Assessment of short-term verbal memory impairments in adolescents and adults with ADHD

Donald M. Quinlan and Thomas E. Brown

The purpose of this study was to determine whether a brief measure of verbal memory can assess short-term verbal memory impairments relative to verbal abilities in adolescents and adults with Attention-Deficit/Hyperactivity Disorder (ADHD) and to ascertain whether significant differences between short-term verbal memory and verbal abilities are more common among persons with ADHD than in the general population.

One hundred seventy-six adolescents and adults diagnosed with ADHD (DSM-IV criteria) were assessed with a measure of short-term verbal memory. The short-term verbal memory score of each subject was compared with the verbal abilities on two measures. Percentages of ADHD subjects with "significant discrepancy" between verbal IQ and short-term verbal memory were compared with the standardization sample for the verbal memory measure.

A majority of adolescents and adults diagnosed with ADHD demonstrated significant discrepancy between performance on the short-term verbal memory measure and verbal IQ. The percentage of ADHD subjects with a significant discrepancy between these two measures greatly exceeded the percentage of persons in the general population showing such a discrepancy.

This brief measure of short-term verbal memory may be a useful measure to include in a comprehensive assessment for ADHD symptoms in adolescents and adults. Replication in other groups of ADHD patients is needed to test the generalizability of the findings.

"Often forgetful in daily activities" is one of the nine inattention symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) in DSM-IV (APA, 1994). In clinical practice, many patients diagnosed with ADHD report that they have good long-term memory function, but are significantly impaired in their short-term memory for daily activities. These patients complain of chronic difficulties holding in mind what they are planning to say while they wait for someone else to finish speaking and remembering what they have just been told or what they have just finished reading. Short-term verbal memory problems can cause significant impairment in school, work, social relationships, and other aspects of daily life.

Beyond "forgetfulness" involving recall of what one has just read, heard, or intended to say, short-term memory impairments may also contribute to other problematic behaviors recognized as symptoms of ADHD. "Often does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace," another DSM-IV ADHD symptom (APA, 1994), may result from persistent failure to hold in mind what one was asked to do or what one had set out to accomplish, especially if instructions or goals have multiple components. "Often loses things necessary for tasks or activities" (APA, 1994) may involve frequent failure to hold in mind where one has placed something. "Easily distracted by extraneous stimuli," a third symptom (APA, 1994), may be understood as resulting from insufficient ability to maintain awareness of current tasks and intentions, rather than an insufficiency of internal barriers against distracting environmental stimuli.

Most examples of "forgetfulness in daily activities" (APA, 1994) reflect impairments in "working memory." One aspect of working memory allows an individual to hold in mind currently relevant intentions and bits of information while simultaneously attending to something else. Working memory also functions as the computational "file manager" of the mind, selecting and retrieving from long-term memory information and plans needed moment-by-moment for current tasks. Working memory is a critical element of those "executive functions" which constitute the management system of the mind (Pennington, Bennetto, McAleer and Roberts, 1996). Increasingly, ADHD is being recognized as

a diagnostic category for developmental impairments of these executive functions (Barkley, 1997; Brown, 2000; Castellanos, 1999).

Assessment of memory impairments in ADHD patients has often been conducted with self-report. Although self-report data derived from rating scales and clinical interviews can be very helpful, a more straightforward assessment can be obtained by using standardized measures of short-term memory function in the evaluation of individuals with ADHD.

Standardized measures used in assessment of short-term verbal memory include list learning or paired-associate learning tasks such as those in the California Verbal Learning Test (CVLT; Delis, 1987). ADHD children (Chang, et al., 1999) and adults (Holdnack, Moberg, Arnold, Gur, & Gur, 1995; Seidman, Biederman, Weber, Hatch & Faraone, 1998) have been found to be significantly more impaired than normal controls on this type of measure. Yet list-learning tasks do not assess the sort of short-term verbal memory impairments often reported by adolescents and adults with ADHD. Tests involving multiple repetitions of a word list do not adequately assess for impairments in remembering more complex series of words heard only once, not repeated, as is most often the case in individual conversations, classroom presentations and discussions, and group meetings.

