

The Diagnosis and Neuropsychological Assessment of Adult Attention Deficit/Hyperactivity Disorder

Scientific Study and Practical Guidelines

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ABSTRACT: The recognition of attention deficit/hyperactivity disorder (ADHD) in adults is a well documented, but relatively new development. Investigations of the disorder have indicated that disturbances in behavior and adjustment are common. These disturbances may be linked to poorly developed executive functions. This paper reviews the neuropsychological studies that have compared persons with ADHD to normal controls and to psychiatric controls. The review indicates that persons with ADHD share many neuropsychological characteristics with other persons with serious psychiatric conditions, although those with ADHD may have a particular profile of slowed performance in tasks of sustained attention and set shifting, and their use of working memory may be particularly impaired. The implications of research for clinical assessment are discussed. We contend that a neuropsychological orientation is necessary for making the diagnosis and gaining a full understanding of adult ADHD. A model for clinical assessment is proposed which utilizes a neuropsychological orientation and the targeted administration of neuropsychological instruments. The careful use of neuropsychological measures is warranted in providing an elaborate picture of a person's functioning, although the use of neuropsychological tests is not necessary to make the diagnosis.

KEYWORDS: Attention deficit hyperactivity disorder; Neuropsychological assessment; Adult ADHD; Diagnostic procedures.

It is well documented that the symptoms of attention deficit hyperactivity disorder (ADHD) persist into the adolescent and adults years for a substantial number of children diagnosed with the disorder.¹⁻³ Community studies indicate that between 3.5 to 5% of adults meet the criteria for ADHD.⁴⁻⁶ Although hyperactive actions are less apparent, difficulties with attention and organization of thought and action are manifest and persistent. Recent discussion has increased the recognition of ADHD in

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adulthood with the result that there is an improved understanding of the condition. Neuropsychological models and neuropsychological investigation have played a significant part in research, but few summaries of the research and its implications for clinical practice have been presented. This chapter presents a survey of the neuropsychological research to date and discusses guidelines for the use of neuropsychological assessment in clinical practice. The guidelines are presented in conjunction with a full discussion of the most effective ways to conduct a thorough and accurate evaluation of adult ADHD and its associated features.

The model used to guide our review assumes that the symptoms of ADHD are a manifestation of a disturbance of at least some of the executive functions linked to the frontal regions of the brain. We assume that the core disturbance in ADHD is the result of poor control over executive functions. The basis for this assumption lies with a comprehensive review of the literature which goes beyond the scope of this paper, but has been elaborated well by Barkley^{3,7} and Pennington and Ozonoff.⁸ In this model, the main characteristics of ADHD—that is, inattention, impulsivity, and hyperactivity—are considered to reflect problems with behavioral control and management. The disturbance of attention is not considered the result of an inability to attend, but rather poor ability in the executive tasks of appropriately deploying attention, sustaining attention on appropriate stimuli, and shifting attention as task demands change. Impulsivity is not considered to result from an inability to control one's actions, but from disturbance in determining when actions should be emitted and in controlling the force and sequencing of those actions. In turn, hyperactivity is seen not as the result of excessive action, but as disturbance in the executive task of controlling arousal and level of activation for the situation.

In our review, we discuss the use of a neuropsychological perspective for making the diagnosis of ADHD and elaborating on the particular profile of an individual. We use a special strategy for providing clinical guidelines based on implications from current research on adult ADHD. To structure the discussion, we proceed through the steps for completing an evaluation of an adult who is suspected of having ADHD. As we proceed through the steps we integrate known research on that aspect of the evaluation process. Because of implications from research summarized elsewhere,^{7,8} our discussion stresses a review of executive functions. The diagnosis of ADHD requires that a person show a historical and current pattern of disturbance in executive functions reflected in poor attention control and poor control over decisions and actions. Clinical assessment and an elaboration of a person's condition requires a determination of how disturbances in executive function have an impact on social, occupational, and emotional functioning. In turn, differential diagnosis involves answering the question of whether or not disturbances in executive functions are present by themselves or whether other emotional, intellectual, and behavioral disturbances are present. Our presentation reviews methods for pinpointing ADHD through diagnostic interviews, history collection, the use of rating scales and evaluation of potential comorbid conditions. The paper is intended to provide researchers with an effective summary, while providing clinicians practical guidelines for the difficult task of assessing adult ADHD.

CLINICAL ASSESSMENT

The process of diagnosing ADHD and elaborating on its impact can usefully incorporate a neuropsychological assessment in the broadest sense of the term. Although a full battery of neuropsychological tests may not be utilized in most cases, an orientation that incorporates concern for the impact of a brain disorder on day-to-day functioning is warranted. A number of questions need to be answered in the assessment. First, the evaluation needs to determine whether the person shows disturbances of executive function that meet the criteria for ADHD in the realm of attention, impulse control, and level of activity at the present time and in the past. Next, the evaluation has to determine whether disturbances in executive function result in impairment and how extensive the impairment is. Third, assessment has to determine whether other conditions could account for the pattern of current and past complaints. Fourth, it must be decided whether the described course of problems is consistent with the developmental profile of ADHD in that problems emerge at an early age and persistently interfere with functioning. Finally, the evaluation has to determine whether other conditions frequently encountered in conjunction with ADHD are present.

To obtain answers to the necessary questions, clinical assessment requires: a thorough review of a person's history; a review of the person's functioning from several perspectives; a review of the impact of the condition on day-to-day functioning; a careful screen for other psychiatric conditions; and a careful assessment of the person's neuropsychological functioning to determine what disturbances in executive function are present and to determine whether there are other forms of cognitive disorder that may affect learning and performance. We review each area for assessment in turn.

History

A full psychosocial history is crucial in the diagnosis of ADHD. Before a diagnosis of ADHD can even be entertained seriously, the clinician must determine that the symptoms of concern have precursors during the developmental years. The criteria for establishing a diagnosis require that the disorder must have influenced functioning before 7 years of age.⁹ Although only hints may be present in the person's history, Murphy and Gordon¹⁰ indicate that clear indications of impairment in social, academic, or family functioning must be present before the age of 12 in order to practically consider a diagnosis of ADHD.

