Rehearsal Strategies and Recall Performance in Boys With and Without Attention Deficit Hyperactivity Disorder

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Examined differences in recall performance and rehearsal strategies in boys with Attention Deficit Hyperactivity Disorder (ADHD) and comparison boys using an overt rehearsal procedure on a self-paced, multi-trial, free recall task. Boys with ADHD recalled fewer words, tended to spend less time rehearsing the items, and spent less time attempting to retrieve them. Although they did not rehearse items less frequently than comparison boys, they relied almost exclusively on repetition of single items. In contrast, comparison boys showed some evidence of using active, multi-item (cumulative) rehearsal. Despite their failure to use cumulative rehearsal, boys with ADHD identified it as more effective than single-item rehearsal in a subsequent forced-choice assessment of strategy knowledge.

KEY WORDS: rehearsal; strategies; memory; Attention Deficit Hyperactivity Disorder.

Children with Attention Deficit Hyperactivity Disorder (ADHD) appear to be capable of encoding, storing, and retrieving information well enough to meet many simple memory demands (Benezra & Douglas, 1988; Douglas, 1983; McGee, Williams, Moffitt, & Anderson, 1989; Ott & Lyman, 1993; Siegel & Ryan, 1989). There is increasing evidence, however, that they perform poorly on

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more complex memory tasks (August, 1987; Borcherding et al., 1988; Douglas & Benezza, 1990; Kinsbourne, 1977; Ott & Lyman, 1993; Weingartner et al., 1980).

Douglas (1988) suggested that defective executive or self-regulatory processes may be implicated in the performance of children with ADHD. Two major hypotheses involving a deficit in self-regulatory processes have been advanced to account for the performance deficits of children with ADHD on complex memory tasks: (a) They fail to deploy effective strategies and/or (b) they fail to sustain effortful processing over time.

Douglas and Benezza (1990) and Kinsbourne (1977) have demonstrated poor performance in children with ADHD on paired associate learning tasks (PAL) in which items were arbitrarily related. Optimal strategies for such tasks involve the use of imagery or elaboration to form links between the items. Although Douglas and Benezza did not obtain direct measures of the strategies used by their subjects, they did ask them about how they tried to learn the pairs. Normal comparison boys more frequently reported using strategies involving imagery and elaboration, whereas boys with ADHD tended to report relying on rote repetition. Although interview data of this kind are of some interest, the reliability and validity of children's self-reports is problematic (Ericsson & Simon, 1980).

There is also some evidence that the memory deficits of children with ADHD do not become evident until later learning trials. Both Benezza and Douglas (1990) and Kinsbourne (1977) found that recall differences between ADHD and comparison children on their PAL tasks reached significance only after repeated trials. Since these studies did not include direct measures of strategy use, it is not possible to specify the processes responsible for the problems of children with ADHD on the later trials.

Other investigations of strategy use in children with ADHD have also relied on indirect measures, or they have inferred strategy deficits from performance deficits. Hamlett, Pellegrini, and Conners (1987) used a single trial, sort-recall procedure to assess memory and executive functioning in children with ADHD. They obtained an indirect measure of strategy use by asking their subjects to provide the instructions they would give to a younger child about how to do the task. Children with ADHD showed less knowledge of optimal strategies in their instructions, but did not differ significantly from comparison children on the recall measure. Although it is possible that they actually used better strategies than the ones they described, it seems more likely that their less-than-optimal strategies were sufficient for coping with the rather limited demands of the single trial task used in this study.

August (1987) also used a sort-recall procedure to assess memory strategies and recall performance in children with ADHD, learning disabilities (LD), and comparison children. His task was more demanding than the one used by Hamlett
Children were presented with a large number of weakly categorizable words and their performance was assessed over repeated learning trials. In a baseline condition, children with ADHD recalled significantly fewer words than both LD and comparison children. They also showed less clustering of related items. When the children were prompted to sort items into meaningful groups, children with ADHD initially improved on both the clustering and recall measures. On Trials 1–3 they reached the level of comparison children on both measures, suggesting that the organization provided by clustering improved their performance on early trials. On Trials 4 and 5, however they again recalled fewer items than comparison children, despite showing no significant difference from them on the clustering measure. August interpreted these findings as evidence for a problem in sustaining effort over time.

