

Neuropsychological Measures which Discriminate Among Adults with Residual Symptoms of Attention Deficit Disorder and Other Attentional Complaints*

Melissa Jenkins^{1,2}, Ronald Cohen¹, Paul Malloy², Stephen Salloway², Eileen Gillard Johnson², Joseph Penn¹, and Ann Marcotte³

¹The Miriam Hospital, ²Butler Hospital or ³Memorial Hospital of Rhode Island, and Brown University School of Medicine, Providence, RI

ABSTRACT

Attention Deficit Disorder (ADD) in children is accompanied by quantifiable deficits on attentional, learning, and memory indices. Symptoms of childhood ADD persist into adulthood in many cases. However, many adults without a history of childhood ADD also complain of difficulties with attention, presumably due to other etiologies than developmental ADD. This study investigated whether performance on neuropsychological measures of attention and memory could differentiate adults with attentional complaints and history of childhood ADD from those without childhood ADD. Adults with a history of childhood ADD demonstrated reduced scores on the Paced Auditory Serial Addition Task and Delayed Free Recall on the California Verbal Learning Test as well as on a verbal fluency task relative to adults who denied attentional problems in childhood. Discriminant function analysis using verbal fluency, performance on the Wisconsin Card Sorting Test, verbal learning and recall, Digit Span Backward, and performance on the Paced Auditory Serial Addition Task as predictors correctly classified adults with and without a history of childhood ADD into diagnostic groups with 75% accuracy.

Attention Deficit Disorder (ADD) is the most commonly diagnosed learning and behavioral disorder of childhood. Subjective complaints of attention and concentration problems are common among adults, and there is now evidence supporting the persistence of childhood ADD into adulthood. It has been estimated that 30% to 70% of children who are diagnosed as having ADD will continue to show symptoms of the condition as adults (Bellak & Black, 1992). Referred and nonreferred adults with ADD have demographic, psychosocial, psychiatric, and cognitive features which mirror features reported in diagnosed children (Biederman et al., 1993). When ADD symptoms persist into adulthood, they can significantly impact both academic and social success, as well as increase the

risk of drug abuse, delinquency, incarceration, job failure, and marital discord (Faigel, 1995). Attentional complaints are a common reason for referral to adult psychiatry, neurology, and neuropsychology clinics. There is a growing need to discriminate between those individuals with only subjective complaints and those with quantifiable attentional and learning dysfunction amenable to treatment. Although numerous studies have been conducted with children, neuropsychological functioning has not been well explored among adults with residual ADD.

A defining characteristic of ADD is an inability to establish and sustain attention (Barkley, Grodzinsky & DuPaul, 1992; Koziol & Stout, 1992; Shue & Douglas, 1992). Attentional and executive functioning have been examined

* Address correspondence to: Melissa Jenkins, Butler Hospital and Brown University School of Medicine, 345 Blackstone Boulevard, Providence, RI 02906, USA.

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quantitatively in childhood ADD, with numerous reports converging on the finding of impairment in executive functioning in this population. Children with ADD have reduced verbal fluency (Koziol & Stout, 1992), and decreased performance on measures of motor control and problem solving skills (Shue & Douglas, 1992). Children with ADD show greater sensitivity to interference on the Stroop Color Naming Task than age-matched normal control children (Carter, Krener, Chaderjian, Northcutt, & Wolfe, 1995). Impulse control is poorer than in age-matched children without ADD (Korkman & Pesonen, 1994). Children with ADD make more commission errors on Go No Go tasks, regardless of whether performance is rewarded or response costs are implemented for incorrect responding (Iaboni, Douglas, & Baker, 1995). They make more impulsive errors than controls on word matching; furthermore, errors are reduced following treatment of the ADD children with methylphenidate (Malone & Swanson, 1993). Children with ADD also show poorer organization of story information, and recall less information on recall trials (Tannock, Purvis, & Schachar, 1993). Similarly, reduced rates of immediate and delayed recall are seen on complex figure drawing, and have also been attributed to poor use of organizational strategies due to normal savings of information over time as well as enhanced performance on learning and recall tasks which require less active organization (Cahn & Marcotte, 1995). Based on these findings, as well as on neuroimaging studies showing anomalous frontal lobe functioning in ADD children compared to controls (Lou, Henriksen, & Bruhn, 1984; Satterfield, 1986; Satterfield et al., 1973), many researchers have concluded that frontal lobe mediated attentional, executive, and organizational dysfunction is central to ADD.