Performance on the Wechsler Intelligence Scale for Children-Third Edition Digit Span subtest (Wechsler 1991) has been found to be impaired in children and adolescents either alone (Karatekin & Asarnow, 1998; Loge, Staton & Beatty, 1990; Palou et al., 1998), or in combination with Arithmetic impairment (Mayes, Calhoun & Crowell, 1998; Perugini, 1999; Perugini, Harvey, Lovejoy, Sandstrom & Webb, 2000), which together form the WISC-III index of Freedom from Distractibility (Wechsler, 1991). But memory for digits does not necessarily parallel memory for words. The classic case of the brain-injured patient, HR, demonstrated that one can perform in the normal range on Digit Span and still show severe impairment in retention of new verbal information, for example, learning lists of paired words (Wagner, 1996).

Impairments in recall of short stories presented just once have been found in children with ADHD. Mealer, Morgan and Luscomb (1996) found that ADHD children generally showed lower short-term memory scores on the Wide Range Assessment of Memory and Learning (WRAML; Sheslow & Adams, 1990) than on their WISC-III (Wechsler, 1991) Verbal Comprehension Index scores; this discrepancy was not found in the matched non-ADHD control group. Brown (2001) reported on 130 children diagnosed with ADHD who were significantly impaired on the immediate Story Recall score of the Children's Memory Scale (CMS; Cohen, 1997) relative to their verbal IQ; the percentage of children showing significant discrepancy was much lower in normal controls in the standardization sample for the CMS. West, Houghton, Douglas and Whiting (in press) found that 50 boys diagnosed with ADHD had very significant impairment in immediate and delayed recall of the CMS stories relative to individually age-matched controls.

This paper reports a study of short-term verbal memory impairments in adults with ADHD using a different measure: the Logical Memory subtest of the Wechsler Memory Scale-Revised (WMS-R; Wechsler, 1987), which uses a single presentation of verbal narratives to be recalled immediately and after a 20- to 30-minute delay. Although brief, the stories used are too long simply to memorize by sound or linear image as one might do with a series of digits. Some understanding of the events described in the stories is required so the relatively more complex, detailed information presented can be categorized and stored for effective recall. Logical Memory requires more active processing of information than do measures such as the Digit Span, Arithmetic, and Letter-Number Sequencing of the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III; Wechsler 1997a), the Paired Associate Learning and List Learning tasks of the CVLT (Delis, 1987), or the Wechsler Memory Scale-Third Edition (WMS-III; Wechsler, 1997b; Bradley, 2000). The Logical Memory task used in this study more closely resembles many daily activities in which individuals with ADHD often report being forgetful. We will refer to this test as "Prose Memory" to more accurately reflect the content of the test.

Verbal memory function level is related to verbal ability. In the national standardization sample for the WMS-III (Wechsler, 1997b), a .58 correlation was found between immediate auditory memory and verbal IQ on the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III; Wechsler, 1997a). The current study compared each individual's score on the Prose Memory measure with his/her Verbal IQ and a verbal comprehension index. Frequency of large differences between short-term auditory verbal memory and Verbal IQ of adults diagnosed with ADHD were then compared with the proportion of such differences in the standardization sample for the WMS-R (Wechsler, 1987).

Method

Participants and Settings

This study was conducted at two clinics specializing in assessment and treatment of ADHD and related problems;

one clinic is private while the other is within a university medical center. All consecutive patients who sought assessment for attentional problems and were found to satisfy DSM-IV diagnostic criteria for ADHD were included. Except for five patients funded by public agencies, all patients paid for their evaluations with or without insurance support.

