CHAPTER 2: ADHD IN CHILDREN: CONTROVERSIES AND DIRECTIONS FOR FURTHER RESEARCH

2.1 INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD), the most commonly occurring neurobehavioural disorder in childhood, is characterized by a consistent pattern of inattention and/or hyperactivity-impulsivity (Chermak et al, 1999, American Academy of Pediatrics, 2000). Recorded prevalence rates for ADHD vary due to different and changing diagnostic criteria as well as variations in the diagnostic tools used by different professionals in different clinical settings across countries (American Academy of Pediatrics, 2000).

Children with ADHD may experience significant functional problems such as academic underachievement, troublesome interpersonal relationships, and poor self-esteem (National Institutes of Health Consensus Committee, 1998, American Academy of Pediatrics, 2000). Adding to the complexities and controversy surrounding ADHD is the co-existence of ADHD with other conditions such as oppositional defiant disorder, conduct disorder, depression, anxiety disorder and many developmental disorders such as speech and language delays and learning disabilities (American Academy of Pediatrics, 2000; Copps, 2002). As many as one third of children with ADHD present with one or more of the above co-existing disorders (American Academy of Pediatrics, 2000). Additionally, differentiating between ADHD and *CAPD* in children is a challenge for professionals as both groups are heterogeneous in nature and yet present with many similar characteristics (Keller, 1998). It has been proposed that CAPD and ADHD may even reflect a singular disorder (Gason et al, 1986, Keller, 1998).

As discussed in Chapter 1 public interest in ADHD has increased, along with debate in the media concerning the diagnostic process and treatment strategies (Gibbs, 1998). Concern has been expressed about the over-diagnosis of ADHD by pointing to the dramatic increase in prescriptions for stimulant medication among children over the past decade (Safer et al, 1996, American Academy of Pediatrics, 2000). In addition, there are significant variations in the type and amount of stimulants prescribed by physicians as well as wide variations in the diagnostic methods and criteria currently employed (American Academy of Pediatrics, 2000).

Chapter 2 presents a critical review of the etiology of ADHD, the different diagnostic criteria and ensuing controversy, additional diagnostic tools, the prevalence rates of ADHD and the ADHD subtypes, co-existing disorders and differentiating ADHD from CAPD, recent developments in the conceptualization of ADHD, the treatment of ADHD and finally, directions for further research.

2.2 THE ETIOLOGY OF ADHD IN CHILDREN

Although the etiology of ADHD remains unknown, data from family genetic, twin, adoption and segregation analysis suggest a strong genetic contribution (Barkley, 1998, Swanson and Castellanos, 1998, Faraone and Biederman, 1999). Preliminary, molecular genetic studies have implicated several candidate genes, including the dopamine D2 and D4 (DRD4-7) receptors as well as the dopamine transporter (DAT-1) (Swanson and Castellanos, 1998, Faraone and Biederman, 1999). Dopamine is the neurochemical that is most highly represented in the frontal cortex. Consistent with these findings is the fact that Methelphenidate, a frequently prescribed stimulant for children with ADHD, is known to release stored dopamine from neurons (Welsh, 1994, Swanson and Castellanos, 1998).

Neuroimaging and electroencephalography studies have identified subtle anomalies in the frontal cortex and projecting subcortical structures of some

individuals with ADHD (Swanson and Castellanos, 1998). Fillepek, Semrud-Clikeman, Steingard, Renshaw, Kennedy and Biederman (1997) used magnetic resonance imaging to study brain anatomy and reported that a group of children with ADHD had brain volumes about 10% smaller than normal in the anterior superior regions (posterior prefrontal, motor association, and midanterior cingulate) and anterior inferior regions (anterior basal ganglia). Castellanos, Giedd, March, Hamburger, Vaituzis and Dickstein (1996) have also reported that the right anterior frontal, caudate, and globus pallidus regions were about 10% smaller in an ADHD group than in a control group.

Despite the above evidence, the American Academy of Pediatrics (2000) does not endorse the routine use of brain imaging studies and electroencephalography in the diagnosis of ADHD (as discussed later under 2.4). Their decision is based on an extensive review of the literature that has shown that, although variations may occur in brain morphology of some children with ADHD, there is a high occurrence of both false-positive and false-negative results. Swanson and Castellanos (1998) contribute the high occurrence of both false-positive and false-negative results to the lack of validation of ADHD as a disorder that can be reliably assessed and researched. This lack of validation of ADHD as a disorder is possibly due to different and changing diagnostic criteria, as well as variations in the diagnostic tools, used by different professionals in different clinical settings across countries (American Academy of Pediatrics, 2000). Recent investigations of a refined phenotype defined by the ICD-10 / DSM-IV consensus criteria namely Hyperkinetic disorder or the combined type of ADHD (as discussed under 2.3) have, however, produced some converging evidence about the possible biological basis (both genetic variation and neurological damage) of this disorder (Swanson and Castellanos, 1998). Further research, that clearly defines the type/s of ADHD being investigated, is thus necessary.