A few studies have failed to demonstrate consistent group differences between children with ADD and children without the disorder on tasks presumed sensitive to these cognitive functions (Fischer et al., 1990; Frost et al., 1989; Loge et al., 1990), leading to debate about the usefulness of neuropsychological tests in making a diagnosis of childhood ADD (Barkley & Grodzinsky, 1992). One problem in using tasks designed to

assess cognitive functioning in adults with children referred for assessment of possible ADD is that all children are presumed to have lower levels of performance on "executive function" tests than adults because frontal brain areas do not mature until the teenage years (Yakolev & Lecours, 1967). Thus, such tests may be less useful in discriminating between children with and without ADD than they would be in making such discriminations among adults.

Accordingly, questions remain regarding the usefulness of neuropsychological measures in discriminating between adults who reported probable childhood ADD and adults who denied childhood attentional problems. It was predicted that adults with attentional complaints who had childhood ADD would exhibit greater difficulties on neuropsychological tests of attention, learning and recall efficiency and executive control than adults with current complaints of attentional difficulties, but no prior history of childhood ADD.

It was also hypothesized that adults without prior childhood ADD who presented for evaluation of attentional problems might show elevated rates of depression, anxiety, or other personality characteristics (as measured by the MMPI) which could account for their subjective complaints. To test these hypotheses, we evaluated adults presenting at an outpatient ADD clinic with primary complaints of attention disturbance on a battery of neuropsychological tests designed to measure attention, executive functioning, and learning efficiency.

METHOD

Participants

A retrospective chart review was conducted on 46 consecutive adult referrals to an outpatient neuropsychology assessment service at a private psychiatric hospital for evaluation of attentional disturbance. All participants denied a history of significant traumatic brain injury (i.e., loss of consciousness or posttraumatic amnesia), seizure disorder, or other neurologic illness. All subjects had normal hearing and normal (or corrected) vision. Retrospective diagnoses of childhood ADD were made using a structured interview designed to parallel

DSM-III-R (APA, 1987), the diagnostic criteria utilized at the time of data collections; other DSM-III-R diagnoses were established by clinical interviews conducted by doctoral-level clinicians. Twenty-two participants met full diagnostic criteria for childhood ADD (CADD), and 18 of the participants indicated no childhood symptoms of diminished attention or hyperactivity (nonCADD). Those who endorsed some symptoms, but did not meet full criteria for diagnosis of childhood ADD ($n = 6$), were not included in data analyses to ensure nonoverlapping groups. While most of the CADD participants suspected that they had ADD as children, none had been formally diagnosed or treated; thus, these participants may have been characterized by mild to moderate symptoms as children, rather than severe manifestations of the disorder mandating earlier diagnosis and treatment.

The CADD and nonCADD groups did not differ in age or either Full Scale, Verbal, or Performance IQ (see Table 1). Mean Verbal, Performance, and Full Scale IQ scores for both groups fell solidly within the average range. Most participants (88%) were right handed; the remainder reported left- or mixed-hand dominance with no between-groups differences in handedness. There was a higher percentage of males in the CADD group (54%, as compared to 22% in the nonCADD group; chi square = 4.31, $p < .05$). This is not unexpected, as higher rates of childhood ADD are generally reported for males than for females (APA, 1987).