Compared with typical diagnostic evaluations for other adult disorders, the time spent reviewing childhood and adolescent functioning needs to be expanded. As the diagnosis of ADHD has become more popular through media attention and other factors, many more people are seeking reviews for the condition. Some adults may be seeking diagnosis not only to receive help, but also to obtain educational and work accommodations under the Americans with Disabilities Act. Because of this, special care must be taken to make certain that the clinical history is not clouded by bias. At least two steps can be taken to decrease bias. First, whenever possible, information from the person's parents should be obtained. Several questionnaires have been created to obtain retrospective information from parents. Wender and colleagues¹¹ developed the Parents' Rating Scale to obtain a quick review of a

person's characteristics during childhood. The measure reviews a parent's impression of the frequency with which they observed problems with attention, hyperactivity, and impulsivity during their child's development. The Retrospective Attention Profile¹⁰ has also been utilized to obtain historical reports of difficulties with attention, impulse control, and hyperactivity. Second, a review of historical records is invaluable. Obtaining a full developmental history often provides an impressionistic understanding of the extent of difficulties in attention, impulsivity, and hyperactivity. In contrast, a review of the record of performance at the time that it occurred provides a more elaborate profile. School records in the form of report cards and completion of standardized tests provide very useful information. For report cards, the grades obtained provide indications of a person's level of performance and consistency of performance. The teacher comments section often highlights problems with classroom behavior, level of effort, and attentiveness. The comments and grades can highlight when problems were first encountered and their persistence across the age span. Completion of standardized tests can provide indications of a person's abilities. This information can be used to contrast with actual performance as noted in grades. Standardized tests may also be useful in highlighting the inconsistent functioning typical of persons with ADHD. Many times a person will show wide variations on standardized measures of reading or mathematics, for example, from one administration to another. If feasible, job performance descriptions can be useful, although concerns about confidentiality must be seriously considered before former or present employers are contacted. At the very least, a full employment history should be gathered.

Review of Current and Past Functioning Using Rating Scales

For pinpointing current concerns and helping to focus the evaluation, rating scales are useful. In these measures, the client requesting an evaluation responds to questions on how well descriptions of problems with ADHD fit his or her experience. The person usually has the option of indicating how much a particular problem interferes with functioning with options ranging from "not at all" to "very much" or the person indicates how frequently the problem is encountered. Some of the scales also obtain ratings from a person familiar with the client to overcome potential problems with low self-awareness. A number of scales have been proposed with varied levels of psychometric development.

Wender Utah Rating Scale

The Wender Utah Rating Scale (WURS¹¹) was developed to obtain information about a person's childhood behaviors and experience. Developed to facilitate a retrospective review of a person's adjustment when historical data or parental information is not available, the 61-item measure requests a self-report on one's development. The items were derived from descriptions of the characteristics of children with attention disorders compiled by Paul Wender. Items include concerns about activity level, inattention, impulsivity, and losing control. Twenty-five of the items were found most helpful in separating groups of persons with ADHD from normal controls. These items were selected for further study and came to compose the scale. Initial analysis indicated that the scale had good split-half reliability and high test-retest reliability.

When used to compare persons who met DSM-III-R criteria for adult deficit hyperactivity disorder with people free of clinical concerns and with people suffering from depression, summary scores on the 25 items were found to be highly effective. Those with ADHD had a group mean that was 2 times higher than that of depressed persons and nearly 4 times higher than that of normal controls, reflecting many more problems with inattention, hyperactivity, and impulsivity. The distribution of scores was also important, for the curves of the normal and ADHD subjects had very little overlap and the curves for the depressed subjects and ADHD subjects had only moderate overlap. In fact, the average score for ADHD subjects was more than 4 standard deviations above the mean for the normal group and 1½ standard deviations above the mean for the depressed group. Needless to say the group differences were statistically significant. Thus, the WURS has been shown to have good validity and utility in clinical practice.

However, some concerns have been raised in using the WURS. One disadvantage of the WURS lies in its retrospective orientation. Persons are asked to report only on their past. In many clinical situations, concerns about accuracy and motivation to respond truthfully should be raised. There are many situations in which a person may find it best to report fewer problems during development or more problems in development than actually encountered. The use of informants who knew the person well during childhood alleviates some of the concerns through the Parents' Rating Scale, but those persons may share an interest in under- or overreporting as well. Second, separate data must be obtained about the current functioning of the person through interview and observer information. Finally, the scale has a heavy emphasis on behaviors reflecting hyperactivity and impulsivity, so that persons may be missed who have suffered long courses of inattention by itself.

Ratings of Current Status

Nadeau created the Adult ADHD Questionnaire as a screening tool of 15 questions.¹² This measure has been described as having clinical utility, but it has not received clinical tests. Another screening instrument of 63 questions was created by Copeland¹³ through consultation with experts in adult ADHD, but it has not been normed. In contrast to these measures, two well-developed measures have strong psychometric properties and show appropriate sensitivity and specificity.

Brown Attention-Deficit Disorder Scales

The Brown Attention-Deficit Disorder Scales (BADDSS) were created to obtain information on how frequently a person encounters difficulties with the cognitive and behavioral consequences of ADHD.¹⁴ Forms for adolescents and adults are available in a format that allows for self-report and report from a person who knows the client well. In an expanded model of ADD, the BADDSS assesses difficulties in five areas: organizing and activating oneself for work; sustaining attention and concentration; sustaining energy and effort; managing affective interference; and utilizing working memory and accessing recall. These five areas are considered to reflect problems persons with ADD demonstrate in activity, appropriate arousal, and use of cognitive skills. The scales are designed to be used as screening instruments to determine whether a person would benefit from a more thorough diagnostic review or they can be used as part of an assessment system in which clinical history of ADD, ratings

of DSM-IV criteria for current ADHD by multiple raters, and a screen for comorbid disorders are included to make the diagnosis. Additionally, once a diagnosis has been established the scales can be used to track response to treatment.

The BADDs for adults is a 40-item measure. Responses of more than 300 adults were used in psychometric development. The items have been found to have high levels of internal consistency. Test-retest reliability has been established for the adolescent version, but is not reported for the adult version. When adults who were diagnosed as having ADHD through structured diagnostic interviews were compared with unaffected adults, the clinical sample had much higher scores, reflecting more problems. The clinical sample means were 2 standard deviations higher than that of the control group on the derived total score and on all of the five cluster scores. Used as a screening instrument with total scores higher than 50, the adult version rejected only 4% of ADD clients as free from the condition and accepted only 6% of controls as having ADD. Thus, when used in conjunction with other efforts, it is a useful instrument.

The Conners Adult ADHD Rating Scale

The Conners Adult ADHD Rating Scale (CAARS) is composed of a 42-item version and a 26-item version. The long version results in a summary score based on how accurately descriptions of behavior reflecting ADHD apply. Scores on four factors are also provided. The factors reflect Inattention, Hyperactivity, Impulsivity/Emotional Lability, and Problems with Self-Concept, the latter being a measure of the person's sense of effectiveness and confidence.¹⁵ For the factor scores and total score, a higher score indicates more problems.

