1986

Children's spontaneous allocation of study time in a paired-associate task.

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Children's Spontaneous Allocation of Study Time in a Paired-Associate Task

by

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A Thesis
Submitted to the Faculty of Graduate Studies
through the Department of Psychology
in Partial Fulfillment of the requirements
for the Degree of Master of Arts at
The University of Windsor

Windsor, Ontario, 1986

ISBN 0-315-32016-8

ABSTRACT

In a series of two experiments, developmental differences in two components of allocation of study time were examined: (a) the ability to allocate more time to more difficult material (i.e., differential allocation), and (b) the ability to allocate sufficient time to meet the recall goal (i.e., sufficient allocation). In addition to study behaviour, children's knowledge relating to allocation of study time was assessed, and the relationship of such knowledge to study behaviour and recall scores was examined.

In order to make the task simple enough for young children, highly related and unrelated paired-associate items were used as "easy" and "hard" tasks. During the first phase of Study I, 20 children in each of grades 1, 3, and 5 were asked to learn the easy and hard lists using a standard study-test method of presentation. The results of this portion of the study confirmed that the easy items were indeed easier for children at all grade levels to recall; and yet the hard task could also be recalled with some reasonable effort.

In the second phase of Study I, children were asked to study two booklets (one easy and one hard) of paired-associate items until they could remember all the pairs perfectly. The same self-terminated study procedure was

used with 32 children in each of grades 1, 3, 5, and 7 in Study II. The results of the self-terminated trials revealed that, while grades 1 and 3 children spent approximately the same amount of time on hard pairs as they spent on easy pairs, grades 5 and 7 children spent a greater amount of time on hard pairs than they did on easy pairs. Grades 5 and 7 children also demonstrated greater ability to allocate sufficient time, as evidenced by (a) recall scores, (b) the number of children who achieved the recall goal (i.e., perfect recall), and (c) the number of children who used self-testing strategies. However, even in this older group, all children were not entirely successful at assessing recall readiness.

Children's knowledge relating to efficient utilization of study time also showed age-related differences. An examination of the relationships among metamemory knowledge, study behaviours, and recall scores suggested that developmental differences in metamemory knowledge may account, in part, for the observed differences in study behaviour, but additional variables also seemed important.

ACKNOWLEDGEMENTS

I wish to express my sincere thanks to my mentor, Dr. Akira Kobasigawa. Throughout the work on this project, he has spent unending hours collaborating with me, as well as providing support and encouragement. The assistance of Dr. Gediminas Namikas and Dr. Anne Foster, the other members of my committee, is also gratefully acknowledged.

Without the participation of the students who served as subjects, this work could not have been completed. I am grateful to all those who made their participation possible, especially the principals of the schools involved, all the teachers who co-operated during the data gathering stage, and of course, the students themselves. Finally, I would like to thank my family and friends for their support.

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CHAPTER I

Introduction

What to study, how much time to spend studying, what strategies to use for studying, represent frequent decisions children must make in everyday learning situations. Although researchers have accumulated much information about children's ability to use various study strategies (i.e., third decision - above), children's ability to decide what to study or how much time to spend studying have not received sufficient attention. (See, for example, Hagan & Stanovich, 1977; Ornstein & Naus, 1978; Rohwer, 1973, for reviews on study strategies.) Therefore, the focus of the present research was on two interrelated components of allocation of study time suggested by the first two decisions: (1) how children distribute their study time among units of learning material, in the present case among "easy" and "hard" units, (i.e., decision 1), and (2) how much study time children allocate to meet the task requirements (i.e., decision 2).

One way to define an effective allocator of study time is that he/she knows how to manage his/her study time so that the goal of the study task can be met in the least amount of time. It is evident that the amount of study time necessary to learn material depends on general abilities, study strategies used, etc. Abilities or strategies that are more specific to management of time, such as allocating sufficient study time to meet the recall goal, or distributing study time so that more difficult material is studied longer, are also important to effective allocation of study time. An example may help to illustrate the two components of allocation of study time of interest in the present research. Generally, the most efficient way to use study time would be to spend more time on difficult or less well-learned units of material (differential allocation of time). This strategy, however, may not necessarily lead to successful test performance. To do well on the subsequent test, the learner also must spend a sufficient amount of study time for the task. The present research represents an experimental analogue to investigate a simple case of children's spontaneous study-time utilization involving these two components: differential allocation of study time, and sufficient allocation of study time.

Previous research provides a preliminary picture of the developing ability to utilize study time (see Appendix A for a more comprehensive review of the literature). Flavell and his associates (Flavell, Friedrichs, & Hoyt, 1970) initially investigated the accuracy of children's judgments that they had studied sufficiently to be able to recall without errors a series of pictures of common objects (sufficient allocation of study time). Children between the ages of 4 and 6 were not adept at determining when they had studied enough to have mastered the recall material, and they did not show any improvement in this skill over trials. In contrast, children between the ages of 7 and 10 usually recalled items perfectly on all three trials. Like many other mnemonic skills, the ability to allocate sufficient time for the task seems to be task-dependent. Thus, when the task involved recall of stories, even 10-year-old children terminated their study activities prematurely, even though the material was well within their ability to learn (Gettinger, 1985).

Following Flavell's initial research, studies examining children's ability to allocate study time differentially revealed that 7- or 8-year-old children demonstrate this skill, although this ability as well is task-dependent. Masur, McIntyre, and Flavell (1973) asked first-, third-grade, and college students to memorize a series of pictorial items over three study trials. For the second and third trials, the subjects were explicitly asked to select only half of the items for further study. Third graders and college students were found to select those items that they had failed to recall on the preceeding trial; however, this strategy led to improved recall only for college students. First graders were found to select items for further study at random, despite the fact that, in follow-up testing, they could distinguish between recalled and unrecalled items.

Similarly, Rogoff, Newcombe, and Kagan (1974) demonstrated that differential allocation of study time emerges around grade 3. When asked to study pictorial items for a recognition memory task, 8-year-old children adjusted their inspection times according to the length of the delay period (a day, a week) between study and test trials. Four- and 6-year-olds, however, did not show longer study times under the longer delay conditions. It should be noted that Rogoff et al. used a between-subjects comparison; that is, the same children were not exposed to different delay conditions.