Materials

A standardized neuropsychological battery was administered, which included tests of intellectual functioning (Wechsler Adult Intelligence Scale, Revised [WAIS-R] Wechsler, 1974), attentional performance (Paced Auditory Serial Addition Task, Revised [PASAT] Levin, Mattis, Ruff et al., 1987), learning and recall (California Verbal

Learning Test [CVLT] Delis, Kaplan, & Ober, 1987), and executive functioning (Controlled Oral Word Association Test [COWAT] Benton & Hamsher, 1978; Wisconsin Card Sorting Test [WCST] Heaton, 1981; Luria's Recurring Figures Drawing and Reciprocal Alternation Motor Task; Luria, 1966). The Minnesota Multiphasic Personality Inventory, Form R (MMPI; Hathaway & McKinley, 1943, 1970) was also administered to each participant.

Data Analysis

Neuropsychological data were analyzed by a MANOVA using seven variables, which included summative scores for the PASAT, Luria Complex Motor Tasks, WCST, and Digit Span Backward. For the CVLT, a summative measure of learning (Trials 1 through 5) and one of memory (Long Delay Free Recall) were included. Post hoc one-way ANOVAs were conducted using a conservative .01 probability level for determining significance, using a one-tailed significance test based on a priori assumptions that the CADD group would perform more poorly on learning and executive function measures. Discriminant function analysis was conducted using the same variables and procedure as the MANOVA to determine whether group membership could be accurately predicted based on neuropsychological test performance. Comorbid diagnoses were compared using chi square analyses.

RESULTS

CADD and nonCADD participants did not differ with regard to mean scores on any of the clinical subscales of the MMPI except Scale 5 (Masculinity-Femininity), suggesting relatively equivalent levels of psychopathology between the

Table 1. Demographic Characteristics.

Variable	CADD ($n = 22$)		NonCADD ($n = 18$)		$t(1,38)$	p
	M	(SD)	M	(SD)		
Age (years)	33.6	(7.6)	31.7	(10.6)	0.69	.54
WAIS-R Full Scale IQ	99.2	(13.7)	105.9	(17.8)	1.62	.19
WAIS-R Verbal IQ	98.6	(12.8)	106.4	(17.9)	1.59	.12
WAIS-R Performance IQ	100.2	(16.4)	103.4	(17.8)	0.58	.56

Note. CADD = subjects with childhood history of Attention Deficit Disorder; NonCADD = subjects without childhood history of Attention Deficit Disorder; WAIS-R = Wechsler Adult Intelligence Scale, Revised.

groups. However, both groups were characterized by higher than normal rates of elevation on the clinical scales (see Table 2). This is probably reflective of both the study setting (outpatient clinic at a psychiatric hospital) and high rates of comorbidity among adults with residual ADD (Biederman et al., 1993). Nine participants (6 CADD, 3 nonCADD) did not complete the MMPI due to time constraints on the day of testing. One participant (nonCADD group) produced an invalid profile which was not included in the data analyses.

As noted, each subject completed a clinical interview with a clinical psychologist who made DSM-III-R diagnoses when diagnostic criteria were satisfied. Among the CADD participants (with previous history of ADD), 15 individuals (68%) were diagnosed with *current* ADD, Residual Type whereas the other 7 had some residual symptoms but did not meet full criteria for a *current* diagnosis. Thus, the majority of participants who met criteria for childhood ADD continued to experience symptoms of the disorder in adulthood. High comorbidity for other psychiatric diagnoses was seen (shown in Table 3). Many subjects in both groups met DSM-III-R criteria for affective, anxiety, substance abuse,

and learning disorders; diagnostic data for both groups are shown in Table 3. Chi-square analyses demonstrated that the frequency of assignment of these diagnoses among the CADD and nonCADD groups did not differ significantly; however, trends were observed in the direction of more anxiety disorders among the nonCADD group ($p = .11$) and more learning disorders among the CADD group ($p = .06$).

The MANOVA revealed a significant difference between groups with respect to overall neuropsychological performance, as nonCADD participants exhibited stronger performance than CADD participants, $F(7, 24) = 2.64, p < .04$. Neuropsychological data are shown in Table 4.