The CAARS has been found to be psychometrically sound. In administration to more than 800 adults, internal reliability measures were high on the total score and four factor scores. Test-retest reliability in a sample of 167 adults referred for ADHD evaluation ranged from .80 to .91 on the factor scores. For validity evaluation, in a sample of clinic referred persons who were well above the norms of the Wender Utah Rating Scale, the scores on the four factors of the CAARS were significantly correlated with the total score on the Wender measure. Importantly, the correlations were highest between the Hyperactivity and the Impulsivity/Emotional Lability factor scores and the Wender total score. Finally, a sample of 39 referred adults who met the criteria for ADHD in a semistructured interview based on DSM-IV symptoms were compared to a nonclinical sample of 39 persons matched for age and gender. The ADHD group was significantly higher than the control group on all four factor scores. The ADHD group was over 2 standard deviations higher than the normal group on the Inattention factor and over 1 standard deviation higher on the Hyperactivity and Problems with Self-Concept factor scores. The ADHD group was just 1/2 a standard deviation higher on the Impulsivity/Emotional Lability factor, although the difference was significant.

At this time, both the BADDs and CAARS have utility in discriminating between adults with current ADHD and adults without clinical concerns. However, the Conners scale appears to have advantages because it has established reliability with adults and it has been normed on a larger sample. Future plans for development of the instrument include efforts to establish norms of ratings provided by significant others as a supplement to the data already gathered on self-report. In the future, the

Conners form may prove more useful as reported plans include studies to evaluate the standing of adults with ADHD in comparison to psychiatric controls.

Rating Scale Guidelines

A set of guidelines emerges from the review of rating scales. All of the rating scales provide a useful screening for the presence of ADHD symptoms during a person's life. The WURS helps determine whether symptoms were prevalent during the course of development, while the BADDs and the CAARS help determine how much a person's present life is affected by symptoms. However, none of the rating scales establish the diagnosis definitively. This fact is acknowledged by the creators of the rating scales, who indicate that they are not designed to be thorough or definitive. Therefore, it is recommended that the scales be used to target people at high likelihood of having ADHD. The combined use of the WURS with either the BAADS or the CAARS is recommended to help characterize the developmental course of symptoms. This is useful to answer questions about the struggles that the person is facing currently and has faced in the past. It is likely that persons with a longer course of difficulty will be at risk for other problems that need to be investigated. Use of the WURS in conjunction with the BAADS or the CAARS may also indicate the breadth of the problems that the person has faced. A person who has the combined impact of difficulties with hyperactivity and inattention compared to a person who has problems only with inattention is expected to have faced more social, academic, and behavioral consequences that need to be reviewed. The rating scales can also be used to place a person in relative position compared to nonclinical and clinical samples for determining the severity of the disorder. For the BADDs and CAARS, use of cluster scores and factors scores, respectively, can help determine the areas in which the person is most afflicted. This is a useful step in considering treatment plans and recommendations.

Reviewing Functional Status and Adjustment

The impact of ADHD can be broad. People with ADHD exhibit problems in their occupational and educational functioning and have significant disturbances in their social and emotional lives. However, it cannot be assumed that all persons with ADHD suffer from major disturbances in their vocational and social lives, so a thorough review of adjustment is required. A combination of clinical interviews with the person and significant others and the use of questionnaires helps.

A general clinical interview should address the reasons for seeking an evaluation and review the person's expectations for assessment and treatment. A standard review of current complaints and current life circumstances should be completed as would be completed in any other initial evaluation. When adult ADHD is considered, the data should be analyzed for the presence of disturbances in executive functions. Several methods are available for determining whether or not the patterns of behavior meet the criteria for adult ADHD. Most methods simply ask a person to indicate whether he or she struggles with a listed set of behaviors reflecting inattention, impulsivity, and hyperactivity.⁶

Once the general concerns are known, a detailed review of responses to the CAARS or BAADS with the person will be helpful to know exactly how a person is affected in day-to-day life. At times, a review of the person's typical schedule for

weekdays and weekend days proves useful in pinpointing when, where, and under what circumstances the person finds that disturbances in executive function has an impact on his performance. Present occupational functioning or educational functioning should also be reviewed. The information gathered should be integrated with the full occupational and educational history described above.

A clinical interview about the person's current relationships and a relationship history is warranted. Frequently, disturbances in relationships motivate the person to obtain an evaluation. A history of relationships with the person's family of origin at present and in the past is useful. Peer relations and intimate relations should also be scrutinized. If the person is married or in a stable relationship of some length, supplemental review using the Locke-Wallace Marital Adjustment Scale is advised.¹⁶ Persons with a nuclear family can complete the Family Environment Scale to determine family functioning.¹⁷ Persons who request evaluations who are themselves parents, whether living with their children or not, should complete the Parenting Stress Index¹⁸ to determine their effectiveness and satisfaction in a realm that often contains major problems.

The emotional reactions to the impact of manifestations of ADHD on a person's life should be reviewed carefully. How the person has coped with frustration and other emotional reactions to the limited success frequently experienced should be reviewed through an analysis of adjustment. The careful history completed will have already eliminated other primary disorders by the time that this stage is reached. The course of ADHD is so different from other psychiatric conditions that one should be able to eliminate consideration of bipolar illness, schizophrenia, and other disorders that are correlated with executive function disturbance before the thorough review of adaptive functioning is completed. Therefore, reviews of adjustment at this point turn to consideration of comorbid conditions.

Assessing for Comorbidity

Steps to screen for other disorders or important reactions can include the SCL-90¹⁹ and the Beck Depression Inventory²⁰ and State Trait Anxiety Scale.²¹ The latter two measures have been found useful in providing additional discriminant power to neuropsychological measures when ADHD is suspected.²² If further evaluation is warranted, the MMPI has been found to be helpful. Holdnack *et al.*²³ report that ADHD adults had a profile of elevations on the Depression, Psychopathic Deviant and Psychasthenia Scales when compared to normal controls. Structured interview schedules should be considered for further analysis. The SCID²⁴ is a valid and reliable instrument for this purpose.

Comorbidity and the Clinical Setting

The setting in which assessment occurs is likely to have a large influence on the comorbid conditions encountered. Distinctions have been reported depending on the recruitment methods used and the setting in which persons are encountered.

In clinical settings in which adults have sought evaluation and treatment of ADHD, emotional disturbances are common.²⁵ In particular, persons report a high frequency of depressive and anxiety disorders. In contrast, prospective studies that have followed children diagnosed with ADHD from their childhood into early adulthood, find problems with continued ADHD symptoms and disturbances of conduct

including antisocial actions, antisocial personality disorder, and a substantial amount of substance abuse disorders.²⁶

The exact nature of adjustment during late adolescence and adulthood has varied from study to study, but a clear pattern of behavioral difficulties emerges. For example, in one sample, at late adolescence and early adulthood (age range of 15 to 23 years), 40% of the ADHD patients continued to show signs of some form of attentional disorder. This contrasted with just 3% of the control group. Conduct disorders were present in 27% of the ADHD group, while only 8% of a control group showed those problems. Nineteen percent of the ADHD group had substance abuse disorder, while only 7% of controls were so affected. With regard to affective or anxiety disorders, only 4% showed problems compared with the same level of concern in the control group. A replication sample found similar results.²⁷ Weiss and Hechtman¹ report a similar pattern of outcome, although their data may be less representative as they lost contact with 40% of their childhood ADHD sample.