Other research, however, reveals that 8-year-old children do not demonstrate the ability to distribute study time effectively in all situations. A study by Brown and Smiley (1978) revealed that only in early adolescence (grade 7) do children appear to demonstrate the ability to distribute their study time according to the importance of the units of material to the text, as evidenced by underlining the important units, and also by a subsequent improvement in recall for the important units.

Do children spontaneously utilize both components of effective allocation of study time? A study by Owings, Petersen, Bransford, Morris, and Stein (1980) is relevant to this question. Fifth graders classified as "successful" or "unsuccessful" on the basis of teacher ratings and an achievement test, were asked to study two one-paragraph stories in preparation for a sentence-completion test. One of the stories was easy and the other difficult in terms of the congruence of sentence subjects and predicates ("The hungry boy ate a hamburger" vs. "The hungry boy took a nap"). The study trial was self-paced. Successful students were aware of having difficulty learning the less sensible stories while unsuccessful students were not. As a result, the more successful students devoted less study time to easy stories but more to difficult stories than the less successful students. However, even the more successful students did not allocate a sufficient amount of study time to difficult stories; their recall for the difficult stories was far from perfect. Of course, one should not conclude that the ability to differentially allocate study time develops earlier than the ability to allocate a sufficient amount of study time since different findings may emerge when different tasks are used. The study by Owings et al. does, however, confirm the utility of distinguishing between these two components of allocation of study time.

The available research appears to suggest that the ability to expend sufficient time as well as the ability to allocate time differentially appears in children approximately eight years of age (e.g., Flavell et al., 1970; Masur et al., 1974), and becomes increasingly generalizable to a wide range of situations as children grow older (e.g., Brown & Smiley, 1978). Further research, however, would appear useful in order to provide further clarification of how the ability to effectively allocate time develops in children. In light of the fact that the ability of children to become self-directed learners who plan, evaluate, and regulate their learning activities is especially important, the ability to utilize study time in a spontaneous situation is of most interest. However, our understanding of age-related differences in children's spontaneous tendency to apportion study time differentially is modest because the relevant studies are few in number: Masur et al. (1973) forced children to be selective in their study; Bogoff et al. (1974) used a between-subjects comparison; and Owings et al. (1980) studied children of a single age group. Therefore, the present research was designed to investigate age-related differences in children's ability to spontaneously distribute study time according to task difficulty, and the ability to allocate a sufficient amount of time for the task.

Another purpose of the present research was to examine developmental differences in metacognitive knowledge relevant to allocation of time, and how such knowledge may be related to children's study behaviour. Although we have some information about children's metacognitive knowledge (e.g., Kreutzer, Leonard, & Flavell, 1975), a broad assessment of knowledge relevant to allocation of time, and how such knowledge relates to behaviour has not been done. The metamemory questions were designed to assess children's knowledge relevant to two areas of allocation of time: (1) differential allocation (e.g., knowledge of the difference in difficulty of materials, and of how difficult material should be studied differently), and (2) sufficient allocation (e.g., knowledge of self-testing strategies).

For the purpose of the present research, it was necessary to devise relatively "easy" and "hard" materials in order to assess the spontaneous tendency of children of different ages to allocate study time differentially. To this end, paired-associate tasks consisting of highly related pairs (e.g., dog-cat, bat-ball) and unrelated pairs (e.g., fish-pencil, airplane-bell) were constructed to make the distinction between easy and difficult materials simple. Study I was conducted to demonstrate: (a) the "hard" task was indeed more difficult to learn than the "easy" task for children at all age levels, and (b) the "hard" task could be learned with some reasonable and comparable effort for children at all age levels. An additional purpose of Study I was to provide initial information concerning age-related differences in allocation of study time in grades 1, 3, and 5 children.

Study II was conducted to examine age-related differences in allocation of study time more extensively than was done in Study I using a wider age range and additional trials. An assessment of children's metacognitive knowledge was also included in Study II to examine developmental differences in such knowledge, and how knowledge might relate to study behaviour and recall performance.

CHAPTER II

Study I

Introduction

Study I was conducted to determine: (a) the length each list should be in order to make the task approximately equally difficult for children of different ages, (b) whether the "hard" task would indeed be more difficult than the "easy" task for children at all age levels, and yet be capable of being done with some reasonable effort, and (c) to provide preliminary evidence of how children of different ages would spontaneously allocate study time for the hard task and the easy task.

The study consisted of two phases. During the first phase, children of grades 1, 3, and 5 were asked to memorize easy and hard paired-associate lists under a standard study-test procedure until they achieved a criterion of one perfect recall. The first phase was included to obtain information regarding the first two purposes (i.e., a and b). During the second phase, children were required to study two new lists of paired-associate items (one easy and one hard) until they thought that they could recall all of the pairs perfectly. The purpose of the second phase was to examine the tendency to allocate time differentially according to task difficulty and to allocate sufficient study time to master the task.

Method

Subjects

Twenty children in each of grades 1, 3, and 5 were used as subjects in Study I. The number of males and females in each grade was approximately equal. These children were drawn from a predominantly middle-class parochial school in Windsor, Ontario.

Materials

The materials consisted of six lists of paired-associate items: three lists containing highly related pairs, and three lists containing unrelated pairs. The items consisted of line drawings of common objects. The highly related pairs were selected so that the relation would be well-known to children of all ages; for example, shoe and sock, bat and ball, cat and dog. The items for the unrelated pairs were selected so that the individual items would be as familiar to the children as the items in the highly related lists (using the Thorndike and Lorge Teacher's Word Book). The items were then randomly paired to construct unrelated pairs, with the restriction that the two items chosen to form a pair were not within the same conceptual category, and were not obviously related to one another. (The paired-associate items are presented in Appendix B.)