In this study, we used an overt rehearsal procedure to assess the strategies used by boys with ADHD and comparison boys on a self-paced, multitrial list learning task. Because the children were required to rehearse aloud, we were able to directly observe the strategies they used to learn the items, as well as the time they spent on rehearsal and retrieval.

The overt rehearsal procedure has been employed extensively in developmental studies by Ornstein and Naus and their associates (see Ornstein, Baker-Ward, & Naus, 1990, for a review). These studies demonstrated a clear developmental progression in rehearsal patterns that appears to reflect improved organization/self-regulation. Strategy use in young children typically involves simple, isolated, repetition of each item as it is presented, whereas, by the age of 10 or 11 years, children show clear evidence of using multi-item, cumulative rehearsal, in which several items are rehearsed together (Naus, Ornstein, & Aivano, 1977; Ornstein, Naus, & Liberty, 1975). Further refinements occur during adolescence, when they begin to group semantically related items (Ornstein, Naus, & Miller, 1977). This transition from simple to more organized strategies occurs gradually and is not an all-or-none phenomenon. It has been shown to vary from task to task and context to context (Ornstein et al., 1990).

Ornstein et al. (1975) have shown that the shift to cumulative rehearsal corresponds to age differences in the serial position curve and to successful recall of material from long-term storage. Significant relationships between rehearsal content and recall performance have also been demonstrated in training studies in which rehearsal strategies were experimentally manipulated (Naus et al., 1977; Ornstein, Naus, & Stone, 1977). Older children instructed to rehearse in a "passive" or single-item fashion showed levels of recall similar to those of younger children who spontaneously rehearsed in this manner. Conversely, when younger children were trained to intermix several different items in their rehearsal sets, their performance approached the level of older children who employed this strategy spontaneously. Rehearsal frequency (number of repetitions of items), on the other hand, was not directly related to recall performance (Naus et
Ornstein and Naus (1978) argue that the intermixing of different items in rehearsal sets serves an organizing function. As a result of this active restructuring of items in the list, individual items are included in a number of different rehearsal sets, thus facilitating multiple encodings and more varied interitem associations. At the time of recall, items that are rehearsed together are recalled together because of the associative strength developed between them.

A number of more recent studies using the overt rehearsal procedure have demonstrated the role of mental effort and motivational factors in the application of cumulative, multi-item rehearsal (Guttentag, 1984, Kunzinger & Witryol, 1984). Kunzinger and Witryol (1984) showed, for example, that even young children in Grade 2 increased their rehearsal set size when a monetary incentive was provided for recalling particular words. Guttentag (1984) demonstrated that engaging in cumulative rehearsal interferes with performance on a simultaneously performed secondary task. He attributed this to the active effort required by the cumulative rehearsal strategy, and he suggested that it is this demand on mental effort that prevents younger children from spontaneously engaging in the cumulative strategy.

We expected a number of features of our list-learning task to make the role of strategic, effortful, self-regulated, and sustained processing particular important. The lists to be learned contained 24 unrelated items. Thus the children were confronted with a high information load with little inherent organization. The task also included five successive presentations of the lists, thus placing demands on the children to improve their performance across learning trials. We hypothesized that boys with ADHD would be less likely than comparison boys to engage in organized, effortful, multi-item cumulative rehearsal. We also hypothesized that their performance deficits would become more pronounced with repeated demands for effortful processing across trials.

Because we wished to observe how the children organized and paced their own learning, besides allowing them to choose their own rehearsal strategies, we allowed them to control the rate of presentation of the items to be recalled. They did this by progressing through a booklet of pictures of the items at their own pace. Only two constraints were placed on them: They had to rehearse the items out loud, and once they finished rehearsing an item, they could not turn back to it (i.e., past items were not visually available). We hypothesized that boys with ADHD would spend less time rehearsing the items than comparison boys. We also hypothesized that they would spend less time attempting to retrieve items during recall.

An additional aim of the study was to assess the boys' understanding that some rehearsal strategies are more effective than others. Although several authors have suggested that boys with ADHD and comparison boys may differ on metacognitive awareness (Campbell & Werry, 1986; Douglas, 1983; Pelham, 1986), there has been little empirical support for this hypothesis. We investigated
the extent of the boys' awareness of the superior effectiveness of multi-item rehearsal by asking them, following the recall task, to judge the relative merits of different examples of rehearsal strategies. Finally, because there have been reports of discrepancies between “knowing” and “doing” in ADHD children (Douglas, 1983, 1988), we examined the relationship between having this metacognitive knowledge and applying it in the learning situation.