In contrast, another study tracking children into full adulthood at the average age of 26 years found that few persons continued to meet the criteria for ADHD: only 8% compared to 1% for controls. However, antisocial personality disorder was found in 18% (vs. 1% for controls) and substance use disorders were present in 18% compared with 13% for controls. At the time of evaluation, affective disorders and anxiety disorders were present at very low rates that were not different from controls. Despite this, lifetime prevalence of affective disorders and anxiety disorders fell near 30% for both groups. Therefore, the ADHD group was no more susceptible than others to encounter disturbances of mood and anxiety. The overall pattern was repeated in an independent sample reviewed at the 24-year-old average age. Attention deficit disorders were present in only 4% of grown-up ADHD children compared to adult counterparts. Substance abuse disorders were encountered in 19% of targets compared to 10% of controls. Finally, antisocial personality disorders were seen in 12% of persons with ADHD compared to 2% of controls. Mood and anxiety disorders were equivalent in between 6 and 11% of ADHD and control groups.²⁸

The contrasting comorbid profiles of persons seeking help during adulthood with adults who are simply followed into adulthood suggests that clinical samples of adult ADHD patients encountered in psychiatric settings have a referral bias. Self-referred adults may be experiencing more distress than those in the general population of ADHD children grown up. The distress that these clinic patients experience may motivate their request for review. In contrast, although most do not continue to meet the criteria for ADHD in adulthood, children with the disorder demonstrate more problems with behavior control as manifested by substance abuse and antisocial personality disorder later in life. These persons seem more likely to be encountered in the community or in other treatment centers. Their motivation to seek psychiatric care may be very different. It is also possible that ADHD persons who no longer manifest the condition in adulthood compose a different population from those that continue to manifest the disorder. Those that do not change may be more susceptible to emotional disturbance, which may reflect a different neuropsychological and neuropsychiatric profile. This possible explanation may account for the lack of differentiation of adult ADHD subjects from other psychiatric populations in their pattern of neuropsychological scores discussed below. Comparisons of those that continue to

demonstrate the disorder from those that do not will have to be conducted in order to determine whether different neuropsychological profiles are present.

A review of the comorbidity data has further implications for treatment settings in which adult ADHD is likely to be encountered. First, clinicians working with substance abuse populations, conduct-disordered populations, and head-injured populations should be on the alert for ADHD. It is known from comprehensive studies with ADHD children that have been conducted in the last decade that psychosocial interventions have limited additional impact on persons with ADHD when medication is already being used.²⁹ If the presence of ADHD in adulthood also diminishes the impact of psychosocial interventions, then those working with populations in which ADHD is a likely component should know whether it is affecting their clients. For example, because substance abuse is a frequent outcome for persons afflicted with ADHD, it may be that typical substance abuse programs will have limited effect if the person has an underlying ADHD in addition to addiction or dependence. Special efforts may be necessary to treat the person. The same may be true of conduct-disordered persons or those with antisocial personality disorder. The already difficult task of altering a person's behavior pattern may be complicated if the person is impaired by poor attention and impulse control. As a final example, as ADHD persons are more prone to car accidents and other injuries,³ those responsible for establishing rehabilitation programs and cognitive remediation efforts should attend to the premorbid possibility of ADHD. Programs to modify a person's attention and execution of tasks may hit limits because of the impact of ADHD. As a result, appropriate modifications need to be considered.

Neuropsychological Testing

To this point we have encouraged an assessment process that incorporates a neuropsychological orientation. Actual use of neuropsychological tests can be important also. However, before recommended guidelines can be presented, it is essential to understand what is known about the neuropsychology of ADHD in populations beyond childhood.

The Neuropsychology of ADHD: Neurophysiological and Neuroanatomical Studies

Giedd, Blumenthal, Molloy, and Castellanos³¹ thoroughly review the current state of knowledge on the neurophysiological basis of ADHD in children and adults. Work in this area has investigated functional and structural variations in the frontal pole and connected subcortical structures because of the assumption that symptoms of ADHD are due to disturbances in executive functions which are mediated by frontal structures and their subcortical connections.³² A reasonable collection of data supports continued investigation of the frontal region. However, not all data support exclusive concentration on frontal structures. Some investigations find variations in right hemisphere functions and also find variations in the volume of structures in the cerebellum.^{33,34} Additionally, disconnection syndromes have been reported with patients showing executive disturbance when lesions are present in medial structures, but not frontal areas.³⁵

Similarly, investigations on neuropsychological factors in ADHD have reviewed behavioral manifestations of the frontal lobes. Assessment of functions mediated by other regions have received much less attention, a situation which may hinder a full

understanding of ADHD in adults because cerebellar involvement and visuospatial functions mediated by the posterior right hemisphere have been implied.³⁶ Therefore, although frontal functions are stressed, it should be remembered that other functions and associated areas warrant review. Wasserstein and Stefanatos³⁷ discuss the evidence for a model of right hemisphere dysfunction.

Neuropsychological Research: Adults with ADHD vs. Controls

The neuropsychological investigation of adult ADHD has just begun. As noted, theoretical models developed to explain ADHD in childhood and adolescence have been applied in research on adults so that a variety of executive tasks have been emphasized. Sustained attention, concentration on details, motor coordination, processing speed and other executive functions including abstraction, verbal fluency, working memory, planning, and mental tracking have been incorporated in a relatively small number of studies. To enhance the discussion, a summary of results in presented in TABLE 1.