Each paired-associate item was presented on a 3 x 6 in. white card, with the stimulus picture on the left side of the card, and the response picture on the right side. Paired-associate items for each list were selected to minimize the degree of interpair interference. The initial estimate of list length, based on previous paired-associate studies (e.g., Bisanz, Vesonder, & Voss, 1978), was as follows: Grade 1 - 5 paired-associate items; Grade 3 - 6 paired-associate items; Grade 5 - 7 paired-associate items. The items for each list were then randomly ordered, placed in clear plastic covers, and bound into study booklets using a metal ring. Three sets of study booklets were constructed by pairing one study booklet of related pairs with one booklet of unrelated pairs. In selecting the two booklets to make up one set, care was taken so that none of the items in the unrelated list were obviously related to any of the items in the related list.

Test booklets were constructed by placing only the stimulus item on the left half of the card, with the right half remaining blank. The test cards were placed in a random order, different from the order of the study items, and were also bound into booklets. For each list, two different random orders for the test booklets were constructed, both of which were different than the order the study booklets were placed in.

Four different paired-associate items (2 hard and 2 easy) were also prepared for a practice trial, along with their corresponding stimulus-only test cards. In addition, each of the individual line drawings that made up the stimulus and response items in the practice booklets and three study booklets were duplicated on individual cards so that the drawings could be presented individually to ensure that all items were known to the subject.

Procedure

Each child was individually tested in a room at his/her school. To ensure that the child could name all the pictures, the experimenter asked the child to name the pictures that would be in the practice booklet and the first set of experimental booklets. These pictures were presented on separate cards, placed in a random order. The child was then presented with the practice booklet and instructed on the paired-associate method as follows:

> I want to play a game with you now. I'm going to show you the pictures you just named two at a time, two together, like partners. And I want you to remember them together, like partners.
>
> When you look at each picture card, I want you to say the names of both pictures. After we go through all the picture cards, I'm going to show you only the picture on this side, like this (demonstrating), and ask you to tell me what the other partner is, what picture is missing from the pair. If you don't get them all right the first time, we'll just go through them again until you

get them right. So pay attention and name these pictures when I show them to you.

Each item was presented for a fixed length of time (5"), followed by a recall test during which the child was asked which item was "missing from the pair." During the recall test, if the child provided an incorrect response or no response, the correct response was provided by the experimenter. For any children who did not remember all the items in the practice list on the first recall test, the study-test procedure was repeated a second time.

Following the practice trial, a set of experimental booklets (containing one easy and one hard booklet) was presented using the same study-test method as was used for the practice booklets. Since there were three sets of study booklets, one third of the children in each grade received set 1, one third received set 2, and one third received set 3. One half of the children were presented with the hard items followed by the easy items on the first trial, with the order of hard and easy booklets counterbalanced across the remaining study-test trials. The order of hard and easy booklets was also counterbalanced for the other half of the children, but they received easy items followed by hard items on the first trial. For the experimental booklets, the study-test procedure was repeated until the child was able to correctly remember all the items in the list, or until four study-test trials had been given. For each child, the recall performance on each trial was recorded, as well as the number of trials needed for perfect recall.

For the second phase, each child was first asked to name the individual line drawings contained in a second set of study booklets (one easy and one hard). The two booklets comprising this second set were then placed in front of the child beside one another. For one-half of the children, the booklets were presented with the easy booklet to the left and the hard booklet to the right, with the other half of the children receiving the reverse order. The child was then instructed to study the two booklets as follows:

> Now I want to play a different game with you. The pictures in these books are also two together, like partners. And I want you to remember them together, like partners, just like you did before. But this time I'm going to give the pictures to you, and I want you to study them until you can remember all the partners perfectly. After you're finished studying them, I'll show you only the picture on this side and ask you to tell me what the other partner is, like we did before. This time I'm only going to ask you one time to tell me what the missing partner is, so be sure you can remember them all before you tell me you're ready. Take your time and study them as long as you want, and look at them as many times as you want. When you think you can remember all the partners perfectly, tell me, and then I'll ask you to tell me what the missing partner is for each pair.

Study time for the hard items and for the easy items was measured by the experimenter with a stopwatch. Study time was operationally defined as beginning when the child turned the cover page of the study booklet and ending when the last page containing study items was turned. The entire session was also recorded using an audio cassette recorder, with the experimenter cuing the microphone when the child began and terminated studying each booklet. These audio tapes were used to check study times and recall scores later.

When the child indicated that he/she had studied enough, recall was assessed by presenting the test booklets and asking the child what picture was missing. The child's response for each pair during the recall test was simply recorded, and no feedback was given to the child as to whether or not the answer was correct.

Results and Discussion

The findings concerning children's performance on the easy and hard lists under the standard paired-associate method will be summarized in the first section, followed by a summary of the findings concerning children's allocation of study time in the self-terminated study trial.

Phase 1 - Standard Paired-Associate Method.

The mean proportion of items recalled on each of the four trials for easy items and for hard items are presented in Table 1 for each grade. These recall scores confirm that the easy items were indeed easier to recall. Children at all grade levels recalled at least 90% of the easy items on Trial 1, and by Trial 2 recall was 100% for the easy items. The recall scores for the hard items were approximately 30% on Trial 1 for all children.

Table 1

Mean Proportion of Easy and Hard Items Recalled for Trials 1-4

	Trial			
Group	1	2	3	4
Grade 1				
Easy	.90	1.00	1.00	1.00
Hard	.28	.62	.87	.90
Grade 3				
Easy	.98	1.00	1.00	1.00
Hard	.27	.70	.92	.91
Grade 5				
Easy	.93	1.00	1.00	1.00
Hard	.32	.74	.91	.96

The number of trials-to-criterion for children in grades 1, 3, and 5 was 1.26, 1.06, and 1.35, respectively, for the easy items, and 3.42, 3.22, and 3.25 for the hard items.[1]

The results of phase 1 confirm that the list length of 5, 6, and 7 pairs for grades 1, 3, and 5, respectively, was appropriate. The large difference in recall of easy pairs versus hard pairs on the early trials confirms that the related pairs were indeed easier for children at all grade levels to recall. The recall scores on the later trials confirm that the task could be performed by children at all age levels with some reasonable effort, such that by trial 3 over 85% of the hard items were recalled.