Possible nongenetic etiologies linked to ADHD include suspected brain damage due to hypoxia and hypotension during fetal development that could damage

neurons in the anatomical networks implicated in ADHD (Swanson and Castellanos, 1998). Fetal exposure to alcohol, lead, nicotine and other substances may also damage neurons in the implicated anatomical networks. Traumatic brain injury may also produce selective interneuron damage in the frontal cortex (Swanson and Castellanos, 1998).

Other proposed etiologies of ADHD include adverse reactions to foods or food additives, a lack of essential fatty acids resulting in a lack of prostaglandins that, in turn, leads to a weakening in neuron cell walls and thus poor transmission between neurons, as well as an emotional cause (Pooley, 2000). While these factors are likely to exacerbate ADHD in some children, most professionals view ADHD as a genetic disorder of neurological origin (Pooley, 2000).

2.3 THE DIFFERENT DIAGNOSTIC CRITERIA USED IN THE DIAGNOSIS OF ADHD.

ADHD is the term used in North America (United States of America and Canada) as well as Australia to describe children with a consistent pattern of inattention and/or hyperactivity-impulsivity with an onset in early childhood (Chermak et al 1999, American Academy of Pediatrics, 2000). In contrast, the term Hyperkinetic Disorder, used in the United Kingdom and by European professionals, is characterized by the early onset of both overactive and inattentive behaviors (McConnell, 1997). As a result, there has been considerable debate in recent years concerning the definition, prevalence and management of attention and hyperactive behavior in children. Using the stricter criteria of the ICD-10 criteria for Hyperkinetic disorder, the prevalence is restricted to approximately 1-2% of children (McConnell, 1997). This has sparked considerable controversy concerning the perceived over-diagnosis of overactive and inattentive behavior in children and consequently the over-prescription of stimulant medication in North America and more specifically the United States of America (McConnell, 1997).

When comparing the DSM-IV criteria (American Psychiatric Association, 1994), used to diagnose ADHD with the ICD-10 criteria for Hyperkinetic Disorder (World Health Organization, 1992), it becomes evident that Hyperkinetic Disorder is, in actuality, most likely one of the three different types of ADHD, namely the combined type that is characterized by both hyperactivity-impulsivity and inattention (Taylor and Hemsley, 1995).

The DSM-IV (American Psychiatric Association, 1994) uses patterns of inattention, hyperactivity and impulsivity to differentiate between the three different types of ADHD. The predominantly inattentive type presents, primarily, with symptoms of inattention. The predominantly hyperactive-impulsive is considered a behavioral regulation disorder and the combined type is characterized by hyperactivity-impulsivity and inattention. The criteria for the diagnosis of the three different types of ADHD types, as stipulated by the American Psychiatric Association (1994), are presented in Table 1.1. The DSM-IV criteria for the diagnosis of the different types of ADHD require the presence of six or more symptoms of inattention and/or hyperactivity-impulsivity persisting for 6 or more months. The combined type of ADHD meets criteria A and B, as outlined in Table 1.1, the predominantly inattentive type meets criterion A, but not B, and the predominantly hyperactive-impulsive type meets criterion B, but not A.

The term Hyperkinetic Disorder, used by European professionals, is characterized by early onset, a combination of overactive, poorly modulated behavior with marked inattention and lack of persistent task involvement; and pervasiveness over time of these behavioral characteristics (World Health Organization, 1992). The cardinal features of Hyperkinetic Disorder are impaired attention and overactivity; both are necessary for the diagnosis and should be evident in one or more situation, for example, both the home and classroom environment. Impaired attention refers to prematurely breaking off from tasks and leaving activities unfinished while overactivity refers to excessive

restlessness in relation to the demands of a given situation (World Health Organization, 1992).

From the above discussion it is evident that the use of different diagnostic criteria such as the DSM-IV (American Psychiatric Association, 1994) and the ICD-10 criteria (World Health Organization, 1992) may lead to misunderstanding and subsequently controversy surrounding the prevalence, diagnosis and treatment of overactive and inattentive behavior in children. For this reason, although the broader diagnostic criteria of the DSM-IV (American Psychiatric Association, 1994) will be used in this study, the results will also be considered against the background of the ICD-10 criteria (World Health Organization, 1992).