The sample included 93 patients from the private clinic and 83 from the university clinic. Their demographic and diagnostic characteristics are listed in Table 1. All patients were 16 years or older (mean age: 31.66 years; range: 16 to 69 years; *SD* = 12.27) and 68.2% were male. Forty-seven (26%) of the patients were adolescents in the age range of 16-19. The mean educational level was equivalent to two years of college (range: eighth grade to doctoral degree). Fifty-five percent met DSM-IV criteria for Predominantly Inattentive Type, 7% for the Predominantly Hyperactive/ Impulsive Type, and 39% for the Combined Type.

Measures

Diagnostic interviews. Each patient was assessed by an experienced, licensed clinical psychologist in a 2 hour clinical interview using the semi-structured format of the Brown ADD Diagnostic Form (Brown, 1996). Current problems; developmental and family history; current and past educational, occupational, and social functioning; health history; substance use history; and symptoms of possible comorbid disorders were queried. Wherever possible, collateral information was sought. During the interview, the Brown ADD Rating Scale (Brown, 1996) was completed. After integration and consideration of all available data, those patients who fully satisfied DSM-IV diagnostic criteria for ADHD were included as participants.

Testing

The full Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981) and the Logical Memory subtest of the WMS-R (Wechsler, 1987) were administered to each subject according to the published directions. The Logical Memory subtest of the WMS-R (referred to in this report as Prose Memory) has the examiner read aloud to the subject two short passages, each with 25 content units. After each story is read, the subject was asked to repeat the story as close to verbatim as possible. The recall was recorded verbatim and scored later according to manual guidelines. After a 30-minute delay during which other tasks were completed, the examiner asked the subject to repeat each of the two stories once again for the delayed recall measure.

Data Analyses

The two samples were compared on demographic variables, IQ scores, and scores on the Prose Memory Index (PMI). Although the private clinic sample was significantly higher on Verbal IQ and FS IQ, analysis of the two samples separately yielded the same pattern and significance of results: two-by-two repeated measures ANOVAs revealed only one of 12 interactions was significant, a number expectable by chance. Therefore, the data of the two samples were combined to simplify presentation of results.

Verbal IQ and Full-Scale IQ scores from the WAIS-R (Wechsler, 1981) were computed for all subjects by the conventional procedures. In addition, Bannatyne Verbal Index (BVI) and Bannatyne Concentration Index (BCI) scores were computed following the procedure described in the Brown Attention Deficit Disorder Scales Manual (Brown, 1996). Brown's Verbal Comprehension Index, adapted from Bannatyne (1974; Kaufman, 1990) utilizes

Table 1. Demograhic and Diagnostic Characteristics of the Sample

Age						
Age Range	16-18	19-21	22-29	30-39	40-49	50+
n	31	26	28	34	46	11
Mean	31.66					
(SD)	(12.27)					

Gender	***N***	**Percent**
F	56	31.8
M	120	68.2

ADD Category	**Frequency**	**Percent**
Predominantly Inattentive	96	54.5
Predominantly Hyperactive	12	6.8
Combined	68	38.6

three verbal subtests of the WAIS-R (Wechsler, 1981) that are relatively less sensitive to impairments of concentration. A regression formula is used to convert age-based scale scores on the Vocabulary, Comprehension, and Similarities subtests into a Verbal Index score (BVI). This index is a more sensitive measure of verbal ability than the Verbal IQ, which includes scores from Arithmetic and Digit Span subtests, both generally sensitive to problems with concentration. The Bannatyne Concentration Index (BCI), adapted from Bannatyne by Brown (1996), converts age-scaled standard scores on Digit Span, Arithmetic and Digit Symbol subtests of the WAIS-R (Wechsler, 1981), subtests which are generally sensitive to impairments of various aspects of concentration, to an IQ-like index score ($M = 100, SD = 15$).