<u>Phase 2 - Allocation of Study Time</u>

The purpose of phase 2 was to provide preliminary evidence of how children would allocate study time for the easy and hard pairs in a self-terminated study trial. To permit comparisons across age groups, the mean study time per pair for easy pairs and for hard pairs was calculated for each child by dividing the study time for a booklet (easy or hard) by the number of items in that booklet (e.g., 6 for grade 3 children). Table 2 presents the mean study times for easy and hard pairs for grades 1, 3, and 5 children. Due to problems with the recording equipment, the data for two subjects in grade 3 and one subject in grade 1

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[1] For children who did not achieve 100% recall by Trial 4, the number of trials-to-criterion was set at 5 for the purposes of calculating the mean trials-to-criterion.

had to be excluded from the analysis. A 3 (grade) x 2 (type of task - easy vs. hard) x 2 (sex) analysis of variance revealed a significant grade x type of task interaction, $F(2, 51) = 3.54$, $p < .05$. Follow-up Tukey H.S.D. tests indicated that grade 5 children spent a significantly greater amount of time on hard pairs as compared to easy pairs, $p < .01$, but grades 1 and 3 children did not. The only other significant comparison arising out of this interaction was the study time for hard pairs for grade 5 children as compared to the study time for hard pairs for grade 3 children, $p < .01$.

The proportion of correct items on the recall test for easy and hard pairs appears in Table 3. The recall data were also analyzed using a 3 (grade) x 2 (type of task) x 2 (sex) analysis of variance. The only significant effect observed in the analysis was a main effect for type of task. Although age differences might be expected to emerge if older children are better able to judge when they have studied sufficiently to recall the items, no such age differences were observed in Study I. From the mean scores, it appears that children at all age levels terminated their study time for the hard pairs prematurely.

The reasons for young children's failure to use strategies or study methods that would help them learn more effectively are always of interest. This is especially true in the present case since the ability to allocate study time

Table 2

Mean Study Time (in seconds) Per Pair for Easy Pairs and Hard Pairs

	Grade		
Type of Task	1	3	5
Easy	8.67	5.81	7.13
Hard	10.08	6.45	12.78

Table 3

Mean Proportion of Correctly Recalled Easy Pairs and Hard Pairs

	Grade		
Type of Task	1	3	5
Easy	.95	.95	.96
Hard	.36	.44	.44

effectively has wide applicability. Also, children's poor performance in the present study is somewhat surprising considering the findings of other studies. Despite the fact that other researchers have demonstrated that the ability to allocate study time differentially begins to emerge in children around grade 3 (Rogoff, Newcombe, & Kagan, 1974; Masur, McIntyre, & Flavell, 1973), the third graders in Study I allocated approximately the same amount of time for hard and easy pairs. Similarly, the fifth graders in the present study appeared to have difficulty determining when they had studied sufficiently, even though for serial recall tasks, children as young as 7 were able to recall the items perfectly after self-terminated study trials (Flavell, Friedrichs, & Hoyt, 1970). Therefore, Study II was designed to examine children's allocation of study time more extensively, and perhaps gain some insight into the reasons for young children's poorer abilities in the area of allocation of study time.

CHAPTER III

Study II

Introduction

The results of Study I indicated that many young children fail to allocate their study time effectively even in this relatively simple situation where the distinction between hard and easy material should be easy to make and where the recall goal is made clear. One purpose of Study II, therefore, was to further explore children's knowledge and skills relevant to effective allocation of study time by extending the design to include the features that will now be described.

Regarding allocation of a sufficient amount of study time to meet the recall goal, even the oldest (grade 5) children's performance in Study I appeared inadequate. In Study II, grade 7 children were also included to examine whether they would be better able to assess their recall readiness. In addition, to examine whether allocation of time (both differential and sufficient) would vary as children gained more experience with the task, the same self-terminated study procedure was repeated on three trials.

It is possible that children do not allocate a sufficient amount of time because they change the recall goal from perfect recall to some lower criterion, either because they forget the goal or they find it too difficult. As a crude measure of the tendency to alter the recall goal, children were asked, after they finished studying, to predict how many of the pairs in the "easy" and "hard" booklets they felt they would recall correctly. If younger children terminate their study time prematurely because they change the goal of the recall task, their predictions should be lower than those of older children.

The second general purpose of Study II was to examine age-related differences in metamemory knowledge useful to efficient allocation of study time, and to investigate the relationship between metamemory knowledge and children's study behaviour. One aspect of metamemory knowledge that is required to distribute study time strategically is the ability to distinguish between easy and difficult materials. In the present study, the materials were designed so that the distinction between easy and hard pairs would be simple. It is possible, however, that some young children were not aware that the easy booklet would be easier for them to recall. It is also possible that although young children are aware of the difference in difficulty when asked about it, the difference in difficulty does not occur to them spontaneously. By asking one half of the children (prompt group) to identify which booklet would be easier to recall, children who could not accurately distinguish between easy and hard booklets could be identified. Also, if the difference in difficulty simply does not occur to children spontaneously, being reminded of the difference in difficulty should be helpful to children in the prompt group.

In order to assess further aspects of children's metamemory knowledge relevant to efficient study time management, all children were interviewed following the second trial. These questions dealt with knowledge related to differential allocation of time (e.g., which booklet will be easier to remember, strategies for studying the harder booklet), and knowledge related to allocation of a sufficient amount of time (e.g., knowledge of self-testing strategies). These questions were included following the second trial so that discussing allocation of study time would not affect children's performance on the first two trials. The third trial was then included to provide some general indication of whether discussion of such areas as strategies for studying harder booklets and strategies for self-testing might result in some changes in children's allocation of study time, although these effects were confounded with the effects of further experience with the task.

The following design thereby provided the basis for Study II. Children in grades 1, 3, 5, and 7 were asked to study paired-associate items until they felt they could recall all the items perfectly. After naming the pairs but before studying them, children in the prompt group were asked to identify which booklet would be easier to recall. After terminating their study time, children were asked to predict how many items they thought they would recall, and were then given a recall test. The same procedure was repeated for Trial 2. Following Trial 2, all children were asked metamemory questions. Trial 3 was then administered following the same self-terminated study procedure.