Some studies have compared persons with ADHD with other groups on a single neuropsychological test. Evidence for executive disturbance in adult ADHD has been found in comparisons between persons with ADHD and persons with other psychiatric and neurological conditions. One of the very early studies found that ADHD adults were similar in their performance to schizophrenic and nonpsychotic psychiatric patients on recall of items from a list-learning task (the Rey Auditory Verbal Learning Test³⁸). In contrast, the ADHD patients and other psychiatric patients were better on this task than amnesic patients and patients with head injuries. The authors concluded that ADHD was similar to other psychiatric conditions in that persons afflicted with the condition showed impairments. Additionally, they concluded that ADHD, similar to other psychiatric conditions, did not show impairments that were as severe as those found in persons with acquired damage. Thus, this study established some difference in list-learning in those afflicted with ADHD. Another study reported less effective performance for ADHD adults on a visual Continuous Performance Test (CPT) when compared to normal controls. In this study, ADHD subjects made more errors of omission and commission.³⁹

Other recent studies have conducted a more elaborate review of neuropsychological functions. In 1995, Holdnack *et al.*²³ utilized a battery of tests that tapped executive functions. Although ADHD subjects were no different from controls in their accuracy in responding to a Continuous Performance Test (CPT), their reaction time was slower. They were also slower in psychomotor speed and showed decrements in their memory on the California Verbal Learning Test (CVLT). Analysis suggested that those with ADHD could not extract information from their memory stores as well as controls. Concept formation and shifting set were executive skills that were not found to be different from controls on the Wisconsin Card Sorting Test (WCST). Subsequently, Seidman *et al.*⁴⁰ compared an ADHD sample to matched normal controls on memory functioning, freedom from distractibility, sustained attention and control of responses on an auditory CPT, visual vigilance, set shifting and maintenance on the Stroop Color Word Test, and completion of the WCST. The groups were not different from one another on the WCST, the Stroop, visual memory, visual motor coordination, visual vigilance, and freedom from distractibility. However, they were different in their attention to auditory detail and their verbal list learning

TABLE 1. Summary of results: persons with ADHD vs. normal controls compared on neuropsychological measures

Authors	Groups	Significant differences found on:	No significant differences found on:
Mungas (1983)	ADHD & psychiatric patients vs. amnesic & head-injured patients	ADHD less effective at list learning recall on Rey Auditory Verbal Learning Test	*****
Epstein <i>et al.</i> (1998)	ADHD Patients vs. Normals	ADHD more omission and commission errors on visual CPT	*****
Holdnack <i>et al.</i> (1995)	ADHD Patients vs. Normals	ADHD slower psychomotor speed, <i>slower CPT reaction time</i> , & lower recall on list learning (CVLT)	No difference on WCST variables
Seidman <i>et al.</i> (1998)	ADHD Patients vs. Normals	ADHD less effective on attention to auditory detail, <i>list learning</i> , and CPT reaction time and omission errors	No difference on WCST variables, <i>Stroop variables</i> , visual memory (WMS-R), <i>visual motor coordination</i> , visual vigilance, and <i>freedom from distractibility on the WAIS-R</i>
Gansler <i>et al.</i> (1998)	ADHD Patients vs. Normals	ADHD less effective on CPT, <i>slower speed in completing Trails A</i> , trend to do less well on recall of consonant trigrams after interference	No difference on WCST variables, <i>Trails B performance</i> , the Progressive Planning Test, <i>general intelligence</i> , and memory variables from the WMS-R
Lovejoy <i>et al.</i> (1999)	ADHD Patients vs. Normals	ADHD less effective on freedom from distractibility measures from WAIS-R, <i>slower on Stroop Color Word Trial</i> , and slower on Trails A & B, <i>lower in verbal fluency on the COWAT</i>	No difference on learning variables from the CVLT

ABBREVIATIONS: CPT, Continuous Performance Test; COWAT, Controlled Oral Word Association Test; CVLT, California Verbal Learning Test; WAIS-R, Wechsler Adult Intelligence Scale-Revised; WCT, Wisconsin Card Sorting Test; WMS-R, Wechsler Memory Scales-Revised.

and recall. Compared to normals, those with ADHD showed decreased effectiveness on these tasks. When several confounding factors including age, gender, presence of comorbid psychiatric conditions and learning disabilities were statistically controlled, the groups continued to be different on list learning and recall and CPT reaction time and omissions (both signs of problems with attention and speed of mental processing). For the authors, the results indicated that ADHD subjects were showing patterns of responses consistent with a model that indicates impaired frontal lobe functioning.

Another study found distinctions between ADHD adults and controls on accuracy in completing a visual CPT, speed of processing on Trail Making Test Part A, and a trend to perform less effectively on the recall of consonant trigrams following a long delay and interfering information.⁴¹ Controls and ADHD subjects were not significantly different on the WCST, Trails B, the Progressive Planning Test, general intellectual functioning, nor on measures of memory from the Wechsler Memory Scales-Revised. Taking analysis a step further, this last study searched for distinctions between adults that met the criteria for two different forms of ADHD. Adults that met the criteria for ADHD—predominantly hyperactive/impulsive type were compared to those that met the criteria for ADHD—predominantly inattentive type. Those with ADHD—hyperactive/impulsive type were less effective than inattentive subjects on the WCST. The ADHD inattentive type adults were less effective than hyperactive/impulsive adults on recalling fewer consonant trigrams after a short and long delay, completing Trails B more slowly, and responding to too many non-target items on a visual CPT. The authors concluded that both groups showed functioning implicating the frontal lobes with the possibility that different disturbances result in different profiles. Those with predominantly hyperactive/impulsive disturbances showed problems with a measure of higher-order working memory, the WCST, which may reflect less-effective functioning of dorsolateral aspects of the frontal lobes. In contrast, those with predominantly inattentive profiles may reflect problems with lower-order, specific working memory mediated by inferior frontal regions and limbic system structures that are connected to medial aspects. Further support of a medial profile for predominantly inattentive ADHD was provided in less-effective performance on a smell discrimination test by subjects who had that diagnosis.

Finally, one more study compared ADHD adults to matched controls on measures of attention, set shifting and maintenance, working memory, verbal fluency, and speed of processing.⁴² The ADHD subjects were less effective in four of five of these areas. Compared to controls, ADHD subjects showed more difficulty attending to details on the subtests of the WAIS-R that measure Freedom from Distractibility. They also were slower on a task that required maintaining cognitive set and inhibiting impulses, the Stroop Color Word Trial, and slower at mental processing on the Trails A and Trails B. Verbal fluency on the Controlled Oral Word Association Test (COWAT) was also lower for the ADHD subjects. No differences in list learning and recall from working memory were documented on the CVLT.

Overall, the results indicate that adult ADHD is associated with deficits in a number of neuropsychological functions including sustained attention, signal detection, working memory, verbal fluency, motor and mental processing speed, and, to a less frequent extent, shifting and maintaining cognitive set. The profile of results is not

consistent across studies, so that only a suspected neuropsychological profile can be discussed when ADHD adults are compared to unaffected controls. In most studies, working memory impairments for auditory information in list learning and recall following delays were documented. The studies also commonly document deficiencies in tasks of sustained attention through slower reaction times or more errors. Forming concepts has not been a seminal problem for ADHD subjects, but hints of problems in maintaining set were indicated in two studies. Only one study reviewed verbal fluency and it was low. The results from the comparison of persons with different forms of ADHD suggest that analyses that combine all forms of ADHD into one group may result in diminished distinctions from controls. Further study of variations within the population of ADHD patients will be necessary to determine whether this pattern is robust.