Each individual's score on the Prose Memory was computed according to the WMS-R Manual (Wechsler, 1987), which yields percentile-rank scores adjusted for age. To facilitate comparison with IQ scores, percentile scores on the Prose Memory subtest were converted to equivalent scores to a distribution similar to IQ scores ($M = 100$, $SD = 15$) yielding Prose Memory Index-Immediate for immediate recall (PMI-1) and Prose Memory Index-Delayed for the delayed recall (PMI-2). The Prose Memory Index score for each subject was subtracted from that subject's Verbal IQ. A "significant discrepancy" was defined as a difference of 15 points or more ($SD_{difference} = 15.01, \geq 1\ SD$) or 30 points or more ($\geq 2\ SD$s) between their Verbal IQ and their Prose Memory Index scores or BVI and Prose Memory Index scores.

Verbal IQ – Prose Memory Index scores of ADHD subjects were also compared with those of the national sample used to standardize the WMS-R (Wechsler, 1987). This standardization sample ($n = 110$) of nonclinical subjects had been selected to match the composition of census data.

Results

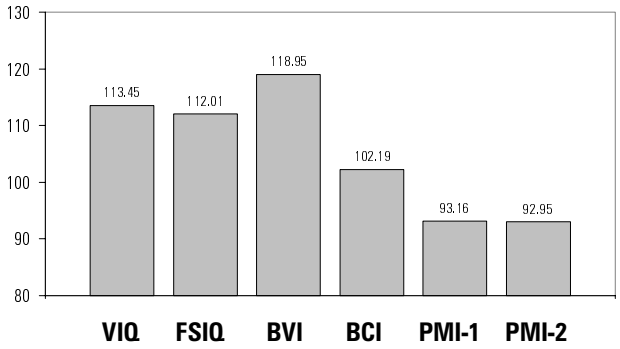
As discussed above, the differences between the two samples, although significant, produced only a chance-level frequency of interactions with the dependent variables, so the samples were combined. All scores were based on age norms. Correlations with age were small (r [174] = .04 to .23). Gender differences were all nonsignificant (t [175] = –.372 to 1.68; all $p > .05$).

Figure 1 presents the means for VIQ, FSIQ and BVI in comparison to means for the measures of concentration and memory, BCI, PMI-1, and PMI-2. Figure 1 shows that the means for overall cognitive abilities (FSIQ) and for general verbal abilities (VIQ) of this sample of ADHD subjects are in the High Average range, well above the mean of 100. When subtests more sensitive to concentration are removed to form the Bannatyne Verbal Index, the resulting mean (BVI) is higher than the Verbal IQ and Full-Scale IQ means, approaching the Superior range. In contrast, Figure 1 shows that the Bannatyne Concentration Index (BCI) for this ADHD sample is lower, close to the mean, in the Average range. Both the Prose Memory Index-Immediate (PMI-1) and the Prose Memory Index-Delayed (PMI-2) scores are markedly lower, below the mean, in the lower part of the Average range.

Table 2 presents statistical comparisons between the means illustrated in Figure 1. In Section A of Table 2, statistical tests of differences between means of the two Prose Memory Indices and the ADHD patients' mean VIQ and mean BVI are shown. The very substantial 20-point difference between IQ means and the Prose Memory Index means highlights the marked impairment of these ADHD adults in their short-term verbal prose memory relative to their more general verbal abilities. The difference of 25 points between the BVI and the PMI-1, more than 1.7 standard deviations, clearly shows that this group of ADHD patients was markedly more impaired in their Prose Memory abilities than in the other verbal abilities represented. Both differences are highly significant and substantial in effect size (both $p \leq 0001$; $eta^2 = .65$ and .72, respectively).

In Section B of Table 2, the 11-point difference between the Bannatyne Concentration Index (BCI) and the mean Verbal IQ, and the almost 17-point difference between the mean Bannatyne Verbal Index (BVI) and the mean BCI are shown. Both differences are highly significant, clearly reflecting substantial impairments of concentration relative to overall verbal abilities in this sample of ADHD adults. The contrast is greater in the comparison of the BCI with the Bannatyne

Figure 1. IQs, Bannatyne Index Scores, and Prose Memory Index Scores



FSIQ = Full Scale IQ, BVI = Bannatyne Verbal Index, BCI = Bannatyne Concentration Index, PMI-1 = Prose Memory Index–Immediate, PMI-2 = Prose Memory Index–Delayed.