CADD participants exhibited weakest performance on the COWAT, CVLT, and PASAT relative to their nonCADD counterparts. On the COWAT, the CADD group demonstrated reduced verbal fluency relative to the nonCADD group. The two groups did not differ in the incidence of perseverative, intrusion, or socially inappropriate responses on the COWAT, suggesting that generativity rather than error-prone responding accounted for this between-groups difference.

Table 2. MMPI Results.

MMPI Scale	CADD T Score (n = 16)		CADD Number with T > 70	NonCADD T Score (n = 14)		NonCADD Number with T > 70
	M	(SD)		M	(SD)	
L Scale	47.0	(5.7)	0	49.4	(9.5)	0
F Scale	65.8	(10.1)	5	63.9	(9.9)	5
K Scale	46.5	(7.7)	0	49.6	(9.6)	1
1 - Hypochondriasis	61.2	(13.2)	4	58.4	(9.9)	2
2 - Depression	70.8	(15.6)	8	72.6	(11.2)	10
3 - Hysteria	64.6	(8.5)	4	64.9	(7.9)	4
4 - Psychopathic Deviate	74.6	(10.0)	10	68.9	(15.3)	7
5 - Masculinity-Femininity	62.8	(10.7)	5	47.9	(12.1)	1
6 - Paranoia	72.0	(11.1)	8	66.6	(7.8)	6
7 - Psychasthenia	70.9	(14.4)	7	69.2	(8.4)	7
8 - Schizophrenia	75.4	(14.5)	8	70.2	(13.2)	8
9 - Hypomania	61.5	(9.8)	4	55.1	(14.0)	4
0 - Social Introversion	62.4	(14.3)	3	61.0	(8.9)	3

Note. MMPI = Minnesota Multiphasic Personality Inventory; CADD = subjects with childhood history of Attention Deficit Disorder; NonCADD = subjects without childhood history of Attention Deficit Disorder.

[CVLT] Delis, Kaplan, & Ober, 1997). In addition, the Controlled Oral Word Test [COWAT] Benton & Leff, 1968; Wisconsin Card Sorting Test [WCST] Milner, 1956; and the Verbal Fluency Test [VFT] Delis, Kaplan, & Ober, 1997) were also administered to each participant.

Statistical data were analyzed by a 2 (group) x 7 (test) ANOVA with seven variables, which included the PASAT, Luria Complex Figure Test, and Digit Span Backward. A summative measure of learning (CVLT) and one of memory (Long Delay Free Recall) were also included. Post hoc one-way ANOVAs were conducted using a conservative .01 level for determining significance, using a significance test based on a priori hypothesis that the CADD group would perform worse than the nonCADD group on learning and executive function tests. A significant main effect analysis was conducted on the variables and procedure as described above to determine whether group membership accurately predicted based on overall test performance. Comorbidity was compared using chi square analysis.

ADD participants did not differ significantly on scores on any of the clinical MMPI except Scale 5 (Masculinity-Femininity), suggesting relatively equivalent psychopathology between the

MMPI Scale	F	p
1	0.69	.54
2	1.62	.19
3	1.59	.12
4	0.58	.56

Note. NonCADD = subjects without childhood history of Attention Deficit Disorder. Revised.

Table 3. Percentage of Subjects Meeting DSM-III-R Criteria for Each Diagnosis.

Diagnosis	CADD (<i>n</i> = 22)		NonCADD (<i>n</i> = 18)		Chi-square	<i>p</i>
	Number	(%)	Number	(%)		
Affective Disorders:	5	(23)	7	(38)	.98	.32
Major Depression	5		6			
Bipolar Disorder	0		1			
Anxiety Disorders:	1	(4)	4	(23)	2.59	.11
Posttraumatic Stress Disorder	1		2			
Generalized Anxiety Disorder	0		1			
Panic Disorder	0		1			
Intellectual/Learning Problem:	6	(27)	2	(11)	3.49	.06
Borderline IQ	1		0			
Learning Disability	5		2			
Substance Abuse	5	(23)	2	(11)	1.07	.30
Other	2	(8)	2	(11)		
Late Luteal Phase Dysphoria	1		0			
Antisocial Personality Disorder	1		0			
Intermittent Explosive Disorder	0		1			
Tourette's Syndrome	0		1			
No diagnosis	3	(14)	1	(6)		

Note. CADD = subjects with childhood history of Attention Deficit Disorder; NonCADD = subjects without childhood history of Attention Deficit Disorder.