Method

Subjects

Thirty-two children from each of grades 1, 3, 5, and 7 (mean ages = 6-7, 8-7, 10-8, 12-7, respectively) from two predominantly middle-class parochial schools in Windsor, Ontario, served as subjects. For each grade, approximately half of the subjects were male and half female. Within each grade level, the children were randomly assigned to the spontaneous group or the prompt group, with the restriction that approximately half of each group was male and half female.

Materials

Paired-associate items.

The materials are described in detail in the Method section of Study I. Briefly, the materials consisted of three lists of highly related, or easy, paired-associate items, and three lists of nonrelated, or hard, paired-associate items.

In order to make the task approximately equal across age levels, and in order to make the easy task definitely easier for all grade levels, the length of the list was varied. The results of Study I indicated that a list length of 5, 6, and 7 pairs for grades 1, 3, and 5, respectively, would result in approximately equal trials-to-criterion in a standard paired-associate presentation, and would also be appropriate to maintain a difference in difficulty between easy and hard pairs for all grade levels. We estimated that 8 pairs would be an appropriate length for grade 7 children.

The items within each list were randomly ordered and bound into study booklets using a metal ring. Again, three sets of study booklets (each set consisting of one easy book and one hard book) and one set of practice booklets were used. These three sets of study booklets were arranged into two different random orders for presentation on the three trials (e.g., set 2, 1, 3, and set 3, 2, 1). One presentation order was used for half of the subjects, and the other for the remaining subjects.

The test booklets contained cards with the stimulus item on the left half, with the right half remaining blank. In order to provide feedback to the children on the recall tests in Study II, the picture card depicting the stimulus and response item was placed on the reverse side of the stimulus-only test card.

<u>Prediction Task</u>.

In order to enable children to make predictions, white sheets with "ladders" pasted on to them were used (two ladders for each grade). The ladders were constructed with 28 cm x 36 cm white art paper as a background, with yellow and green alternating squares, approximately 5 cm x 5 cm, pasted in a shape similar to a ladder on the white paper. The squares were numbered from the bottom to the top, from 1 to whatever number of pairs were included for that grade (e.g., 6 for grade 3). Two small round buttons were used for children to place in the square representing the number of pairs they felt they would recall correctly. A small plastic figure of a little man (approximately 5 cm high) was used to move up the ladder whenever children recalled an item correctly.

<u>Metamemory items</u>.

The metamemory items consisted of six questions. The first three questions were designed to assess metamemory knowledge relevant to differential allocation of study time. Questions 4 - 6 were designed to tap knowledge more relevant to allocating a sufficient amount of time.

1. Now I want you to name the pictures in these two booklets and tell me whether you think it would be easier to remember which pictures go together in this booklet or in this booklet? Why? (The booklets the child received on Trial 3 were used for this question.)
2. One of the children that I tested told me he (she) thought that one book was a lot harder to remember than the other one. If you wanted to help him (her), what could you tell him (her) to do so he (she) could remember the hard book as well as he (she) remembers the easy book? Anything else?
3. The other day I asked two children to study some pictures like you just did so they could remember what pictures were partners. I told them they could take as long as they wanted to study the pictures. One child studied the pictures for a short time, only one minute. The other child studied the pictures for a longer time, five minutes. Which child do you think remembered more of the partners, the one who studied for a longer time, five minutes, or the one who studied for a short time, one minute? Why?
4. How did you decide when to stop studying the pictures?
5. If your friend had to study these two booklets to remember what pictures are partners, and he (she) really wanted to remember all the partners perfectly,

what would you tell him (her) to do so he (she) could remember all the partners? Anything else?

6. One boy (girl) that was studying the booklets looked at the booklets a few times, and then covered the picture on this side while he looked at the booklets (demonstrating). Why do you think he (she) was covering the pictures on this side?

Procedure

Each child was tested individually at his/her school. Before the experimental lists were presented, a practice trial was given using a list containing 4 items (two in each booklet) in order to acquaint the child with the paired-associate learning task. The experimenter placed the two practice booklets beside one another in front of the child, and gave the following instructions:

> Now I want to play a memory game with you. On each card, there are two pictures together, like pairs or like partners. And I want you to try to remember which pictures go together, or which pictures are partners. I want you to study these pictures until you can remember all the partners perfectly. After you're finished studying them, I'm going to show you only the picture on this side (pointing), and ask you to tell me what the other partner is, what picture is missing from the pair. Each time you remember the missing partner correctly, this little man will move up one square. If you remember all the partners perfectly, the little man will get to the top. Before we start, I want you to name all the pictures.

After the child named all the pictures in both practice booklets, the instructions continued as follows:

> Now I want you to study the pictures until you can remember all the partners perfectly. Take your time, and study the pictures as long as you want, and look at them as many times as you want. When you think you can remember all the partners perfectly, ring this bell. (A desk bell was placed beside the child on the table.)

After the child rang the bell, he/she was asked to place the button on the ladder as high as he/she thought the "little man" would reach when the recall test was given (prediction task). Then the recall test was given, using the test booklets. For each item, 7 seconds were allowed within which to make a response. After 7 seconds, the experimenter turned the page in the test booklet to reveal the stimulus and response picture, thereby giving feedback to the child.

Two identical experimental trials were then given, using the same procedure as for the practice trial. The only difference in the experimental trials was that the subjects in the prompt group were asked this additional question after naming the pictures in both books and before studying: "Which book do you think it will be easier to remember the partners in? Why?"

In order to control and check for any effects associated with a booklet being presented to the child's left or right side, the booklets were presented with the easy booklet to the left and the hard booklet to the right for one half of the children, with the other half of the chilren receiving the reverse order. Also, since the three sets of study booklets were arranged in two different random orders, one half of the children were presented with the first random order for the three trials, and the other half of the children received the second random order. Only one study and test trial was given for each list. On Trial 2, the same procedure was followed with a different list.