Table 2. Verbal IQ, Concentration Index, and Prose Memory Indexes

Repeated-Measures *t*-tests	Comparison	Mean Difference	*SD*	*t*	*df*	*p* (2-tailed)
A. Verbal IQ & Index vs. Memory Indexes	VIQ – PMI-1	20.29	15.01	17.94	175	< .001
	VIQ – PMI-2	20.45	15.28	17.65	173	< .001
	BVI – PMI-1	25.79	16.01	21.37	175	< .001
	BVI – PMI-2	25.89	16.2	21.08	173	< .001
B. Verbal IQ & Index vs. Concentration Index	VIQ - BCI	11.26	10.14	14.73	175	< .001
	BVI - BCI	16.76	14.2	15.67	175	< .001
C. Comparison within Memory Indexes	BCI - PMI1	9.03	15.18	7.89	175	< .001
	BCI - PMI2	9.32	14.9	8.25	173	< .001
	PMI - PMI2	0.17	8.11	0.27	173	*ns*

Verbal Index, which is uncontaminated by inclusion of the Digit Span and Arithmetic subtests.

Section C of Table 2 shows comparisons between the Bannatyne Concentration Index and Prose Memory Indexes. These comparisons, unlike those discussed above, are between two measures of functions presumably impaired in these ADHD patients. The mean BCI score, however, is not as sensitive a measure of impairment in this sample as are the Prose Memory Index scores. The BCI-PMI-1 and BCI-PMI-2 differences are highly significant (both $p < .001$).

Section C also shows that the differences between Prose Memory-1 and Prose Memory-2 are not significant. The score for the recall of the prose passages did not deteriorate more than is characteristic for the normative sample over the 20- to 30-minute interval between immediate recall and delayed recall. Impairment of Prose Memory in these subjects appears to be related to problems of encoding and immediate retrieval, not to a more pronounced decay over time. Given the lack of significant differences between PM-1 and PM-2, the remainder of our data analysis uses only PM-1 comparisons.

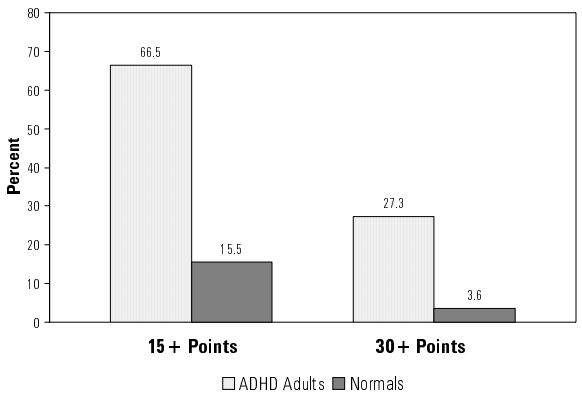
To ascertain how frequently the Prose Memory Index of an individual with ADHD is significantly impaired relative to his/her verbal abilities, we calculated the frequency of differences of 15 points or more and 30 points or more, roughly one and two standard deviations. Figure 2 shows that two thirds (66.5%) of the sample had a difference of 15 points or more between their Verbal IQ and their Prose Memory Index-Immediate. Over one fourth (27.3%) had a difference of 30 points or more between these two scores.

These high percentages of ADHD patients showing significant discrepancy between their Verbal IQ and Prose Memory Index scores can be clinically meaningful only if comparable differences are not found in the general population. To address this issue, we obtained from the publisher of the WMS-R (Wechsler, 1987) data on how frequently such discrepancies were found in a subsample of the census-based standardization sample of the WMS-R that had also been given the WAIS-R.

Figure 2 shows that relatively small percentages of the WMS-R standardization sample demonstrated the wide discrepancies between Verbal IQ and Prose Memory Index-1 shown by our ADHD patient sample. Four times as many ADHD subjects as standardization subjects showed a 15-point difference between these measures; the proportion for a 30-point difference was sevenfold.

