactions with the environment, such as those described by the children in the clinical groups in the present study, may lead to an increase in depressive symptoms in adults (Lewinsohn, 1974). It is possible that such interactions may have led to the increased depressive symptoms reported by the clinical groups in the present study.

While the children in the clinical groups in the present study reported depressive symptoms in a variety of areas, it should also be noted that the CDRS-R includes questions for the child regarding school and attention problems and assumes that reported

problems are the result of depression. As was expected based on their diagnosis, children in the clinical groups reported more problems paying attention and more problems in school than control children, which increased their scores on this measure; however, it is possible that the attention problems that these children reported were the result of ADHD symptoms rather than of depression.

In addition to self-reported symptoms of depression on the CDRS-R, the mothers of children in the ADHD+SODD/CD group also reported significantly more child symptoms of depression/anxiety on the CBCL when compared to the control group; however, the mothers of children with ADHD-only reported no more depression/anxiety symptoms on the CBCL when compared with controls. The fact that children with ADHD-only and those with ADHD+SODD/CD were similar in terms of self-reported depressive symptoms but that child depressive symptoms were not reported by the ADHD-only mothers has several possible explanations. It is possible that mothers of children with ADHD+SODD/CD were more aware of their children' s depressive symptoms than were mothers of children with ADHD-only. This explanation seems likely given the fact that the mothers' report of child depressive symptoms was consistent with the self-report of the children in the ADHD+SODD/CD group. Further support for this explanation is found in the fact that the mothers in this group were found to be more depressed than those in the control group, and maternal depression has been found to heighten perceptions of child symptoms (Fischer, 1990). Although this explanation seems likely, it is also possible that mothers of the ADHD+SODD/CD children over-reported pathology in their children, a hypothesis that is supported by the fact that the mothers of

the ADHD+SODD/CD children in the present study reported higher stress in general, and higher stress has been associated with increased reporting of child symptoms (Fischer, 1990). However, this seems unlikely given the consistency of the childrens' and mothers' report of depressive symptoms in the ADHD+SODD/CD group.

Clinical Relevance of the Current Study

The results of the current study have important implications for clinical practice. At the present time, the symptoms of ADHD are most frequently treated with stimulant medications. The medications are assumed to improve child functioning by improving the functioning in the frontal lobe of the brain, thereby causing improvement or normalization in executive functioning (Barkley, 1997). The results of Pennington et al. (1993) and of the current study suggest that when comorbid with either SODD/CD or RD, ADHD symptoms may not be associated with neuropsychological deficits. It is possible that medication would not adequately control symptoms in these children, as it seems unlikely that medication used to correct an executive functioning deficit would be effective if such a deficit is not present. These results suggest utilizing stimulant medication as a first-line therapy in treating ADHD children with comorbid conduct disorders may be ineffective and inappropriate. It may be more appropriate, given the fact that children with ADHD+SODD/CD in the present study and the children with ADHD+RD in the Pennington et al. (1993) study had more negative family functioning and circumstances, to treat children with comorbid disorders by targeting family functioning (e.g., parental discipline practices and expectations of child behavior), or to at least make family-based behavioral interventions an integral part of the therapeutic intervention.

Also clinically relevant is the fact that because children with ADHD-only demonstrated clear deficits on the executive functioning measures utilized in the current study, these children may uniquely benefit from treatment with stimulant medications, as these medications may improve or correct their neuropsychological problems. Also, given the fact that family functioning (e.g., parental discipline) was demonstrated to be impaired when compared with control children in the current and previous studies (Fischer, 1990), it is likely that families with children who have ADHD-only would benefit from therapy targeting parent functioning. The efficacy of such treatment for families of children with ADHD has been shown in previous studies (Anastopoulos, Shelton, DuPaul, and Guevremont, 1993); however, these treatment outcome studies typically include children with comorbid conduct disorders and reading disabilities in the ADHD group. Given the possibility of different etiologies of the ADHD symptoms in children with ADHD-only and children with ADHD+SODD/CD or ADHD+RD, and the fact that ADHD symptoms caused by a primary neuropsychological deficit may be more difficult to treat behaviorally, future studies in this areas should investigate the possibility that these groups of children are differentially affected by positive changes in family environment brought on by parent training. Finally, given that the findings of the present study indicate the presence of depressive symptoms in children in both of the clinical groups, it is important that clinicians assess for the presence of depressive symptoms in children with ADHD-only and in children with ADHD+SODD/CD, and provide appropriate treatment for these symptoms when necessary.

Limitations of the Current Study

The present study had a relatively small sample size and may have had limited power to detect differences between groups. It should be mentioned that even with small samples, the present study did detect differences between groups on many of the variables examined; future studies in this area may benefit from larger sample sizes and greater statistical power. Also, as mentioned above, another limitation of the current study was the use of self-report parenting measures. A more objective measure of parental discipline practices may have revealed a difference in discipline techniques between the two clinical groups, as it is possible that mothers misreported their parenting practices. Future research in this area may benefit from the use of more objective measures of discipline styles (i.e., observation) or by using a collaborative source to confirm discipline styles.

Another limitation of the current study is the fact that the ADHD+SODD/CD consisted of children with ADHD and either severe ODD or CD. Although some studies have shown ODD and CD to be qualitatively similar (Anderson, Williams, McGee, & Silva, 1987; Wherry, Mehuen, Fitzpatrick, & Dixon, 1983), others have shown differences in the psychosocial correlates linked to these two disorders (Kuhne et al., 1997). Future studies in this area should examine the possible distinctions between ADHD+SODD and ADHD+CD on the variables examined in the current study in order to determine if these two behavior disorders are associated with the same neuropsychological, cognitive, and parenting/family environment factors.

Perhaps the most significant limitation of the current study is it' s cross-sectional design, which does not allow for demonstration of the sequence of the development of the

variables of interest in either the child, parent, or environment. Although there seems to be evidence that ADHD+SODD/CD is associated with negative family environments, the methodology of the current study does not allow determination of whether mothers of the children in this group developed poor discipline practices, inappropriate expectations of their children, parent/family stress, and depression before the onset of child symptoms, or as a result of having a child with behavior problems. In addition, the majority of the evidence supports the hypothesis that children with ADHD-only have executive functioning deficits and that children in both clinical groups have more depressive symptoms than controls; however, the design of the current study also makes it difficult to determine the sequence in onset of the behavioral, neuropsychological, cognitive, and emotional problems in the clinical children. Future research in this area should be conducted using longitudinal designs, as this would allow for the determination of the sequence of the above-mentioned and other important variables in symptomatology and family environment. Such research will help to determine more specifically the etiology of ADHD symptoms in children with comorbid conduct disorders.

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