Following the study and test trials for the second list, each child was asked the metamemory questions listed above. A third trial was then given, using the same procedure as for trial 1 and 2 with the third set of booklets. For this trial, both the prompt group and the control group were treated identically since all children had already been asked which booklet would be easier to remember during the metamemory questions.

The entire testing procedure was videotaped so that children's study time scores, self-testing behaviours, and metamemory answers could be assessed later. In addition, the experimenter noted study times and self-testing behaviours during the session to serve as a check on the videotaped data.

Scoring Criteria

Study Time.

The amount of study time children allocated was operationally defined as beginning when the child turned the cover page, and ending when the last page of the booklet was turned. In the infrequent event that a child's attention was directed away from the task while the booklets were open, study time was adjusted accordingly. In the case of any discrepancy between experimenter-noted study times and study times assessed using the videotapes, the time as measured from the videotape was used as the study time score.

Metamemory Data.

Children's answers to the metamemory questions were transcribed from the videotapes and classified according to categories generated on the basis of the intended focus of each question. To check the reliability of the scoring criteria, the protocols for one half of the children from each of the four grade levels were scored independently by two judges. Interjudge reliability for each question was calculated by dividing the number of instances in which coders agreed on the use of the particular categories by the sum of agreements plus disagreements on the use of criteria. Reliabilities for various questions ranged from 96% to 100%. Disagreements that occurred in the scoring were reviewed and resolved by obtaining a consensus between coders.

Results and Discussion

The results of Study II will be presented under the following three headings: (a) study time, predictions, and recall scores, (b) metamemory data, and (c) relationships among metamemory knowledge, study behaviours, and recall scores.

Study Time, Predictions, and Recall Scores

To make cross-age comparisons possible, the following dependent measures were calculated for each child: (1) the mean study time per pair for easy and hard pairs on each trial, (2) the number of easy and hard items (converted to proportion scores) the child predicted he/she would recall correctly on each trial, and (3) the number of easy and hard items (converted to proportion scores) recalled correctly on each trial. In each case, these scores were calculated by dividing the appropriate score (e.g., study time for hard booklet, number of easy items recalled) by the number of pairs in each booklet.

Separate analyses of variance were performed on each of the three quantitative measures obtained: study time, prediction, and recall scores. Because the main independent variables of interest were grade, group, trial, and type of task, only the analyses using these variables will be presented here. (See Appendix C for further analyses of study time scores and recall scores.) Each analysis consisted of a 4 (Grade) x 2 (Group - control vs. prompt) x 2 (Type of Task - easy vs. hard) x 3 (Trial) analysis of variance. Following the recommendations for repeated measures analyses of variance of Hertzog and Rovine (1985), Huynh and Feldt's adjusted probability values were used where appropriate because estimates of sphericity indicated moderate assumption violations of univariate F tests. All significant interactions in these analyses were followed up with appropriate one-way analyses of variance, and further mean comparisons were made with Tukey H.S.D. tests.

Study Time.

Study time scores were analyzed to examine whether or not (a) age-related differences would be observed in differential allocation of study time according to task demands (grade x type of task), (b) children would show differentiated allocation of study time more effectively under the prompt than under the control conditions (group x type of task), and (c) the patterns of study times would become different over trials for easy and hard tasks (trial x type of task). The mean study time per pair for the easy and hard task are presented in Table 4 separately for grades and trials. Significant main effects and interactions are summarized under the heading Time Scores in Table 5.

Contrary to one of our hypotheses, the judgment as to task difficulty that children in the prompt group were required to make did not affect how they distributed their study times for the easy and hard booklets (n.s. group x type of task interaction). However, there was a significant trial x group interaction. The children in the control group for some reason significantly increased their study

Table 4

Mean Study Time (in seconds) per Pair for Easy and Hard Booklets for Children in Grades 1, 3, 5, and 7

	Trial			
Group	1	2	3	Combined
Grade 1				
Easy	5.42	5.09	5.69	5.40
Hard	4.99	4.94	5.72	5.20
Grade 3				
Easy	4.43	4.71	7.45	5.53
Hard	5.50	5.38	10.01	6.96
Grade 5				
Easy	4.54	3.81	4.35	4.23
Hard	7.64	8.10	9.51	8.42
Grade 7				
Easy	4.25	4.16	4.94	4.45
Hard	10.63	12.82	14.00	12.48
Combined				
Easy	4.66	4.44	5.60	4.90
Hard	7.19	7.81	9.81	8.27

Table 5

F Values and Associated p Values for Analysis of Variance Effects for Time Scores, Prediction Scores, and Recall Scores

		Time Scores		Prediction Scores		Recall Scores	
Variable	df	F	p	F	p	F	p
Between Subjects							
Grade	3, 120	6.59	.001	.21	n.s.	11.69	.001
Within Subjects							
Trial	2, 240	25.23	.001	6.74	.01	8.86	.001
Type of Task	1, 120	68.00	.001	142.18	.001	508.77	.001
Trial x Group	2, 240	4.70	.05	1.00	n.s..	.53	n.s.
Trial x Grade	6, 240	4.94	.001	1.29	n.s.	.38	n.s.
Type of Task x Grade	3, 120	19.41	.001	11.77	.001	10.92	.001
Trial x Type of Task	2, 240	11.44	.001	1.93	n.s.	10.70	.001

time from trials 2 ($\bar{X}$ = 6.19) to 3 ($\bar{X}$ = 8.37), $p < .01$, although those in the prompt group did not show a comparable increase in study times between these two trials.

There were some differences across age levels in children's study times across trials, as evidenced by the trial x grade interaction. This significant grade x trial interaction reflects: (a) both grades 1 and 5 students expended comparable amounts of study time across trials, and (b) both grades 3 and 7 students studied for a significantly longer period of time on trial 3 (Grade 3 $\bar{X}$ = 8.73, Grade 7 $\bar{X}$ = 9.47) than on trial 1 (Grade 3 $\bar{X}$ = 4.97, Grade 7 $\bar{X}$ = 7.44), $p < .01$. The difference between trial 3 ($\bar{X}$ = 8.73) and trial 2 ($\bar{X}$ = 5.04) was also significant for grade 3 children, $p < .01$, but not for grade 7 children. Although the interaction between trial, grade, and type of task was not statistically significant, an examination of the means in Table 4 indicates that this increase in study time on Trial 3 for the grade 3 children consisted of an increase in study time for both the hard task and easy task, unlike the grade 7 children, who increased their study time mainly for the hard task.