Adults with ADHD vs. Normal and Psychiatric Controls

The exact neuropsychological profile that is associated with symptoms of ADHD becomes more clear when psychiatric controls are added to the analysis. Including psychiatric controls is very important, for many of the neuropsychological disturbances found in adult ADHD have been found to be associated with other adult psychiatric conditions. For example, weak performance on tests that tap executive functions have been found in depressed patients (Wisconsin Card Sorting Test⁴³), in bipolar illness⁴⁴ and in schizophrenia.^{45,46} In fact, one of the seminal measures of ADHD, the continuous performance test, was originally developed to understand the attentional disturbances found in schizophrenia. It is possible that the neuropsychological profiles hypothesized and described in ADHD may simply reflect common characteristics found in persons affected by neuropsychiatric conditions. Analysis of this possibility requires a comparison of adult ADHD patients with persons with other disorders. TABLE 2 presents a summary of studies that have compared persons with ADHD to psychiatric controls.

There are only a few studies that have incorporated psychiatric controls. To gain as much information as possible, studies that utilized adolescent as well as adult subjects are discussed. Jenkins *et al.*⁴⁷ compared two groups of persons who sought evaluation for attentional complaints. One group did not have a childhood history of ADHD while the comparison group had histories of childhood ADHD. Those adults with a childhood history of ADHD had lowered scores on two tests of working memory, the Paced Auditory Serial Addition Test and the California Verbal Learning Test, and one measure of verbal fluency. Another study found that adults whose symptoms met the criteria for ADHD were less effective than a control group recruited from a psychiatric outpatient program who had current problems with attention. The ADHD adults were less effective on Digits Backwards from the WAIS-R, a measure of working memory, and they showed slowed reaction time on a task that required a motor response under complex set-shifting rules.²² Finally, when utilizing discriminant function analysis to determine the best model for separating ADHD adults from a group of depressed patients, Katz and colleagues⁴⁸ found that measures from the California Verbal Learning Test, the Paced Auditory Serial Addition Test and the Stroop Test were effective at a significant level.

In contrast to these findings, however, Walker and colleagues⁴⁹ did not find differences between ADHD adults and matched psychiatric controls on any of 18

TABLE 2. Summary of results: persons with ADHD vs. psychiatric controls compared on neuropsychological measures

Authors	Groups	Significant differences found on:	No significant differences found on:
Jenkins <i>et al.</i> (1998)	Psychiatric patients with attentional complaints –with vs. without childhood ADHD	Childhood ADHD less effective on Paced Auditory Serial Addition Test and CVLT, <i>lower fluency on COWAT</i>	*****
Kovner <i>et al.</i> (1998)	ADHD vs. psychiatric controls	ADHD less effective on Digits Backwards from WAIS-R, <i>slower reaction time and more variable reaction time on competing motor programs task</i>	No differences on measures of language, <i>visual-spatial perception and construction</i> , academic skills, <i>other short-term memory and working memory tasks</i> , attention to visual and auditory detail on the CPT and Digit Span forward, <i>personality and adjustment measures</i>
Katz <i>et al.</i> (1998)	ADHD vs. persons with depression or dysthymia	ADHD less effective on Paced Auditory Serial Addition, <i>lower scores on CVLT</i> , slower Stroop performance	*****
Walker <i>et al.</i> (2000)	ADHD vs. normals and mixed psychiatric controls	ADHD less effective than Normals on many measures including CPT variables, <i>freedom from distractibility variables</i> , COWAT, <i>verbal fluency in stating animal names</i> , Stroop variables	No differences between psychiatric controls and ADHD on any measures
Øie, Rund, & colleagues (various dates)	ADHD adolescents vs. Early Onset Schizophrenia	ADHD less effective on auditory processing	No differences on many other measures including verbal learning recall, <i>motor speed</i> , & visual-motor processing

ABBREVIATIONS: CPT, Continuous Performance Test; COWAT, Controlled Oral Word Association Test; CVLT, California Verbal Learning Test; WAIS-R, Wechsler Adult Intelligence Scale-Revised; WCT, Wisconsin Card Sorting Test; WMS-R, Wechsler Memory Scales-Revised.

measures of neuropsychological functioning that included similar measures of attention, working memory, verbal fluency, and set shifting including the Conners CPT, WAIS-R Digit Span and Arithmetic, the Controlled Oral Word Test, and the Stroop. The lack of distinction between ADHD and psychiatric controls was present even though ADHD subjects were significantly different than normal controls on 11 of the 18 measures.

In a set of studies completed in Norway, only one study reported a distinction between ADHD adolescents and psychiatric controls composed of adolescents afflicted with schizophrenia.⁵⁰ Both groups were less effective than controls on measures of verbal learning and recall and visual motor processing and attention. The schizophrenic group was less effective than the ADHD group on motor processing and visual memory. ADHD subjects were only worse than schizophrenics on auditory processing. The authors concluded that ADHD subjects demonstrated a specific difficulty with auditory processing including attention to auditory detail, while schizophrenics showed a wider pattern of neuropsychological deficits. However, no differences were found in responses to a degraded stimulus continuous performance test⁵¹ nor were schizophrenics and ADHD adolescents different from one another when asked to recall strings of digits following a distractor series, although both groups performed worse than controls.⁵² Thus, although ADHD subjects showed more problems on a single task, they were not distinctly different from early-onset schizophrenics on a series of measures considered important in frontal functioning.

It is hard to state that ADHD adults demonstrate a distinct and specific pattern of neuropsychological disturbance in light of this research. A summary of the results, finds that problems with working memory under stressful conditions as measured by the PASAT or Digits Backwards are common. Some difficulty with shifting and maintaining set have also been documented in more than one of the studies. Finally, difficulties with list learning and recall have been found in more than one study. Only one study has documented problems with auditory processing. Verbal fluency was found deficient in one study, although only one other study investigated this function and found that there were no distinctions. Generally, different versions of the CPT have not been effective in separating ADHD and psychiatric controls.

Summary of Comparisons and their Implications

At this time, it seems best to conclude that attention during working memory tasks and problems with maintaining set are important areas of concern for persons with adult ADHD. Tasks that tap the executive skill of deploying attention while maintaining information in working memory, such as Digits Backwards and the Paced Auditory Serial Addition Test, seem to be sensitive to the added executive difficulties that persons with ADHD have over persons with other psychiatric conditions. Disturbances in maintaining set have been reflected in slowed time, not the end result of performance. As a result, measures such as the Wisconsin Card Sorting Task, in which the end answer is reviewed, but not reaction time, may be less valuable than set-shifting tasks that measure the process of responding, including the time it takes to organize an accurate response. Compared to ADHD at younger ages, adult ADHD seems to be manifested more by problems in cognitive control and use of executive functions for cognitive tasks rather than combined deficits in both cognitive and behavior control seen in childhood.