When we used the Bannatyne Verbal Index as the base against which to compare Prose Memory Index, 77.3% of adults with ADHD had a difference of 15 points ($SD_{difference}$ BVI-PM-1 = 16.01); more than one third had differences of 30 points or more. Data from the standardization sample of the WMS-R (Wechsler, 1987) to provide the relevant BVI comparison were not available, so we have presented our findings here only in comparison with the more conservative Verbal IQ.

Figure 2. Percentage of ADHD Patients and WMS-R Normative Sample Subjects Having a VIQ-Prose Memory Index-1 Difference of 15 Points or More and 30 Points or More



Discussion

Taken together, the results show that, for a large majority of these patients with ADHD, there was a substantial difference between Verbal IQ and Bannatyne Verbal Index and short-term Prose Memory scores. Comparisons with the standardization sample of the WMS-R (Wechsler, 1987) suggest that such large discrepancies between Verbal IQ and prose memory are relatively rare in the general population. We interpret these findings as a useful example of "Often forgetful in daily activities" (APA, 1994), which is one of the ADHD symptoms in DSM-IV, a symptom often reported as significantly impairing by adolescents and adults with ADHD.

There are limitations in the selection of subjects in this study that need to be considered. First, this is a heterogeneous sample with regard to other diagnoses. In addition to ADHD, subjects had a mixture of other DSM-IV diagnoses, although subjects with diagnoses of Major Depressive Disorder, Bipolar Affective Disorder, Schizophrenia, Schizoaffective Disorder, Pervasive Developmental Disorder, or disorders with neurological deterioration (e.g., traumatic brain injuries, dementia) were excluded. Studies of ADHD in adults have shown a high degree of comorbidity, principally with Dysthymia and anxiety disorders (Brown, 2000). In addition, some of the subjects had varying degrees of learning deficits. Further investigation of the relationship between other diagnoses and learning disorders and Prose Memory is indicated to tease out the contribution of such disorders to the observed memory deficits. Such conditions need to be considered in evaluating the meaning of Prose Memory deficit when found.

The inability of most patients in our ADHD sample to recall significant portions of the two brief passages just read to them is a dramatic illustration of their chronic forgetfulness. Compared to most environments for work, school, and social situations, the clinical setting in which they were tested is quiet and relatively free of external distractions. These adults appeared to be trying hard to listen carefully as the examiner read the brief prose passages to them in clearly audible tones. They had been told that immediately after each story was read, they would be asked to repeat it, as close to verbatim as possible. Yet most did very poorly on this task. When they saw how few of the specific details of each story they had been able to recall, many subjects noted that they chronically have similar difficulties in remembering what they have just heard in lectures, business meetings, social conversations, and family interactions.

As Baddeley (2002) has noted, integration and maintenance in memory of complex prose passages, even the brief passages used in this study, places heavy demands on working memory and executive processing. Results of this study add to the increasing evidence that individuals with ADHD tend to be significantly impaired in verbal working memory, a critical element of the executive functions impaired in ADHD (Barkley, 1997; Brown, 2000).

Although a number of models of working memory have been proposed (Miyake and Shah, 1999), most current models recognize that attention is very closely related to working memory. The connection is so close that Baddeley (1993) acknowledged that the terms "working memory" and "working attention" might be used interchangeably to describe this multi-faceted cognitive function. The close connection between working memory and sustained attention has recently been demonstrated in an imaging study by de Fockert, Rees, Frith and Lavie (2001). This research showed that working memory has a major role in the control of visual selective attention. Much remains to be learned about the complex ways in which working memory is linked to other aspects of memory and to attentional impairments associated with ADHD, but findings of our study highlight the importance of assessing verbal working memory impairment in persons being evaluated for possible ADHD.