The significant grade x type of task interaction, as illustrated in the last column in Table 4, is more relevant to the purpose of the present study. An examination of this interaction revealed that age differences in study time emerged for the hard task, $F(3, 120) = 17.71$, $p < .001$, but not for the easy task. Grade 7 students spent longer on average for each hard pair than children of any other age level, $p < .01$. The mean study time per hard pair for grade 5 children was also significantly greater than the mean time for grade 1 children, $p < .05$. The lack of a significant effect for the easy task suggests that children at all age levels spent approximately the same amount of time studying the easy pairs. Further comparisons of study times for the easy task compared to study times for the hard task within each grade indicated that only grades 5 and 7 children allocated significantly more time to the hard pairs than to the easy pairs, $p < .01$.

Finally, the significant trial x type of task interaction indicated that differences in study times for easy and hard pairs gradually increased with trials (see bottom row, Table 4). Within each type of task, children significantly increased their study times from trial 2 to trial 3, $p < .01$.

To provide a more complete picture of the developing ability to allocate study time differentially according to material difficulty, the number of children at each age level who allocated more study time to hard pairs was calculated. A child was categorized as spending more time on hard pairs if the proportion of study time spent on hard pairs was 60% or greater. In addition, any child who looked at each of the hard pairs at least one more time than he/she looked at the easy pairs (regardless of the proportion score) was also categorized as spending more time on the hard pairs. The same criteria were used to identify children who spent more time on the easy pairs. Children with proportion scores between .40 and .60 were classified into the "about the same" category. The number of children at each grade level who were placed in the three categories of differential allocation of study time is set out in Table 6.

The data in Table 6 were analyzed by forming 2 x 2 tables (e.g., grade 1 vs. grade 3, spending more time on hard vs. not spending more time on hard - i.e., "more time on easy" and "about the same" category) and applying Mainland and Murray's (1952) four-fold contingency tables. Mainland and Murray's tables substitute for direct computation of Yates' correction or Fisher's exact probabilities, and therefore only p-values are reported. This analysis confirmed that there were significantly more older (grade 5 and 7) than younger children (grade 1 and 3) who allocated more study time to hard pairs on all trials ($ps < .01$). There was also a significantly higher number of children who allocated more time to hard pairs in grade 3 as compared to grade 1 on trial 1 only ($p < .05$). Only in grades 5 and 7 were there significantly more children classified into the category of "More time on hard pairs" than into the remaining categories, as evidenced by a Chi-

Table 6

Number of Children in Each Grade who Allocated Study Time Differentially

Group	Allocation of study time		
	More Time on Easy	About the Same	More Time on Hard
Grade 1			
Trial 1	5 (16%)	25 (78%)	2 (6%)
Trial 2	4 (13%)	25 (78%)	3 (9%)
Trial 3	3 (9%)	25 (78%)	4 (13%)
Grade 3			
Trial 1	2 (6%)	20 (63%)	10 (31%)
Trial 2	2 (6%)	21 (66%)	9 (28%)
Trial 3	0 (0%)	22 (69%)	9 (28%)
Grade 5			
Trial 1	1 (3%)	14 (44%)	17 (53%)
Trial 2	0 (0%)	10 (31%)	22 (69%)
Trial 3	0 (0%)	9 (28%)	23 (72%)
Grade 7			
Trial 1	0 (0%)	8 (25%)	24 (75%)
Trial 2	0 (0%)	5 (16%)	27 (84%)
Trial 3	0 (0%)	6 (19%)	26 (81%)

square analysis performed on the grade 5 data (since this data was less likely than grade 7 data to be significant), χ^2 (1, N=32) = 4.5, p. < .05.

Prediction Scores.

Prediction scores were included in the present study to address the possibility that young children terminate their study time prematurely not because they lack the ability to monitor readiness for recall, but because for some reason they change the goal of the task from perfect recall to some lower criterion. As a crude measure of this tendency, after children terminated studying, they were asked to predict how many of the items in the two booklets (easy and hard) they would recall correctly. Therefore, the effects of most interest in the prediction scores were age differences in predictions, especially for the hard task, which might suggest that young children modify the recall goal for the hard items.

The mean proportion of easy and hard items children in grades 1, 3, 5, and 7 predicted that they would recall correctly for each trial are presented in Table 7. The analysis of the prediction scores revealed (see Table 5) a significant main effect for trial because the mean prediction for all grades combined was significantly higher on trials 2 ($\bar{X}$ = .86) and 3 ($\bar{X}$ = .87) than on trial 1 ($\bar{X}$ = .83).

Table 7

Mean Proportion of Easy and Hard Items Children in Grades 1, 3, 5, and 7 Predicted They Would Recall Correctly on Trials 1, 2, and 3

Group	Trial 1	2	3	Combined
Grade 1				
Easy	.84	.86	.88	.86
Hard	.74	.86	.88	.83
Grade 3				
Easy	.88	.91	.90	.90
Hard	.80	.80	.78	.79
Grade 5				
Easy	.93	.96	.96	.95
Hard	.75	.78	.81	.78
Grade 7				
Easy	.93	.93	.96	.94
Hard	.71	.73	.78	.74
Combined				
Easy	.90	.92	.93	.92
Hard	.75	.79	.81	.78

An examination of Table 7 suggests that young children's predictions for the hard task were not lower than the older children's predictions. The analysis confirmed this impression. One way analyses following from the significant type of task x grade interaction (see Table 5) did not reveal a significant effect for grade, either for the easy task nor the hard task. This significant type of task x grade interaction, as is shown in the last two columns in Table 7, can be explained by the fact that predictions were significantly lower for the hard task than for the easy task for grades 3, 5, and 7 children, ($p < .01$), but not for grade 1 children.