METHOD

Participants

Thirty boys participated in the study; 17 met criteria for a DSM-III-R diagnosis of ADHD (American Psychiatric Association, 1987) and 13 were comparison boys. All boys were selected from Grades 2 through 6 in a middle-class school district of suburban Montreal. Their ages ranged from 7 to 12 years. The boys all had verbal IQs over 90 on the Peabody Picture Vocabulary Test (Dunn, 1965), were white, and spoke English as their first language.

Boys with ADHD were selected by having teachers identify students in their classes who: (a) had significant attentional problems, (b) were overactive, and (c) were impulsive. Teachers were asked to rate these potential subjects on the Conners Teacher Rating Scale—Revised (CTRS-R; Goyette, Conners, & Ulrich, 1978). The CTRS-R is a widely used instrument used for screening for ADHD. This is a behavior rating scale on which teachers indicate the extent to which the child exhibits each of 28 different symptoms. To be included in the ADHD group, boys had to receive mean ratings above 1.5 on the 7-item hyperactivity factor.

Mothers of all potential subjects were contacted by phone to obtain consent for their child's participation in the study. Information was also obtained about the child's medical and developmental history. A child was included in the ADHD group only if his mother confirmed that he showed clear evidence of poor attention, overactivity, and impulsivity in the home. She also had to report that these difficulties had been evident before he started school. Where there was any suspicion that symptoms could be attributed to emotional disturbance or a stressful home situation, the child was excluded from the ADHD group. Because stimulant medication was not frequently used in the community in which we recruited ADHD boys, only three potential subjects were currently receiving stimulant medication. They were not included in the sample as their mothers were reluctant to take them off medication for the study.

Mothers were then asked to complete a consent form and the Conners Parent–Teacher Rating Scale—Revised (the 10-item short form) (CPRS-R; Goyette et al., 1978). All boys with ADHD accepted into the study received mean ratings of at least 1.5 on the CPRS-R.
Table I. Mean Scores of ADHD and Comparison Boys on Screening Measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>ADHD (n = 17)</th>
<th>Comparison (n = 13)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in months)</td>
<td>112.40</td>
<td>116.00</td>
<td>0.42</td>
<td>&gt; .10</td>
</tr>
<tr>
<td>Peabody IQ</td>
<td>109.53</td>
<td>106.15</td>
<td>0.52</td>
<td>&gt; .10</td>
</tr>
<tr>
<td>CTRS-R: hyperactivity factor</td>
<td>1.99</td>
<td>0.35</td>
<td>11.69</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>CPRS-R:10-item short form</td>
<td>1.76</td>
<td>0.41</td>
<td>14.19</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

Comparison boys were selected from the same classrooms as the boys with ADHD, by asking teachers to select the next boy on their class list who matched an ADHD boy on age (within 6 months) and estimated intellectual ability. Teachers and mothers also completed Conners ratings on each potential control boy. To be accepted as comparison boys, boys had to receive mean ratings of 1.0 or less on both the hyperactivity factor of the CTRS-R and on the CPRS-R.

These subject selection criteria yielded two groups of boys matched on age and verbal IQ. Mean ages of the ADHD and comparison boys were 9.4 and 9.7 years, respectively. Data on the screening variables are reported in Table I.

Design and Materials

The items to be remembered were 24 pictures of common objects (e.g., star, flag). Object names were high-frequency, concrete nouns (Thorndike & Lorge, 1944). Because effects of rehearsal vary as a function of the structure available in the to-be-remembered material (Ornstein & Naus, 1985), items were selected to minimize possible semantic or acoustic associations within the list. Each object was depicted by a simple colored picture presented on 7.5 × 12.5 cm cards bound into a booklet.

All subjects received the same 24 pictures in the same serial order for each of five alternating study-recall trials.