2.4 ADDITIONAL DIAGNOSTIC TOOLS AND METHODS USED IN DIAGNOSING ADHD

Establishing the diagnosis of ADHD requires a strategy that minimizes over-identification and under-identification. Pediatricians and other primary care health professionals are advised to apply DSM-IV criteria, as outlined in Table 1.1, in the context of their clinical assessment of the child (American Academy of Pediatrics, 2000). In addition, but not as a substitution, a synthesis of information from parents, school reports, other involved professionals and an interview/examination of the child is recommended as an adjunct but not as a substitute for the DSM-IV criteria. The acquisition of additional information is necessary as the behavioral characteristics specified in the DSM-IV, despite efforts to standardize them, remain subjective and may be interpreted differently by different observers (American Academy of Pediatrics, 2000). Additionally, instruments used in the primary care practice will not reliably assess the nature and degree of the functional impairment of children with ADHD.

Behavior symptoms can be obtained from parents and teachers using a variety of methods, including open-ended questions, semi-structured interviews, questionnaires, and rating scales. Specific questionnaires and rating scales

have been developed to review and quantify the behavioral characteristics of ADHD, such as the Conners Parent Rating Scale and the Conners Teacher Rating Scale based on the DSM-IV criteria (as discussed in American Academy of Pediatrics, 2000). Other examples of checklists and rating scales are the Child Behavior Checklist (Parent and Teacher Form) and the Barkley's School Situations Questionnaire (as discussed in American Academy of Pediatrics, 2000). Although a valuable adjunct in diagnosing ADHD, the questions included in these questionnaires and rating scales are often subjective and thus subject to bias. The results of questionnaires and rating scales may thus convey a false sense of validity and should, therefore, always be considered in the context of the overall evaluation of the child (American Academy of Pediatrics, 2000).

In addition to the above DSM-IV criteria, questionnaires and rating scales, other diagnostic tests such as brain imaging studies including electroencephalography as well as tests of continuous performance have been considered. The American Academy of Pediatrics (2000) does, however, not endorse the routine use of brain imaging studies and electroencephalography in the diagnosis of ADHD. Their decision is based on an extensive review of the literature that has shown that, although variation may occur in brain morphology of some children with ADHD, there is a high incidence of both false-positive and false-negative results.

The American Academy of Pediatrics (2000) also does not endorse the routine use of tests of continuous performance in the diagnosis of ADHD at this time due to the significant variations in the test material that is currently available. Continuous performance tests have been designed to obtain samples of a child's behavior (generally measuring vigilance and attention/distractibility) that are thought to correlate with behaviors associated with ADHD (American Academy of Pediatrics, 2000). Significant variations between tests have, however, been noted for the modality of presentation, the type of target, the assessment of errors as well as the speed of stimuli presentation. Additionally, research

examining the relationship between continuous performance and the different types of ADHD is necessary to determine the reliability and validity of these measures. Although the American Academy of Pediatrics (2000) does not endorse the routine use of tests of continuous performance clinically, their use in research may facilitate the development of new insights into the nature of the attention deficits associated with the different types of ADHD. The value of tests of continuous performance in describing the attention deficits associated with the different types of ADHD will be discussed in greater depth in Chapter 3.

There are a number of commercially available tests of continuous performance. One example, is The Auditory Continuous Performance Test compiled by Morris, O'Neil, Crawford and Mockler (Riccio et al, 2001). The individual is presented verbally with a randomized set of letters using the English alphabet and is required to respond to a target letter by pressing the space bar on a keyboard. The Visual Continuous Performance test by the same authors is a separate test during which letters are visually presented to the individual with the instruction to push the space bar when the target letter is seen. The above tests require a sound knowledge of the English alphabet and their corresponding phonemes and do not take aspects such as visual perception into account. Additionally, the auditory and visual modalities are assessed separately, and are thus not representative of the integrated modality demands placed on the child outside the test situation.

Another test of auditory continuous performance, with the same title namely the Auditory Continuous Performance Test, was compiled by Keith (1994). This auditory vigilance task requires the child to listen to a list of words and raise his/her thumb each time the target word is heard. This test thus requires a certain level of language competency and once again, only one modality, namely the auditory modality is assessed.