Some might wonder whether an alternative explanation for our findings might be found in the characteristics of our sample. Examining for gender and ADHD diagnostic subtype (Predominantly Inattentive, Predominantly Hyperactive/Impulsive, or Combined) did not yield significant differences in our results beyond what would be expected by chance given the number of tests calculated. Age effects were minimal as well (all scores were computed according to age-corrected norms).

Regression Effects

One other characteristic that might be considered as an alternative explanation for our findings is the effect of the high Verbal IQ of the sample (VIQ $M = 113$). *Regression effects* can arise when a sample is selected for an atypical score on one measure; under such circumstances, other measures tend to be closer to the mean. This alternative interpretation of our findings can be tested statistically by comparing the magnitude of our obtained differences with the discrepancies estimated by a regression formula. Using the correlations found between VIQ and Verbal Comprehension Index with the PM-1 score (r [174] = .45

and .41, both $p < .001$, respectively), the predicted mean PM-1 from VIQ is 106.84 ($SD = 6.78$) and from the VCI is 107.66 ($SD = 6.27$). The obtained PM-1 score was 93.16, 20 points lower than the mean Verbal IQ, 12.94 points lower than the PM-1 predicted from VIQ, and 14.49 points lower than the PM-1 predicted from VCI (paired *t*-tests of the predicted/obtained PMI-1 scores [$df = 175$] = 14.04 and 15.32, respectively, both $p < .001$). The discrepancies obtained are much too large to be accounted for simply by the effects of regression.

Some cautions need to be considered with regard to the presented results. In addition to the high level of verbal ability, these patients were self-selected by applying for an evaluation. The selection factors that led patients to seek out evaluation in a private or university clinic are not clear. Awareness of the disorder, access to financial resources to meet the expense of the evaluations, and the interest in seeking out such an evaluation are all likely to be characteristics that differentiate the samples of patients from adolescent and adult patients with ADHD in general. Further study with samples controlling the potential biases of the selection influences would test further the generalizability of the findings.

Statistical considerations suggest further cautions. The use of difference scores, while providing advantages of clarity, are subject to influences such as differences in reliabilities of the underlying measures. The obtained differences need to be viewed with some caution, but the magnitude of the obtained differences clearly suggests that further investigation with measures of prose memory are promising for assessing patients with ADHD.

The large discrepancies found between ADHD subjects' verbal abilities and their Prose Memory might be explained in any of several ways: as indications of failures of attention needed to encode the stories for memory, of inadequate memory storage capacity, or as a very rapid decay of encoded memories occurring between the reading and the first recall. More research is needed to clarify our understanding of the cognitive processes underlying the impairments of verbal memory demonstrated in these ADHD patients.

The differences in the sources of the groups of subjects for the current study suggest caution in the interpretation of the results. The comparisons of data from patients were made with the data from the normative sample of the tests, which is broader in location, ethnic composition, and socioeconomic status. The patient samples in this study had mean verbal abilities well above the normative sample. A stronger study would compare the ADHD patients with nonselected subjects with comparable age, education, and SES.

The results obtained suggest that individuals with ADHD are substantially different in their Prose Memory ability relative to unselected "normal" subjects. Subjects with other conditions (e.g., learning disabilities, depression, anxiety), were not assessed. As a result, the specificity of low Prose Memory scores is not known. A large discrepancy between Prose Memory and verbal abilities does not necessarily indicate the presence of ADHD. Additional research comparing ADHD subjects with patients who do not have ADHD, but do meet criteria for other psychiatric disorders (e.g. depression, anxiety disorders, etc.), would be useful to determine specificity of our findings to ADHD relative to other psychiatric and learning disorders.

Discrepancies between verbal comprehension and this brief measure of Prose Memory can be a useful measure for assessing the verbal memory impairments identified as one aspect of ADHD. Since Prose Memory impairment is not present in all persons diagnosed with ADHD, and is present in some persons without ADHD, this measure cannot be validly used alone to make or dispute a diagnosis of ADHD. As with other measures used for assessment of ADHD, Prose Memory discrepancies should be used in conjunction with other relevant measures. Clinicians assessing for possible ADHD need to look for convergence of diagnostic indicators relevant to ADHD diagnostic criteria, while carefully considering alternative diagnostic hypotheses that may be more compelling.