CADD participants also exhibited weaker performance than nonCADD participants on the CVLT, indicating greater problems with verbal learning and recall. A trend ($p < .04$) was observed in the direction of less efficient learning in the CADD group by the fifth learning trial. Group differences were also noted on delayed

free recall of the newly learned information following a 20-min delay interval. Group differences were reduced by cueing, though trends toward better performance in the nonCADD group continued to be seen on cued recall trials. The two groups did not differ on single trial learning or delayed recognition memory of

Table 4. Neuropsychological Test Results.

Neuropsychological Tests	CADD (<i>n</i> = 22)		NonCADD (<i>n</i> = 18)		<i>t</i> (1,38)	<i>p</i>
	<i>M</i>	(<i>SD</i>)	<i>M</i>	(<i>SD</i>)		
PASAT Overall Score	72.5	(14.5)	81.8	(9.8)	2.32	.01
COWAT	28.3	(6.8)	37.3	(9.2)	3.58	.001
Digit Span Backwards	6.4	(2.2)	7.6	(2.4)	1.56	.06
Luria motor tasks (errors)	3.6	(4.9)	0.9	(2.1)	1.45	.03
WCST - Categories	5.4	(1.3)	5.8	(0.6)	1.02	.16
CVLT Learning (Trials 1 to 5)	53.7	(8.0)	60.1	(10.0)	1.82	.03
CVLT Long Delay Free	11.2	(2.8)	13.3	(2.8)	2.29	.01

Note. CADD = subjects with childhood history of Attention Deficit Disorder; NonCADD = subjects without childhood history of Attention Deficit Disorder; PASAT = Paced Auditory Serial Addition Test, Revised; COWAT = Controlled Oral Word Association Test; WCST = Wisconsin Card Sorting Test; CVLT = California Verbal Learning Test.

Diagnosis.			
CADD (n = 18)			
Number	(%)	Chi-square	p
7	(38)	.98	.32
4	(23)	2.59	.11
2	(11)	3.49	.06
2	(11)	1.07	.30
1	(6)		

Disorder: NonCADD = subjects without

of the newly learned information following a 10-min delay interval. Group differences were reduced by cueing, though trends toward better performance in the nonCADD group continued to be seen on cued recall trials. Groups did not differ on single trial or delayed recognition memory of

NonCADD (n = 18)			
M	(SD)	t (1,38)	p
31.8	(9.8)	2.32	.01
37.3	(9.2)	3.58	.001
7.6	(2.4)	1.56	.06
0.9	(2.1)	1.45	.03
5.8	(0.6)	1.02	.16
10.1	(10.0)	1.82	.03
3.3	(2.8)	2.29	.01

Disorder: NonCADD = subjects without auditory Serial Addition Test. Revised: Wisconsin Card Sorting Test; CVLT = California

words that had previously been presented. Thus, CADD participants had mild deficits in free recall which were diminished by cueing and ameliorated by testing in recognition format.

Overall performance on the PASAT differed between groups. When the four presentation rates were analyzed separately, significant differences were seen only on the fastest presentation rate, though trends toward worse performance ($p < .05$) were observed for all interstimulus interval (ISI) conditions. These data are illustrated in Figure 1.

Trends were observed in the direction of poorer performance in the CADD group on Digit Span Backwards and Luria's complex motor sequences. No differences were noted between groups in the number of categories completed on the Wisconsin Card Sorting Test.