Procedure

Overt Rehearsal Task

Subjects were tested individually. They were told that they would be given a booklet of pictures of objects, and that they should try to remember the names of the objects by practising them out loud.
Subjects were then given five practice pictures for rehearsal and recall to ensure that they understood that they were to rehearse the names of the pictures out loud. They were told that they could practice the items as many times and in whatever combinations they wished. The method employed by Orstein et al. (1975) was used to insure that the children were informed about the possibility of using either repetition or cumulative rehearsal strategies. Those who rehearsed only one item at a time (e.g., "dog," "dog," "dog") were informed of the alternative strategy of rehearsing more than one item together (e.g., "dog, house, kite"). Similarly, if a child did not use one-item rehearsal, this strategy was demonstrated to him.

Prior to the first rehearsal trial, boys were asked to go through the test booklet and name each picture. Any reasonable label used by the child was accepted. Before beginning the first of five trials the examiner again emphasized that the child was responsible for deciding how best to practice the items. He was encouraged to move through the booklet at his own pace, the only restriction being that he was not allowed to view a previous picture once he had moved on to the next one. The child then began the first rehearsal trial. After he had rehearsed the final item in the booklet, he was asked to recall as many items as possible, in any order. When he indicated that he could not remember any more items, or a period of 30 seconds elapsed with no additional recall, he was asked if he could remember any other pictures. If not, the recall period ended and the child was again presented with the same picture booklet for the next trial.

The examiner recorded the child’s rehearsal and recall protocols verbatim. They were also taped to allow for later transcription, as some protocols were too fast-paced to be recorded accurately during testing. Transcriptions of rehearsal protocols were divided into 24 rehearsal sets comprising the items the child voiced as he viewed each of the 24 pictures.

A number of dependent measures were taken on each of the five trials. Words Recalled was the number of correct items recalled. Rehearsal Frequency was defined as the mean number of rehearsals of each of the 24 items. Rehearsal Set Size was defined as the mean number of unique items verbalized by the child following presentation of each of the 24 items (e.g., if the child said "star, clock, star," rehearsal set size was scored as 2). Rehearsal Time was defined as the total time (in seconds) taken to rehearse the 24 items on each trial. Recall Time was defined as the time taken (in seconds) to recall all of the words remembered on each trial.

Assessment of Strategy Knowledge

Following the final recall trial, boys were presented with three forced-choice questions (adapted from Naus & Dennig, 1979) to assess their knowledge of the efficacy of various rehearsal strategies for the list-learning task. In the first
question, the child was asked to compare the effectiveness of rehearsing a single word three times (e.g., boat, boat, boat) with rehearsing the same word seven times. In a second question, he was asked to compare the effectiveness of rehearsing words individually several times with rehearsing them the same number of times as part of a multi-item group (e.g., boat, star, clock; boat, star, . . .; as opposed to boat, boat, boat; star, star . . .). In the third question, the child was asked to compare repeating individual words seven times, with practicing the same words as a multi-item group, just three times. After each question the child was asked to explain his choice. The answer was scored correct only if the boy chose the more effective strategy and gave an appropriate reason for his choice. Strategy choices and the reasons given by the boys were recorded.

RESULTS

A 2 (Group) \times 5 (Trials) analysis of variance, with repeated measures on the second factor, was carried out for each of the dependent measures. Conservative degrees of freedom are reported for all repeated measures (Geisser & Greenhouse, 1958). The raw scores for the dependent measures of rehearsal time, rehearsal frequency, and recall time were transformed to natural logarithms for the analyses. Data on the dependent measures on the five learning trials are reported in Table II. Raw scores are reported in the table.

Words Recalled. There was a significant main effect for group on number of words recalled, with boys with ADHD recalling fewer words than comparison boys, \( F(1, 28) = 4.98, p < .05 \). There was also a significant main effect for trial, \( F(4, 112) = 65.53, p < .01 \). The interaction between trial and group failed to reach significance; boys in both groups recalled more words on later trials.

Rehearsal Frequency. There was no significant main effect for group or trial on the Rehearsal Frequency measure. Although comparison boys appeared to rehearse words more frequently than boys with ADHD, this difference was not significant, \( F(1, 28) = 1.87, p > .10 \). There was also no significant change in how frequently words were rehearsed across the five trials.