The Integrated Visual and Auditory Continuous Performance Test (IVA CPT) (Sandford and Turner, 2001) has addressed many of the criticisms directed at tests of continuous performance. This 20 minute computerized continuous performance test combines both auditory and visual stimuli. By combining the auditory and visual modes in a counterbalanced design, together with inattention and vigilance, the IVA CPT incorporates two continuous tests of performance into one. The test task is simple and requires the individual to click on the mouse only when s/he hears or sees the target (the number "1") and not to click when s/he hears or sees the non-target or foil item (the number "2"). Since the "1's" and "2's" are presented in a pseudo-random combination of visual and auditory stimuli, it is more demanding, than other tests of continuous auditory performance, as it challenges the individuals ability to change cognitive sets. Additionally, the test administration is automated and the presentation of auditory and visual stimuli is standardized.

Kane and Whiston (2001) suggest that the inclusion of both visual and auditory attention measures in a single administration provides the IVA CPT with an advantage over other commercially available test materials. In addition, the scoring is computerized, removing the element of human error and by providing a number of scale quotients; the IVA CPT attempts to measure the multi-dimensionality of attention (Kane and Whiston, 2001). Sandford, Fine and Goldman (1995) have reported that children diagnosed with ADHD assessed using the IVA CPT made more errors for auditory than for visual stimuli and were more likely to present with auditory modality impulsivity than their peers. A weakness in the study of Sandford et al (1995) is that the diagnostic criteria and methods used in their study are not adequately described and participants are simply described as having the diagnosis of ADHD.

2.5 THE PREVALENCE RATES OF ADHD AND THE DIFFERENT TYPES OF ADHD.

The recorded prevalence rates for ADHD vary, due to the different diagnostic criteria as well as variations in the diagnostic tools used by different professionals in different clinical settings across countries (American Academy of Pediatrics, 2000). The prevalence of ADHD has been estimated at between approximately 3 to 5% in children, aged between 2 to 8 years of age (American Psychiatric Association, 1994, National Institutes of Health Consensus Committee, 1998). More recently and based on an extensive review of reported prevalence rates, the American Academy of Pediatrics (2000) has estimated an ADHD prevalence of 9,2% for boys and 2,9% for girls. Studies based on parent reports indicate a persistence of ADHD of 60-80% into adolescence (Biederman, Faraone and Milberger, 1996, Mannuzza, Klein, Bessler, Malloy, and La Pudula, 1998, American Academy of Pediatrics, 2001).

The uncertainty surrounding the prevalence rates of ADHD is, in turn, reflected in the limited and varying reports of the prevalence rates of the different types of ADHD. Millstein, Wilens, Biederman and Spencer (1998) examined a group of 149 adults diagnosed with ADHD and found that 56% of the adults have the combined type of ADHD, 37% had the inattentive type, and only 2% had the hyperactive-impulsive type. For children diagnosed with ADHD, Wilens, Biederman and Spencer (2002) estimate that 50-75% of children have the combined type of ADHD, 20-30% of children have the inattentive type of ADHD with less than 15% of children meeting the criteria for the hyperactive impulsive type of ADHD. Furthermore, Millstein et al (1998) report that there is a greater decrease in symptoms of hyperactivity and impulsivity than in symptoms of inattention from childhood to adulthood.

When considering gender, there is a higher prevalence of ADHD reported for males than for females, with estimates ranging from 3:1 to 6:1 (Chermak et al, 1999). Interestingly, more females than males are diagnosed with the inattentive

type of ADHD (National Institutes of Health Consensus Committee, 1998, Wolraich, Hannah, Baumgaertel, Pinnock and Feurer, 1998). Wolraich et al (1998) also report that co-existing learning disorders are more frequent in children with the inattentive and combined types of ADHD.

2.6 ADHD, CO-EXISTING DISORDERS AND CAPD

A variety of other psychological and developmental disorders frequently co-exist in children with ADHD. As many as one third of children with ADHD, have one or more co-existing disorders (American Academy of Pediatrics, 2000). Although the primary care clinician may not always be in a position to make a precise diagnosis of co-existing conditions, consideration thereof should be an integral part of the evaluation process (American Academy of Pediatrics, 2000). The evaluation and long-term care of the child with ADHD thus requires an ongoing and collaborative partnership among the child, physician, parents, teachers and other involved professionals.

The more common co-existing conditions (and their percentage of co-existence) include conduct and oppositional defiant disorder (35%), mood disorders/depression (18%), anxiety disorders (18%), speech and language impairment and learning disabilities (reported to range from 12-60%) (American Academy of Pediatrics, 2000). The relationship between the different types of ADHD and the different co-existing disorders is not documented in the literature and research in this area is thus required.