Regarding the development of a neuropsychological model for adult ADHD which would justify the selection of a discriminating set of tests for making the diagnosis, it is fair to state that smoke has been detected in the general arena of executive functions, but the fire that is the source of that smoke has eluded discovery. Whether or not impairments solely linked to the frontal lobes will account for differences found between ADHD and normal controls or whether problems with right parietal orientation systems or cerebellar functioning must be considered is yet to be determined. Studies that utilize functional neuroimaging while persons perform relevant neuropsychological tasks will be most useful in determining if and how persons with ADHD are different from others. A true model for adult ADHD awaits the outcome of such research.

Clinical Implication of Neuroanatomical and Neuropsychological Data

Despite the fact that a distinct neuropsychological profile has not been established for ADHD, research supports several important conclusions for clinical practice. First, persons with ADHD do have difficulties completing complex tasks. They demonstrate inefficiencies and ineffectiveness in completing cognitive tasks. The cognitive difficulties are not highly different from cognitive disturbances found in other psychiatric conditions when those conditions are in the active phase, so the persons with ADHD are likely to suffer from some of the same problems of slowed cognition, poor memory, and the sense that one cannot control her own mind that are experienced by people in an acute depressive episode or schizophrenic disturbance. Yet, the person with ADHD may suffer more because the condition and its cognitive impact has a chronic course that does not recover. Second, the distinct behavioral manifestations of ADHD have different neuropsychological correlates. Those persons who struggle with attention alone are more likely to show problems in memory, reaction time while shifting set, and using attention selectively. In contrast, those who show more overt behavioral manifestations in impulse control and level of activation are more likely to have problems in determining and generating new actions when situational parameters change. They are more likely to have difficulty suppressing responses once a response-set has been established. Thus, all persons who have ADHD cannot be considered to have the same deficits in task completion, nor the same challenges in meeting daily demands. Finally, neuropsychological studies suggest that one must take into account the complex nature of ADHD in order to truly assist someone with ADHD by diagnosing its presence and elaborating its features. A simple confirmation that a person fits the developmental profile may guide broad treatment, but it may not provide the detailed description of deficits and strengths that a neuropsychological analysis of executive skills has to offer a full rehabilitation plan.

Diagnostic Specificity

One further aspect of research on neuropsychological distinctions between persons with ADHD and other conditions is the ability to utilize the information in clinical practice. In group studies, when measures have been found to significantly discriminate between adults with ADHD from adults with other conditions or no condition, the rate of false positives and false negatives must be considered. False negatives are cases in which data suggest the rejection of the diagnosis of ADHD

when it is really present. A false positive occurs when the level of performance on measures suggests that a person matches people with ADHD when in fact the condition is not present.

When rate of identification has been analyzed, false negatives are frequent. Identification rates of between 80 and 90% are common, which suggests good statistical sensitivity, but in practice the chance that a true case of ADHD is missed in up to 20% of cases may be unacceptable. On the other hand, when other psychiatric conditions have been included, concern about false positives has entered the picture. For example, Lovejoy *et al.*⁴² report false positive rates of 12% to 17% on measures that significantly discriminated between persons with ADHD and normal controls. Katz *et al.*⁴⁸ report that many people with forms of depression are also selected as having ADHD even when significantly discriminating variables are utilized. These rates are important because a failure to identify other disturbances that may need immediate care in 17% of cases would not be considered a good outcome by most clinicians. Kovner *et al.*²² provide indications that the rate of false positives decreases when measures of depression and anxiety are factored into the equation, but this means that the neuropsychological assessment model must be complex.

Overall, then, it is unwise to exclusively rely upon performance on neuropsychological measures when making the diagnosis of ADHD in adults, but it is equally unwise to ignore neuropsychological functioning. Clearly, there are no selective pathognomonic patterns that have been found and then replicated in the data to date. For clinical practice, when neuropsychological measures are used in evaluation, they need to be used with caution and in conjunction with other measures of adjustment in order to rule out other disorders where attention, working memory, reaction time, and control of mental functions are influenced. Similar to conclusions drawn in studies of ADHD in children and adolescents, no definitive statement can be made about a single case based on neuropsychological measures alone.³ This means that assessment must go beyond the administration of neuropsychological measures, which has already been noted, but it also means that neuropsychological thinking and neuropsychological measures can play an important role in a full evaluation for treatment planning.^{10,12} Given this conclusion, how can neuropsychological assessment be utilized to enhance the data collected through the steps already detailed?

Pragmatic Neuropsychological Assessment

A relatively brief assessment package is recommended that incorporates the data reviewed above. It is recommended that a brief intelligence test be utilized to determine the person's general problem-solving skills. Measures such as the Kaufman Brief Intelligence Test⁵⁴ or the Wechsler Abbreviated Scale of Intelligence⁵⁵ are appropriate. Next, assessing sustained attention and variations in reaction time during a lengthy attentional task is also advised through the use of an auditory or visual CPT. For clinical purposes, this measure can document the level of struggle that a particular person has in maintaining focus and arousal. Also, measures of working memory are advised since disruptions in the use of these skills can severely hinder the person's capacity to keep track of tasks and information. Tests that are difficult, such as the Paced Auditory Serial Addition Test⁵⁶ and components of the California Verbal Learning Test,⁵⁷ are recommended to use as ways to stress even talented individuals. Finally, tasks that tap the executive skill of suppressing responses and

shifting set under timed conditions should also be utilized to determine the person's efficiency rather than the person's power. The Stroop⁵⁸ and other timed measures may be helpful. With the information gained from these tests, the true challenges that a person faces will be elaborated so that recommendations made can be specific. For example, if a person shows severe problems in sustaining attention on a dull task such as the CPT, but is strong on challenging tasks stressing working memory, that person may be advised to avoid job choices that involve repetitive completion of the same tasks. Alternatively, another person with ADHD could have a profile of slow time on tasks that require shifting set or inhibiting responses, but effective sustained attention on a dull task. This latter person may be advised to avoid work that requires rapid decisions in environments that are extremely fast-paced. In effect, once a diagnosis is made, thoughtful use of neuropsychological assessment can carefully delineate the idiosyncratic profile presented by an individual client.

Determining a Skills Profile

Further neuropsychological testing will be useful when concerns about learning and educational performance are present. Although the rate of learning disabilities in adults with ADHD is not known, if rates are similar to those in childhood, it can be expected that between 10 and 30% of persons with ADHD will perform poorly in reading, spelling, mathematics, and language tasks.³ Persons requesting evaluations want to know how to improve their circumstances. If a long-hidden ADHD is discovered, that disorder by itself could account for the limits that the person has experienced in educational and occupational performance. However, if there are indications of other cognitive deficits, neuropsychological assessment should be utilized to delineate the profile of strong and weak skills. A comprehensive review that incorporates assessment of language processing, nonverbal reasoning, memory, motor coordination, sensory perception, and academic functioning in addition to the review of intellectual skills and executive functions is recommended.^{30,53} By performing such an assessment, remedial treatment planning could be undertaken to further enhance success.