Recommendations for Practice

We have found it useful to include this measure in our standard assessment of individuals being evaluated for possible ADHD. It is brief, taking only about 10 minutes to administer once the baseline verbal IQ has been established, and it appears to have considerable ecological validity (i.e., it assesses a function related to impairments widely recognized as important in the day-to-day environments of most people).

Since data for this study were collected, the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III; Wechsler, 1997a) and Wechsler Memory Scale-Third Edition (WMS-III; Wechsler, 1997b) have been published as updated versions of the instruments used in our study. The new procedures incorporate a second administration of the second story. For the Prose Memory test we are now using scores from the first reading of the two stories provided in Logical Memory I of the WMS-III (Wechsler, 1997b),

ignoring the second reading of the second story. The subject's raw score obtained on the first reading of the two stories is converted to a standard score using the age-graded section of Table D.2 of the WMS-III Manual (pp. 148-161). For the WAIS-III and WMS-III, this scaled score is compared to the individual's Verbal IQ and/or Verbal Comprehension Index. For reasons stated above, we consider the Verbal Comprehension Index to be a more sensitive and appropriate measure for comparison.

The distribution of the differences between Verbal IQ and Prose Memory/Logical Memory I are presented in Table 3, with a caution that the distribution is derived from a sample with a high Verbal IQ.

We consider a Prose Memory Index score (i.e., the scale score for LM I or II converted to the IQ distribution) that is 15 points or more lower than the individual's Verbal IQ or Verbal Comprehension Index to be suggestive of ADHD impairment, while a 30-point (2 *SD*s) difference is regarded as strongly suggestive of ADHD impairment. Clinical interview data, scores on ADHD symptom rating scales such as Brown Attention Deficit Disorder Rating Scales (Brown, 1996) and/or Conners Adult ADHD Rating Scales (Conners, Erhardt & Sparrow, 1999), and other measures are used together with the Prose Memory discrepancy measure and clinical judgment to determine whether the patient fully meets DSM-IV diagnostic criteria for ADHD. Quinlan (2000) described this assessment protocol in more comprehensive detail.

The brief measure of short-term memory impairment, described in this paper as the Prose Memory Index, when used in comparison with an individual's Verbal IQ, can be a relevant, useful, and efficient component of a comprehensive clinical assessment for ADHD symptoms in adults. It is brief, easy to use, and can provide a valuable, cost-effective addition to a comprehensive assessment for cognitive impairments of ADHD in adolescents and adults.

Table 3. Distribution of Verbal IQ and Prose/Logical Memory Differences

Percentile Rank	PMI-1 Difference	PMI-2 Difference
0 - 10	< 0	< 1
11 - 20	0 - 7	1 - 7
21 - 30	8 - 11	8 - 11
31 - 40	12 - 17	12 - 17
41 - 50	18 - 19	18 - 19
51 - 60	20 - 22	20 - 22
61 - 70	23 - 26	23 - 27
71 - 80	27 - 32	28 - 33
81 - 90	33 - 39	34 - 40
91 - 95	40 - 45	41 - 45
96 - 100	> 46	> 46
Mean	20.29	20.44
SD	15.01	15.28

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Donald M. Quinlan and **Thomas E. Brown** are in the Department of Psychiatry, Yale School of Medicine and the Psychiatry Section, Yale-New Haven Hospital.

Correspondence concerning this article should be addressed to Donald M. Quinlan, Clinic for Attention and Related Disorders, 2041 Clinic Building, Yale-New Haven Hospital, 20 York Street, New Haven, CT 06504. Telephone: (203) 785-2166. Facsimile: (203) 227-6068. Electronic mail: donald.quinlan@yale.edu.