Differentiating between children with ADHD and CAPD is another challenge for professionals as both groups are heterogeneous in nature and yet present with many similar characteristics as highlighted in Table 2.1 (Keller, 1998). It has been proposed that CAPD and ADHD may even reflect a singular disorder (Gason et al, 1986, Keller, 1998). Children diagnosed with ADHD are frequently reported to present with difficulties on tasks that challenge the central auditory nervous system (Chermak et al, 1999, Copeland, 2002). Some researchers

Table 2.1: Characteristics of children with ADHD and CAPD (From: Keller, 1998)

Attention Deficit Hyperactivity Disorder (ADHD)	Central Auditory Processing Disorders (CAPD)
General characteristics Inability to sustain attention Impaired focused attention Impaired selective attention Impaired divided attention Impaired vigilance **Symptoms often seen in school setting** Disorganization Short attention span Impulsivity Problems completing work Work completed impulsively Takes too long to complete work Chronic academic underachievement Variability in academic performance Messy work, often carelessly done Failure to follow instructions Motor restlessness Noisy/excessive talking **Associated features** Cognitive deficits Specific learning disabilities Auditory processing disorders Problems with visual perceptual Processing Academic underachievement for Intelligence	**General characteristics** Says "huh" and "what" frequently Inconsistent responses to auditory stimuli Often misunderstands what is said Constantly requests that information be repeated Poor auditory attention Easily distracted Difficulty following oral instructions Difficulty listening in the presence of background Noise Difficulty with phonics and speech-sound Discrimination Poor auditory memory Poor receptive and expressive language Slow and delayed response to verbal stimuli Reading, spelling and other academic problems Learns poorly through the auditory channel Exhibits behavior problems **Emotional difficulties** Temper tantrum / explosive behavior Low self-esteem Problems interpreting others emotions Low frustration tolerance Mood swings Hyperactivity/hypermotionality **Social difficulties** Poor peer relationships Impulsiveness Hyperactivity Aggressiveness Noncompliance Lying / stealing Poor self-control Poor general social skills Alcohol/drug abuse **Physical features** Poor general health Enuresis / encopresis Increased incidence of otitis media Allergies / food sensitivities Disturbance in sleep patterns Poor motor coordination Suspected under-aroused central nervous system Minor physical anomalies Familial pattern

have suggested that the diagnosis of CAPD and/or ADHD may be a function of the profession of the diagnostician and diagnostic procedures rather than the specific disorder (Riccio and Hynd, 1996). ADHD is a medical diagnosis usually made by pediatricians, while CAPD is an audiological diagnosis (Chermak, Somers and Seikel, 1998). The observed comorbidity of CAPD and ADHD may reflect a shortcoming in the accuracy of differential diagnosis using current procedures and criteria (Riccio and Hynd, 1996) and is an area that warrants further research.

Despite the shortcomings in the conceptualization and differential diagnosis of ADHD and CAPD, Chermak et al (1998) reported that the pediatricians and audiologists included in their study viewed the predominant symptoms of ADHD and CAPD as being rather distinct, with only 2 (namely, inattention and distractibility) of the 11 most frequently cited behaviors reported as common to both conditions. Inattention and distractibility were ranked as the first and second most typical behaviors characterizing ADHD. Audiologists ranked these same behaviors as seventh and sixth respectively, in cases of CAPD. CAPD was characterized by a selective attention deficit and associated language processing and academic difficulties. In contrast, ADHD was characterized by inappropriate motor activity, restlessness, and socially inappropriate interaction patterns. The results of the study suggest that the pediatricians and audiologists included in the study perceived ADHD and CAPD to be separate entities despite the shortcomings in the conceptualization and differential diagnosis of these two disorders (Chermak et al, 1998).

More recently, Chermak, Tucker and Seikel (2002) continued this research by comparing audiologists' and pediatricians' rankings of 58 behavioral symptoms associated with CAPD and the inattentive form of ADHD. The audiologists ranked the degree to which each symptom pertained to individuals with CAPD and the pediatricians ranked the same behaviors as they relate to the inattentive form of ADHD. The analysis revealed that the audiologists and pediatricians

identified a reasonably exclusive set of behaviors characterizing the two conditions. None of the four behaviors (i.e. inattention, academic difficulties, asking for things to be repeated, and poor listening skills) ranked 2 standard deviations above the means (depicting a higher incidence of the symptoms) was ranked in common.