Discriminant function analysis was conducted using the same measures entered into the MANOVA: COWAT (verbal fluency), WCST (mental inflexibility), Learning and Long Delay Free Recall on the CVLT (verbal acquisition and unstructured retrieval efficiency), Digit Span Backward (immediate auditory attention and recall), and PASAT (sustained attention/information processing speed) as predictors. These measures were selected to represent a variety of cognitive functions broadly associated

with attention, executive, learning, and memory abilities. Statistically significant discriminability was seen between the CADD and nonCADD groups (Wilks Lambda = .56; chi square (1, 7) = 28.25, $p < .0001$). This indicates a moderately strong relationship between neuropsychological functioning and childhood CADD status ($R = .63$). COWAT (.85) and CVLT Long Delay Free Recall (.65) had the strongest canonical loadings, while CVLT Learning (.49) had a moderate loading on the canonical factor. Digit Span Backwards and PASAT were marginally significant, loading .43 and .34, respectively, on the canonical factor. WCST and Luria complex motor performance did not load significantly on the canonical factor (.14 and .05, respectively). Participants could be correctly classified into diagnostic groups (CADD or nonCADD) with 75% accuracy overall. NonCADD participants were classified with 71% accuracy while CADD participants were classified with 78% accuracy.

DISCUSSION

The present findings demonstrate that neuropsychological performance in adults with attentional complaints may vary depending upon history of childhood ADD. Adults with a positive his-

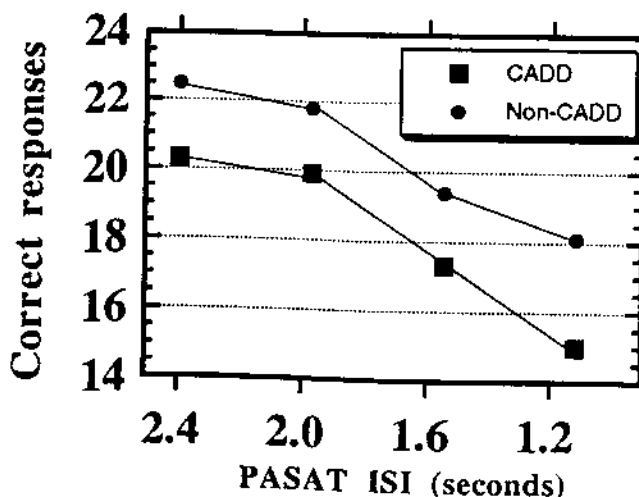


Fig. 1. Performance of Childhood Attention Deficit Disorder and nonChildhood Attention Deficit Disorder groups on the Paced Auditory Serial Addition Task (PASAT) over four interstimulus intervals (ISIs).

tory of childhood ADD exhibited greater impairments on measures of attention, executive functioning, and free recall as measured by the PASAT, COWAT, and CVLT. They also exhibited a trend towards greater impairment on several other frontal lobe sensitive screening measures, including reciprocal alternating hand movements, copying recurring figures, and digit span backwards. Like other patient groups with probable dysfunction of frontal systems mediated cognitive functions (Jenkins et al., in press; Jetter, Poser, Freeman, & Markowitsch, 1986), the CADD group demonstrated impaired free recall but normal recognition test performance for newly learned material. Thus, adults with a history of childhood ADD have deficits on neuropsychological testing similar to those seen in children with the disorder (Cahn & Marcotte, 1995; Koziol & Stout, 1992; Shue & Douglas, 1992; Tannock, Purvis, & Schachar, 1993). In concert with previous research, the current findings suggest that demonstrable cognitive dysfunction accompanies ADD, and does not inevitably self correct with maturity.

Overall, the level of neuropsychological impairment in the CADD group was mild. On average, the CADD group showed normal performance on the WCST, and scored within one standard deviation of the mean for normative subjects on Digit Span Backwards and CVLT Learning. Moderate deficits (between one and two standard deviations from the mean) were seen on the PASAT, CVLT Delayed Free Recall, and COWAT. Scores within one half standard deviation of the normative mean were obtained by the nonCADD group on all tests. Thus, the cognitive deficits detected in the CADD group were in the mild to moderate range, and one would speculate that these individuals do have clinically significant problems in daily living secondary to reduced cognitive efficiency.