Rehearsal Set Size. There was a significant group effect on the Rehearsal Set Size measure, \( F(1, 28) = 6.19, p < .05 \). The mean number of unique items per rehearsal set was 1.1 for boys with ADHD and 2.1 for comparison boys. Thus, comparison boys engaged in some multi-item rehearsal, whereas boys with ADHD showed almost no evidence of using this strategy. Instead, the boys with ADHD relied almost exclusively on rote repetition of single items.

Rehearsal Time. The group effect on Rehearsal Time approached significance on a two-tailed test. As anticipated, boys with ADHD tended to spend less time rehearsing, \( F(1, 28) = 3.37, p < .08 \). There was a significant trial effect, \( F(4, 112) = 7.53, p < .05 \). However, the interaction between trial and group
Rehearsal and Recall in Boys with ADHD

### Table II. Scores of Rehearsal and Recall Measures for ADHA and Comparison Boys*

<table>
<thead>
<tr>
<th>Trials</th>
<th></th>
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<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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#### Words recalled

<table>
<thead>
<tr>
<th></th>
<th>ADHD</th>
<th>Comparison boys</th>
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<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>ADHD</td>
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<tr>
<td></td>
<td>9.5</td>
<td>2.9</td>
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<td></td>
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#### Rehearsal frequency

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<td>M</td>
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<tr>
<td>ADHD</td>
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<td>2.3</td>
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#### Rehearsal set size

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<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>ADHD</td>
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<tr>
<td></td>
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#### Rehearsal time (seconds)

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<td></td>
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<tr>
<td>ADHD</td>
<td>87.5</td>
<td>79.7</td>
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<td></td>
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<td>53.9</td>
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<tr>
<td></td>
<td>58.4</td>
<td>16.6</td>
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<tr>
<td></td>
<td>66.7</td>
<td>49.4</td>
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#### Recall Time (seconds)

<table>
<thead>
<tr>
<th></th>
<th>ADHD</th>
<th>Comparison boys</th>
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<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>ADHD</td>
<td>58.4</td>
<td>23.8</td>
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<td></td>
<td>58.6</td>
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<td></td>
<td>79.9</td>
<td>48.8</td>
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</table>

*For the ADHD group, n = 17; for the comparison group, n = 13.

failed to reach significance. Boys in both groups spent less time rehearsing items as trials progressed.

Recall Time. The analysis of variance on recall time revealed a significant main effect for Group, $F(1, 28) = 5.02, p < .03$. Boys with ADHD spent less
time engaged in retrieval than comparison boys. The main effect for trial was not significant.

Assessment of Strategy Knowledge

Knowledge about effective strategies for list learning was assessed by the three questions in which boys were asked to choose between pairs of strategies and provide a rationale for their choices. Chi-square analyses of the frequencies of correct choices on each of the three questions revealed no significant differences between groups. On the question asking subjects to compare rehearsing a word a few or many times, 11 of the 17 ADHD and 12 of the 13 comparison boys recognized that rehearsing a word many times is more effective, $\chi^2(1) = 1.78, p < .20$. When the boys were asked to compare the effectiveness of rehearsing a word in a multi-item group with rehearsing the word alone the same number of times, 13 of the 17 boys with ADHD and 9 of the 13 comparison boys were aware of the benefits of multi-item rehearsal, $\chi^2(1) = .001, p < .90$. There was also no evidence of a significant group difference when subjects were asked to directly compare the benefits of repeated single-item rehearsal and multi-item rehearsal; 11 of the 17 boys with ADHD and 8 of the 13 controls chose rehearsing a word just a few times as part of a multi-item group over rehearsing the same word alone, many times, $\chi^2(1) = .05, p < .80$. Two additional boys with ADHD who chose the multi-item rehearsal strategy for the wrong reason (e.g., rehearsing a single word many times would “take too long” or “be too much work”) were counted as making an incorrect choice.