Furthermore, Bellis and Ferre (1999) and Bellis (2003a) have suggested that children with ADHD can be expected to either perform normally or poorly across all measures of CAPD, with no clear error pattern emerging in the test results. Further research examining the CAPD of children with the three different types of ADHD, namely the combined type, the inattentive type and the hyperactive-impulsive type is indicated. The value of tests of CAPD in differentiating between ADHD and CAPD will be discussed in greater depth in Chapter 3.

Recent developments in the conceptualization of and assessment procedures used in diagnosing ADHD and CAPD, are predicted to provide new insights into the probable linkages and distinctions between these two disorders (Bellis and Ferre, 1999, Bellis, 2003a). The recent conceptualization of ADHD as an executive function disorder is discussed under 2.7 and serves as an introduction to Chapter 3 where the three opposing theoretical schools of thought regarding the conceptualization of ADHD and CAPD are presented. Against this background, the value of tests of auditory and visual continuous performance and central auditory processing, in defining the nature of the attention deficits associated with the different types of ADHD, are discussed.

2.7 THE RECENT CONCEPTUALIZATION OF ADHD AS AN EXECUTIVE FUNCTION DISORDER.

There has been a recent shift in the conceptualizing of ADHD as a behavioral regulation or executive function disorder rather than a primary attention disorder for the combined and hyperactive-impulsive types of ADHD (Chermak et al, 1999). Although executive functions are defined differently across disciplines,

there are generally agreed on components (Singer and Bashir, 1999). These include inhibiting actions, restraining and delaying responses, attending selectively, setting goals, planning and organizing, as well as maintaining and shifting set (Singer and Bashir, 1999).

Executive function is a component of metacognition referring to a set of general control processes that ensure that an individual's behavior is adaptive, consistent with a goal and beneficial to the individual (Torgesen, 1996). Executive control processes thus coordinate cognitive and metacognitive knowledge in support of task analyses, planning, reflective decision-making and finally the transformation of this knowledge into appropriate behavioral strategies. These strategies include learning, problem solving, psychosocial function, goal directed behavior and listening (Chermak et al, 1999).

Executive functions are thus necessary for goal-directed behavior and include the skills of planning, working memory, organized search, flexibility and impulse control (Welsh, 1994). The frontal cortex of the brain is thought to mediate executive function. This supports the evidence pointing to a possible frontal lobe dysfunction (due to neurochemical perturbation) explanation for ADHD (Welsh, 1994). Volkow et al (2001) hypothesize that stimulants such as methylphenidate enhance executive function by facilitating dopamine transmission in the frontal cortex.

In the new conceptualization of ADHD, the combined and hyperactive-impulsive types of ADHD are perceived to be an output disorder or executive dysfunction. The sustained multi-modal attention deficit is thus seen to occur secondary to the behavioral disinhibition and poor self-regulation (Chermak et al, 1999). In contrast, the inattentive type of ADHD is perceived to be an input or information-processing deficit. The inattention accompanying the inattentive type is perceived to be selective and multi-modal in nature (Chermak et al, 1999). Differentiating between the inattentive type of ADHD and CAPD is more

challenging as both disorders are considered to be an input or information-processing deficit. The differentiation lies in the conceptualization of CAPD as a specific auditory perceptual deficit presenting with both selective and divided deficits. In both the inattentive type of ADHD and CAPD, executive dysfunction is seen as the secondary disorder with attention as the primary dysfunction (Chermak et al, 1999). Executive function and attention in the different types of ADHD and CAPD are discussed in greater depth in Chapter 3.

Executive functions can be assessed using a variety of neuropsychological assessments such as the Wisconsin Card Sort, the Cambridge Neuropsychological Tests Automated Battery, Category test, and Trailmaking (Packer, 2002). There is, however, currently no agreed on test battery for assessing executive dysfunction in children (Packer, 2002). Computerized tests of continuous performance have also been reported to tap into executive function (Packer, 2002). Welsh (1994) reasons that although tests of continuous performance were originally designed to measure the global construct of attention, it is evident that sub-processes including effortful information processing over time and inhibition of irrelevant and impulsive responding are also tapped. Thus, the performance measures observed on these attention tasks may also reflect executive function deficits (Welsh, 1994, Packer, 2002). The importance of further research examining the executive functions and continuous performance of children with ADHD is thus underscored.

2.8 TREATMENT OF ADHD IN CHILDREN

The American Academy of Pediatrics (2001) recommends the use of stimulant medication and/or behavioral therapy in the treatment of ADHD in children. For most children, stimulant medication is highly effective. For many children, behavioral interventions are valuable as the primary treatment or as an adjunct to stimulant medication (American Academy of Pediatrics, 2001).