The Overall Assessment Timeline

A schematic representation of the components for a full assessment of ADHD in adulthood is presented in TABLE 3. Overall, in clinical assessment, the recommended steps include (1) a review of current concerns; (2) the completion of ADHD rating scales by the person and a significant other; (3) a review of history through interview and the retrospective rating scales and a review of whatever old records are available; (4) an assessment of functional impairments in important arenas; (5) an interview to review for DSM-IV criteria for ADHD or other conditions, including a screen for other psychiatric conditions as either comorbid conditions or alternate explanations for the current concerns; (6) a screen or referral for physical status; (7) a brief administration of neuropsychological tests to provide an elaborate determination of cognitive strengths and weaknesses in executive skills; and (8) an elaborate administration of neuropsychological measures if educational planning or remediation is an expected part of treatment. Taking the first seven steps helps answer basic questions essential to making a diagnosis of ADHD.¹⁰ The seventh step is deemed essential for determining the true nature of the individual's profile of executive skills in deploying

attention, maintaining control of behavior, and sustaining motivation, crucial components of day-to-day success. Without this essential step, it is believed that an evaluation will simply recognize that a person suffers with ADHD. With the step included, the evaluation will provide a substantial picture of the person's life and challenges. The final evaluation step, incorporating an extensive neuropsychological assessment, is recommended for full clinical assessment, but is not necessary for making the diagnosis of ADHD. Clearly, comprehensive clinical neuropsychological assessment will provide a great deal of useful data for understanding an adult's functioning. In the hands of a gifted and well-informed clinician the data can be used to

TABLE 3. Recommended components for evaluating adult ADHD

	Description	Methods Used
1	Review of current concerns	Clinical Interview of Person & Significant Others
2	Completion of rating scales—Use 1 measure of childhood functioning and at least one measure of current functioning	Wender Utah Rating Scale for retrospective report on child and adolescent functioning Conners Adult Attention Rating Scale for review of current symptoms and/or Brown Attention and Arousal Disorder Scale for review of current symptoms – may have advantages for delineating problems with inattention, under arousal, and organization of activities
3	Review of history	Interview of person, interview of significant others, review of academic records and reports – look for comments on report card
4	Review of adaptive functioning	Educational and occupational history, relationship history, if married – completion of the Locke Wallace Marital Adjustment Scale and the Family Environment Scale, if a parent—completion of the Parenting Stress Index
5	Review for other disorders or comorbid disorders	SCL-90, SCID, DSM-IV Interview, Beck Depression Inventory, State-Trait Anxiety Scale, MMPI-2
6	Screening for physical disorders	Physical Evaluation
7	Assessment of cognitive profiles and essential executive tasks	K-BIT, WASI, CPT, Paced Auditory Serial Addition Test, CVLT, timed measure of set-shifting such as the Stroop Color Word Test
8	Extensive neuropsychological evaluation	A full review of neuropsychological functioning and academic achievement if learning difficulties or disorders have been present or are suspected
9	Feedback session and treatment planning	A full discussion of the evaluation results to address questions and review treatment recommendations

ABBREVIATIONS: MMPI-2, Minnesota Multiphasic Personality Inventory-2; K-BIT, Kaufman Brief Intelligence Test; WASI, Wechsler Abbreviated Scale of Intelligence.

establish highly effective treatment plans. Therefore, although neuropsychological assessments should be considered as adjuncts in diagnosis, they will be of great utility in the full assessment of an adult with ADHD to provide strategies for compensation, remediation, and treatment.

SUMMARY

Research on the neuropsychological aspects of attention deficit hyperactivity disorder (ADHD) in adulthood is a new endeavor. Studies have primarily focused on a review of executive functions following the lead of more extensive research on childhood and adolescent ADHD. The studies have utilized a variety of neuropsychological measures and have investigated a wide variety of executive functions. As a result of the variety of methods used, there have been very few findings that have been truly replicated. Despite this, several tentative conclusions can be drawn from the research. First, ADHD can be differentiated from normal functioning by significant differences on tasks that require executive skills. Second, it can be inferred that ADHD is a disturbance of executive functioning in the deployment of attention, the control of actions, and the control of activation and arousal. However, the disturbance in executive function may not be exclusive, as other structures and functions in those with ADHD have been found to be different from those in normal controls including cerebellar structures and functions mediated by several regions of the right hemisphere. Third, disturbances in executive functions go beyond attention deployment, impulse control, and activity level, and include problems with working memory, speed of motor movement, and speed of processing in response-shifting tasks. Fourth, the disturbances found in ADHD share characteristics of other persons with serious psychiatric conditions including schizophrenia and depression. Those with ADHD seem to be different from those with other psychiatric conditions in that the disturbances are less severe than those reported in schizophrenia and they are most often found in tasks stressing working memory and speed of reaction in response-shifting tasks. Finally, the disruptions in executive functions found have not been clearly tied to a specific region of the brain, but it is likely that frontal, prefrontal, and connecting subcortical regions are involved. Full evaluation of these conclusions and the full development of a neuropsychological model of ADHD in adulthood requires much more extensive research that is more consistent across studies.

The research to date has clinical implications that are important. It is important to use a neuropsychological perspective when diagnosing and evaluating persons with ADHD. The clinician should engage in a diagnostic process that reviews for disturbances in the executive functions of attention deployment, impulse control, and activation level in the present and throughout development. A number of clinical aids, in the form of questionnaires and rating scales, are available to review the person's functioning. These measures have varied psychometric status and clinical utility. In addition to the use of such rating scales, a comprehensive evaluation process is recommended that incorporates a careful review of history and historical documents, a review of the social, occupational, and academic status, and a review for comorbid conditions. Consideration of the context in which evaluation is requested is recommended since the likelihood of encountering ADHD and certain forms of

comorbid conditions differs with the setting. In particular, those working in substance abuse treatment settings, settings in which conduct disorders are common, and settings in which persons are impaired by head injuries through motor vehicle accidents are advised to carefully review their clients for premorbid and current ADHD. Targeted use of neuropsychological instruments in all clinical settings is advised for pinpointing the disturbances that a particular person experiences. This targeted use will allow clinicians to avoid clumping all persons with ADHD into the same behavioral profile. Although clients share many characteristics, those with ADHD in adulthood are as variable in their particular profile as persons encountered in childhood. It is believed that adult clients should be provided with evaluations that respect their unique characteristics so that treatment plans can be personalized.

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