Neuropsychological performance enabled a relatively reliable discrimination (75% accuracy) between adults with and without histories of childhood ADD. This indicates that neuropsychological measures may facilitate accurate diagnosis of adult ADD. Furthermore, these findings suggest that individuals with neuropsychological impairments of attention and learning are

more likely to report a childhood history of ADD. Therefore, an accurate determination of prior behavioral, educational, and medical history with respect to possible childhood ADD appears central to evaluating adults who present with complaints of poor attention/concentration. It should be noted that study participants were evaluated in a psychiatric setting, and a high percentage of both groups met criteria for other diagnoses. Whether the findings reported here generalize to "pure" ADD remains to be seen. One might expect greater reliability in distinguishing between our ADD sample and nonpsychiatric control subjects, as all research participants had attentional complaints.

The current battery of neuropsychological tests was selected on a theoretical basis to sample a range of "executive" functions rather than for optimal discriminability between groups. Thus, with further empirical research, one would expect that significantly better diagnostic accuracy could be demonstrated than was seen in the current study. While researchers (Barkley & Grodzinsky, 1992) have cautioned against reliance on individual neuropsychological measures in the diagnosis of childhood ADD, it does seem that there is a place for more comprehensive neuropsychological assessment in the clinical diagnosis of Residual ADD. Further research is needed to determine what specific measures or instruments might comprise an optimal battery for this purpose. Such research will also be useful in refining our current diagnostic conceptualizations of ADD to more accurately describe its cognitive sequelae.

While the battery of neuropsychological tests was able to make discriminations between the nonoverlapping study groups, their utility in clinical settings remains to be seen. Obviously, a number of psychiatric disorders, including schizophrenia, posttraumatic stress disorder, and severe depression are accompanied by measurable impairments in attention. Among populations with significant rates of these disorders, one might expect the clinical utility of the quantification of attention to decline. Further research is needed to elucidate the specific aspects of attentional functioning which are disrupted by each of these disorders. Development

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report a childhood history of an accurate determination of educational, and medical history to possible childhood ADD in evaluating adults who present with poor attention/concentration. In that study participants were recruited in a psychiatric setting, and a high percentage of groups met criteria for other than "ADD" remains to be seen. The greater reliability in distinguishing our ADD sample and control subjects, as all research on attentional complaints.

A battery of neuropsychological tests on a theoretical basis to sample "executive" functions rather than discriminability between groups. In empirical research, one would expect significantly better diagnostic accuracy demonstrated than was seen in the current study (Barkley & Murphy) have cautioned against relying on neuropsychological measures of childhood ADD, it does seem to place for more comprehensive clinical assessment in the clinical setting of adult ADD. Further research is needed to determine what specific measures or tests comprise an optimal battery. Such research will also be useful in the current diagnostic conceptualization to more accurately describe its nature.

A battery of neuropsychological tests to determine discriminations between the study groups, their utility in distinguishing psychiatric disorders, including post-traumatic stress disorder, and how they are accompanied by measurement of attention. Among population rates of these disorders, the clinical utility of the current study to attention to decline. Further research to elucidate the specific social functioning which are disrupted in these disorders. Development

of an "optimal" battery for discerning between clinical groups would necessitate inclusion of a representative sample of individuals seen in that setting, rather than selected nonoverlapping samples.

There has been a great deal of controversy regarding the overdiagnosis of ADD. Much of the controversy may be due to the clinical practice of assigning this diagnosis on the basis of subjective complaints rather than actual performance indices. Taken as a whole, the present findings indicate that there is not necessarily a relationship between subjective self perceptions of concentration and attention problems and measurable performance impairments on tests of attention. Consequently, relying solely on subjective complaints in the diagnosis of adult ADD is not advisable, as this study shows that many patients with subjective complaints do not have measurable impairments. The advantage of performance-based indices is that individuals can be evaluated by standardized procedures with established age-appropriate normative standards.