Correlations Between Strategy Knowledge and Strategy Application

To determine the relationship between the boys’ strategy knowledge and the strategies they actually used, boys in both the ADHD and normal samples were divided into two groups based on their answers to the strategy knowledge questions. One group consisted of boys who identified the multi-item rehearsal strategy as superior on both of the relevant questions. The other group either responded on the basis of rehearsal frequency or were inconsistent in their choices. Point biserial correlations between the subjects’ classifications and the mean rehearsal set size in their rehearsal protocols (a measure of the degree to which they used multi-item rehearsal) were calculated with the ADHD and comparison samples. In the comparison group, there was a significant positive correlation between identification of multi-item rehearsal as superior and actual use of this strategy ($r = .63, p < .05$). This relationship did not hold, however, for the boys with ADHD ($r = .02$).
DISCUSSION

Boys with ADHD recalled fewer words than comparison boys on our self-paced overt rehearsal list-learning task. Whereas comparison boys recalled an average of 11 words across trials, boys with ADHD recalled only 8.5 words. These results agree with those of other investigators in demonstrating recall deficits in children with ADHD on complex memory tasks (August, 1987; Borcherding et al., 1988; Douglas & Benezra, 1990; Kinsbourne, 1977; Ott & Lyman, 1993).

Previous investigators have suggested two possible hypotheses to account for the poor performance of ADHD children on complex memory tasks: (a) They employ less effective strategies than comparison boys, and/or (b) they fail to sustain effortful processing over time. Our overt rehearsal procedure made it possible to evaluate these possibilities by directly assessing the children's rehearsal strategies on a self-paced, multi-trial task.

The strategies employed by the boys with ADHD were less organized and less effortful than those used by their normal peers. They relied almost exclusively on simple, passive, repetition of single items, while the comparison boys showed some evidence of more active multi-item rehearsal.

The fact that the ADHD group did not differ significantly from comparison boys on number of item repetitions suggests that they exerted at least some effort to commit the items to memory. In addition, both groups demonstrated improved recall over trials. Thus, their minimal investment of effort enabled the boys with ADHD to comply, at least superficially, with task instructions. Nevertheless, consistent with previous overt rehearsal studies, their failure to employ cumulative rehearsal was associated with inferior performance. Rehearsing different items together aids retrieval because it helps establish interitem associations (Ornstein & Naus, 1978). An examination of the recall protocols indicated that 10 of the 17 boys with ADHD relied completely on the single-item strategy. Of the 7 boys who made some attempt at multi-item rehearsal, none maintained this strategy with any consistency on any trial, and none used it on more than one trial. In contrast, no comparison boy relied solely on rote repetition. All 13 boys in the comparison group showed at least some evidence of combining multiple items in their rehearsal sets. As would be expected in a sample ranging in age from 7 to 12 years, a variety of rehearsal styles were found in the protocols of comparison boys. Some of the youngest boys relied mainly on rote repetition, interspersed with occasional multi-item rehearsal. Older comparison boys tended to practice the current item together with the immediately preceding one, and a few labeled several items and then rehearsed the multi-item group.

Our time measures provide further insight into the boys' approach to the task. Boys with ADHD tended to spend less time than controls rehearsing the
items, and they also spent less time attempting to retrieve items during recall. Although recall time is not independent of the number of words recalled, it also reflects the amount of time the boys were willing to invest in trying to remember the items.

Taken together, the strategy and time measures provide strong evidence that the quick and relatively effortless rehearsal style of the boys with ADHD was a major factor contributing to their inferior recall. On the other hand, we found no evidence that a failure to maintain processing over later learning trials could account for their poor performance. Both groups recalled an increasing number of words across trials, and there was no evidence of a group by trials interaction on any of the rehearsal or recall measures.

It is important to note, however, that recall deficits were apparent in the boys with ADHD from the first trial. This contrasts with previous studies in which children with ADHD were able to match the performance of controls on early trials but fell behind on later trials (August, 1987; Douglas & Benezra, 1990; Kinsbourne, 1977). On Trial 1, boys with ADHD recalled only about half as many words as comparison boys (3.9 vs. 7.4). Their almost exclusive reliance on rote repetition, and their tendency to devote minimal time to rehearsal and retrieval were also evident from the initial trial. Rehearsal set size for boys with ADHD was 1.2 on the first trial versus 2.8 for comparison boys. In addition, boys with ADHD spent only 87.5 seconds rehearsing on the first trial, compared with 236.8 for the comparison boys, and they spent 58.4 seconds on retrieval, as opposed to 90.5 for the comparison boys. It appears, therefore, that our overt rehearsal procedure gave boys with ADHD license to adopt a quick and easy approach from the first trial, and they continued with this approach through the remaining trials. This pattern virtually precluded the possibility of demonstrating defective sustained processing across trials.