Stimulant medication, currently available, includes short-, intermediate-, and long-acting methelphenidate, and short-, intermediate-, and long-acting dextroamphetamine (not available in South Africa). Volkow et al (2001) hypothesize that stimulant medication exerts a therapeutic effect by enhancing executive function by facilitating dopamine transmission in the prefrontal cortex. The different types of medication and their doses are presented in Table 2.2. The McMaster report (in American Academy of Pediatrics, 2000) reviewed 22 studies and found no significant differences in the effectiveness of methelphenidate and dextroamphetamine, or among different forms of these stimulants. Individual children may, however, respond better to one of the stimulants than the other. Antidepressants can be considered as a second line of treatment. Current evidence supports the use of only two types of medication in this category, namely tricyclic antidepressants and bupropion (American Academy of Pediatrics, 2001). Clinicians are advised to consider this second line of treatment only after the failure of 2 or 3 stimulants and only if they are familiar with their use. Despiramine use has, for example, been associated, in rare cases, with sudden death (Biederman, Thisted, Greenhill and Ryan, 1995).

Unlike most other medications, stimulant dosages are not weight dependent and clinicians are advised to begin with a low dose of medication and to titrate upward because of the marked individual variability of the dose-response relationship (American Academy of Pediatrics, 2001). The dosing schedules should be determined by the required outcomes for the child. Stimulants are generally considered safe medications with few contra-indications to their use. The most common side effects such as decreased appetite, stomach ache or headache, delayed sleep onset, jitteriness or social withdrawal can successfully be managed through adjustments to the dosage or schedule of the medication (American Academy of Pediatrics, 2001).

Table 2.2: Medication used in the treatment of ADHD (From: American Academy of Pediatrics, 2001)

Generic class (Brand name)	Daily dosage schedule	Duration	Prescribing schedule
Stimulants (First-Line Treatment)			
Methylphenidate			
Short-acting (Ritalin, Methylin)	Twice a day (BID) to 3 times a say (TID)	3-5 hr	5-20mg BID to TID
Intermediate-acting (Ritalin SR, Metadate ER, Methylin ER)	Once a day (QD) to BID	3-8 hr	20-40mg QD or 40mg in morning and 20 early afternoon
Long-acting (Concerta, Metadate CD, Ritalin LA[1])	QD	8-12 hr	18-72mg QD
Amphetamine			
Short-acting (Dexedrine, Dextrostat)	BID to TID	4-6 hr	5-15mg BID or 5-10mg TID
Intermediate-acting (Adderall, Dexedrine spansule)	QD to BID	6-8 hr	5-30mg QD or 5-15mg BID
Long-acting (Adderall-XR[1])	QD		10-30mg QD
Antideressants (Second-Line Treatment)			
Tricyclics (Imipramine, Desipramine)	BID to TID		2-5mg/kg/day[2]
Bupropion			
(Wellbutrin)	QD to TID		50-100mg TID
(Wellbutrin SR)	BID		100-150mg BID

KEY:
[1] Not FD approved at time of publication
[2] Prescribing and monitoring information in *Physicians' Desk Reference*

Behavior therapy represents a broad set of specific interventions that have a common goal of modifying the physical and social environment to alter or change behavior, including more structure, closer attention, and limitations of distractions (American Academy of Pediatrics, 2001). Behavior therapy is then implemented by training parents and teachers in specific techniques, as presented in Table 2.3, for improving behavior. Behavior therapy should be differentiated from psychological interventions (such as play therapy) that are directed at changing the child's emotional status.

Table 2.3: Behavioral techniques for children with ADHD (From: American Academy of Pediatrics, 2001)

Technique	Description
Positive reinforcement	Providing rewards or privileges contingent on the child's performance
Time-out	Removing access to positive reinforcement contingent on performance of unwanted or problem behavior
Response cost	Withdrawing rewards or privileges contingent on the performance of unwanted or problem behavior
Token economy	Combining positive reinforcement and response cost. The child earns rewards and privileges contingent on performing desired behaviors and loses the rewards and privileges based on undesirable behavior

In a 14-month randomized clinical trial of treatment strategies for children with ADHD (The MTA Cooperative Group, 1999), a group of 579 children with the combined type of ADHD were assigned to 4 research groups, respectively receiving 14 months of medication management, intensive behavioral treatment, the two types of management combined, or standard community care. The results showed that children in the combined treatment and medication management groups showed significantly greater improvement than those given intensive behavioral treatment and community care. Combined and medication treatments did not differ significantly on any direct comparisons, but in several instances (oppositional/aggressive symptoms, internalizing symptoms, teacher-rated social skills, parent-child relations, and reading achievement) combined treatment proved superior to intensive behavioral treatment and/or community care while medical management alone did not. The medical management of ADHD or combined management of stimulants together with behavior therapy are thus the preferred and recommended management regime at this time (The MTA Cooperative Group, 1999, American Academy of Pediatrics, 2001).