Of course, it is also possible that participants with subjective complaints and no neuropsychological evidence of impaired performance might exhibit actual attentional problems within particular environmental contexts not paralleled by the test situation. Whether or not that is the case, the current study suggests that these individuals are not exhibiting impairments of attention of the type seen in individuals with CADD. It is also possible that some of these individuals would exhibit impairments on other neuropsychological tasks not included in this study, though the current battery of tests was designed to measure a broad range of cognitive functions and therefore should have been sensitive to most clinically significant forms of attentional disturbance.

The distinction between subjective and neuropsychologically-verified attentional impairment may have important treatment implications. For example, individuals with neuropsychologically identified ADD may respond better to stimulant medication trials, while those with only subjective complaints of inattention may respond better to other interventions, such

as alternate medications, psychotherapy, or behavior modification. While stimulants are widely believed to enhance vigilance and sustained attention among both normal individuals and those with ADD, the amount of medication related improvement may vary according to the degree of measurable impairment. While speculative, this is a testable hypothesis. Furthermore, neuropsychological assessment may have a role in providing an objective means of gauging response to stimulant medications via pre and post test scores. Further research is needed to explore these treatment issues.

In the present study, adults in both the CADD and nonCADD groups had similar levels of overall psychopathology as measured by the MMPI. Therefore, by itself, psychopathology does not appear to account for the objective impairments of attention observed in the patients with CADD. However, it does not rule out the possibility that an interaction between psychopathology and ADD could account for the neuropsychological impairments described herein, rather than ADD *per se*. With regard to the MMPI, between groups differences were noted only on Scale 5 (Masculinity-Femininity). These differences are difficult to interpret in light of the gender inequity between groups (higher percentage of males in the CADD group). It may be that psychopathology was exaggerated due to the fact that some subjects did not complete the MMPI. Clinicians may have assigned a higher priority to this measure for subjects whom they suspected of having psychopathology. However, as diagnosed by clinicians, 84% of the CADD sample also met criteria for another diagnosis which suggests that psychopathology was genuinely high in our samples, and likely attributable to the psychiatric setting.

Comorbid psychiatric diagnoses for the CADD group and primary diagnoses for the nonCADD group appeared subjectively to show some differences which were not significant by chi-square analysis (though approached significance for anxiety and learning disorders). For example, almost twice as many (38% vs. 23%) of the nonCADD group participants as CADD participants were diagnosed with Major Depression, and five times as many (23% vs. 4%) were

diagnosed with an anxiety disorder. Non-significantly higher rates of learning disabilities and substance abuse were seen in the CADD group. Small cell counts may have obscured real group differences in the current study. Furthermore, the current study dichotomized each of these constructs (i.e., asked, "does the individual meet diagnostic criteria?"), rather than quantifying them using inventories or achievement test scores. Such quantification might be a better way in which to study the contribution of other psychiatric symptom clusters to both subjective complaints of poor attention and measurable performance deficits.

Obviously, one shortcoming of the current study was reliance on retrospective self-report to establish whether or not patients had symptoms of ADD in childhood. Reliability of these reports is unknown. Structured checklists paralleling DSM-III-R diagnostic criteria for ADD were used, and the distinction between symptoms experienced in childhood and current symptoms emphasized. Additionally, subjects reporting some symptoms of childhood ADD without the full syndrome of attentional and behavioral problems were not included in the analyses. It is hoped that these measures enhanced the reliability of self-report data, but that cannot be conclusively established. Clinical diagnoses of ADD are often made on the basis of similarly obtained self-report data. Retrospective self-report is commonly used in clinical and research contexts (Ward, Wender, & Reimharr, 1993). Longitudinal studies encompassing neuropsychological evaluation are needed to overcome the problems associated with this methodology.

Further research is also needed to examine differences between childhood ADD sufferers with and without residual attentional problems in adulthood. The current study examined a group of patients who presented to an outpatient clinic with complaints of attention. As such, it is likely that individuals with histories of childhood ADD who do not experience attentional difficulties in adulthood were excluded from the study because they did not seek treatment. Longitudinal studies would also help to overcome this sampling bias.

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