Our assessment of the boys' strategy knowledge did not reveal a significant difference in the ability of boys with ADHD and comparison boys to identify examples of more effective strategies. The choices made by boys with ADHD reveal an awareness that rehearsing items many times works better than rehearsing them a few times and, more important, that multi-item rehearsal is more effective than single-item rehearsal. Other studies have yielded similar results. Using a structured interview developed by Kreutzer, Leonard, and Flavell (1975) to assess knowledge in a number of different memory domains, Voelker, Carter, Sprague, Gdowski, and Lachar (1989) found no differences in the responses of children with ADHD and comparison children. Similarly, O'Neill and Douglas (1991) found that ADHD and comparison boys did not differ in their ability to generate appropriate study plans to help remember stories. However, when confronted with the actual memory task, the boys with ADHD employed much less sophisticated strategies than the ones they described.

These findings suggest that knowledge that more sophisticated strategies are
more effective than simple ones is not sufficient to mobilize ADHD children to employ them. Our analysis of the relationship between choosing examples of cumulative rehearsal on our metamemory assessment and using this strategy on the recall task further supports this interpretation. These two measures were highly correlated in the comparison sample ($r = .63$), but not in the ADHD sample ($r = .02$).

Several authors have discussed possible reasons to explain why a child may be aware of the superior effectiveness of good strategies but fail to apply them (Cornoldi, Gobbo, & Mazzoni, 1991; Pressley, Borkowski, & Schneider, 1987). For example, the child may have insufficient knowledge about how, when, and where to apply a particular strategy, or he may have had insufficient practice in applying it. We suspect, however, that the emphasis placed by several investigators on the effortful aspects of strategy deployment provides a more basic explanation for the failure of our boys with ADHD to use multi-item rehearsal. For example, Guttentag (1984) demonstrated that multi-item rehearsal requires considerable mental effort. Also, in describing the attributes of a “Good Strategy User,” Pressley et al. (1987) stressed the importance of understanding that good performance is tied to effort, “particularly effort expended in carrying out appropriate strategies” (p. 90). In reviews of research findings with ADHD children, Douglas and her colleagues have hypothesized a central, self-regulatory (executive) defect: They have proposed, further, that difficulty with effortful processing constitutes an essential feature of the children’s self-regulatory problem (Amin, Douglas, Mendelson, & Dufresne, 1993; Douglas, 1983, 1988; Shue & Douglas, 1992).

Our findings suggest that training children with ADHD to adopt more effective rehearsal strategies will not be easy. Having an adult remind them about multi-item rehearsal, as we did on the practice items, is clearly insufficient. In a recent study (Douglas, 1990), we investigated the combined effects of more explicit demonstration of the strategy and administration of stimulant medication. Again, there was no evidence of a shift to multi-item rehearsal. Interestingly, however, recall performance improved on medication, presumably because the children with ADHD applied their typical single-item strategy more effectively.

It would also be interesting to manipulate variables that are likely to affect the children’s motivation to do well. Kunzinger and Witryol (1984) were able to induce cumulative rehearsal in young (Grade 2) normal children by providing differential incentives for particular list items. Introducing negative consequences for poor recall performance might also encourage children with ADHD to adopt a more organized and effortful approach to the task. O’Neill and Douglas (1991) found that, in the absence of feedback about their performance, ADHD children were overly optimistic in judging how well they would do on an upcoming story-recall task, as well as how well they had actually done on one they had just taken.
We believe, however, that, to have more lasting effects on the children's strategy use, it is necessary to employ training techniques that more directly address their self-regulatory and effort-deployment problems. In a study with hyperactive, underachieving children, Reid and Borkowski (1987) worked directly on the children's attributions about the importance of clustering and interrogative-elaborative strategies. They were able to demonstrate good strategy maintenance 10 months after training in a group that received a combination of three ingredients: training and practice with the strategies; the use of higher-order sequencing and monitoring techniques while applying them; and training in attributing their performance successes to strategy use and their failures to a lack of strategy use. Although the ADHD symptoms of the children in Reid and Borkowski's (1987) study were less severe and pervasive than those in our ADHD group, this combination of strategy, self-control, and attribution training appears to be particularly appropriate for addressing the self-regulatory and effort deployment problems of children with ADHD.

REFERENCES


Rehearsal and Recall in Boys with ADHD