In the study of The MTA Cooperative Group (1999) only children with the combined type of ADHD were used. Further research using children with the

inattentive and hyperactive-impulsive types of ADHD would be of value in determining the most effective treatment for these two groups of children.

2.9 DIRECTIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

Much of the controversy surrounding research in the field of ADHD appears to have arisen from poorly defined participant selection criteria and, in particular, the diagnostic criteria used. The controversy surrounding ADHD and Hyperkinetic disorders bears testimony to this (McConnell, 1997). The intensive debate surrounding the use of the DSM-IV or the ICD-10 proves to be futile when it is recognized that Hyperkinetic disorder, as described in the ICD-10 classification, is comparable to one of the three ADHD types of the DSM-IV classification, namely the combined type of ADHD (Taylor and Hemsley, 1995). It is pertinent that future studies examining ADHD in children clearly define (and thereby validate) the type/s of ADHD being examined as well as the specific diagnostic criteria and diagnostic tools used in making the diagnosis of ADHD. Recognition of the different ADHD types is crucial when researching the etiology and prevalence rates of ADHD as well as the value of different diagnostic tools and treatment options. The validation of ADHD as a disorder will also facilitate comparisons between studies that, in turn, will enhance both researchers' and clinicians' understanding of ADHD.

Recent developments in the conceptualization of and assessment procedures used in diagnosing ADHD and CAPD, are predicted to provide new insights into the probable linkages and distinctions between these two disorders (Bellis and Ferre, 1999, Bellis, 2003a). Although the American Academy of Pediatrics (2000) does not endorse the routine clinical use of tests of continuous performance, their use for research purposes may facilitate the development of new insights into the nature of the attention deficits associated with the three different types of ADHD. Bellis and Ferre (1999) and Bellis (2003a) also propose that tests of CAPD may be helpful in differentiating between CAPD and ADHD and suggest that children with ADHD either perform normally or poorly across all

measures of CAPD, with no clear error pattern emerging in the test results. Further research examining the continuous performance and central auditory processing abilities of children with the three different types of ADHD, namely the combined type, the inattentive type and the hyperactive-impulsive, type is warranted and will be discussed in greater depth in Chapter 3.

2.10 SUMMARY OF CHAPTER 2

Chapter 2 provides a critical review of the etiology of ADHD, the different diagnostic criteria and ensuing controversy, additional diagnostic tools, the prevalence rates of ADHD and the different types of ADHD, co-existing disorders and differentiating ADHD from CAPD, recent developments in the conceptualization of ADHD, the treatment of ADHD and finally, directions for further research.

The debate surrounding the DSM-IV and ICD-10 criteria is addressed, and the similarity between the Hyperkinetic disorder of the ICD-10 and the Combined ADHD type of the DSM-IV criteria is highlighted. The use of additional diagnostic tools, including questionnaires and rating scales, brain imaging and continuous performance is discussed. Further research investigating the value of these measures against the background of clearly defined ADHD types and criteria is recommended. The uncertainty of the prevalence of ADHD and the ADHD types is ascribed to the lack of validation of ADHD as a disorder, different diagnostic criteria as well as variations in the diagnostic tools used. The validation of ADHD as a disorder and the recognition of the different ADHD types are seen to be crucial, not only to research investigating the etiology and prevalence of ADHD, but also research investigating the value of different diagnostic tools and options.

The variety of other psychological and developmental disorders (such as conduct and oppositional defiant disorders, mood disorders/depression, anxiety disorder and speech and language disorders) that frequently co-exist in children with ADHD are addressed in Chapter 2. It is concluded that consideration of these

co-existing disorders should form an integral part of the evaluation and diagnostic process.

Finally, the importance of differentiating between ADHD and CAPD in children and the recent conceptualization of ADHD as an executive function disorder is presented and serves as an introduction to Chapter 3 (where the theoretical models differentiating between ADHD and CAPD and value of tests of continuous performance and CAPD are discussed).