Recall Scores.

The recall scores were relevant to two general areas of interest. Firstly, the hypothesis that younger children are less able to allocate study time sufficiently would lead to the prediction that age differences in recall would emerge for the hard tasks in self-terminated study trials (grade x type of task). Secondly, as was indicated previously, children increased their study time for hard items from trials 2 to 3. Analogously, did children improve recall scores from trials 2 to 3?

The mean proportion of easy and hard items recalled correctly on each of the three trials by grades 1, 3, 5, and 7 children are presented in Table 8. The results of the analysis of variance of recall scores, as seen in Table 5, revealed significant main effects of grade, trial, and type of task, and significant interactions between type of task and grade, and trial and type of task.

An examination of the means in Table 8 illustrates that children at all age levels recalled easy items very well. Recall of the hard items was considerably lower, even though children could take as long as they wanted to study the items. The significant interaction between type of task and grade, confirmed this impression. Examination of the last column of Table 8 illustrates this interaction. Comparisons of the means revealed that at all grade levels recall was significantly lower for hard items as compared to easy items, $p < .01$. Further analysis of the type of task x grade interaction indicated significant effects of grade level in recall scores for the hard items, $F(3, 120) = 33.09$, $p < .001$, but not for the easy items. More specifically, grades 5 and 7 children recalled significantly more hard items than grades 1 and 3 children did, $p < .01$.

Also of interest with regard to children's recall scores was whether recall performance improved over trials. Further examination of the trial x type of task interaction revealed that recall scores improved over trials only for the hard items, $F(2, 240) = 18.39$, $p < .001$, but not for the easy items. Mean recall scores for easy and hard items, collapsed across grades, are shown in the bottom row of Table 8. The mean recall scores for the hard items were

Table 8

Mean Proportion of Correct Responses for Easy and Hard Items for Children in Grades 1, 3, 5, and 7 on Three Trials

Group	Trials 1	2	3	Combined
Grade 1				
Easy	.96	.96	.96	.96
Hard	.48	.53	.55	.52
Grade 3				
Easy	.98	.98	.98	.98
Hard	.46	.56	.56	.53
Grade 5				
Easy	1.00	.99	.98	.99
Hard	.63	.67	.76	.69
Grade 7				
Easy	1.00	.98	.99	.99
Hard	.68	.71	.82	.74
Combined				
Easy	.99	.98	.98	.98
Hard	.56	.62	.67	.62

significantly higher on Trial 3 than on trial 1 or 2, $p <$ .01.

In order to directly examine the number of children in each grade level who achieved the recall goal (i.e., 100% recall), the number of children in each grade who had perfect recall scores was identified for each of the three trials. As illustrated in Table 9, the number of children who recalled all items perfectly increased with grade, especially on the third trial. The comparison between younger (grades 1 and 3) and older (grades 5 and 7) children was significant for trial 2 and 3, $ps < .01$, but not for trial 1.

Table 9

Number of Children in Each Grade Level who Recalled all Items Perfectly

Grade	Trial 1	Trial 2	Trial 3
1	4 (12%)	1 (3%)	2 (6%)
3	1 (6%)	1 (3%)	1 (3%)
5	3 (9%)	5 (16%)	9 (28%)
7	6 (19%)	8 (25%)	16 (50%)

Summary.

With respect to the developing ability to allocate study time differentially in accordance with task difficulty, the results indicated that only grade 5 and grade 7 children allocated more study time for the hard pairs than for the easier pairs. Since study times for the easy task were approximately equal across ages, it seems that when unlimited study time is given, older children allocate more study time to the hard units not by distributing the same amount of total study time differently than young children, but by allocating more total time to the task and spending this additional time on the hard units.

The greater ability of older children to allocate study time more effectively was reflected not only in their study behaviour but also in their recall scores. Although recall of children at all grades was below the 100% criterion, grade 5 and 7 children recalled a significantly higher proportion of the hard items than the younger children recalled. It is difficult to separate whether the improvement in recall was due to the ability of older children to better sense when they have studied sufficiently, or whether it is due to the fact that most older children tend to use the strategy of allocating more study time to the hard task.

The results of the prediction scores suggest that the younger children did not modify the recall goal, but actually thought they would recall the items fairly well. In fact, only grade 3 or older children predicted they would recall fewer of the hard items than the easy items. Grade 1 children predicted their recall would be approximately the same for both types of tasks.

The present study was also designed to explore some factors that might be related to young children's inefficiency in allocating study time. Asking children to identify the easier booklet, perhaps reminding them of the difference in difficulty, did not seem to affect either the study time allocated, nor the prediction or recall scores of the children in the expected manner.

Of further interest was whether behaviour would change over trials. All three dependent measures showed some differences over trials. The study time scores for some grade levels increased in Trial 3. More specifically, grade 3 and grade 7 children spent more study time on Trial 3 than on Trial 1, but grade 1 and grade 5 children spent approximately the same amount of time over trials. Although the difference in prediction scores was not great, it proved significant for all grades combined. Recall scores of the easy items were consistently high across trials, but recall of hard items showed improvement over trials.

Metamemory Data

Differences between two grade levels, or younger (grades 1 and 3) and older (grades 5 and 7) children were examined for all cases by forming 2 x 2 tables (e.g., grade 1 vs. grade 3, knowledge present vs. knowledge absent). Then Mainland and Murray's (1952) four-fold contingency tables were applied to the data.

Metamemory Related to Differential Allocation of Study Time.

One purpose of the prompt questions was to identify which children could distinguish between easy and difficult booklets, both before experience with the task (trial 1), and after experience (trial 2). The number of children in the prompt group who could correctly identify the easier booklet, as well as the number who could also justify their response, is set out in Table 10. A child's explanation was scored as an adequate justification if the child indicated somehow that the items were related (e.g., "They go together, like shoe and sock," "Because they're like pairs, like a spider makes a web, a coat goes with a hat.")

As indicated in Table 10, there was a slight increase with age in the number of chilren who could correctly identify the easier booklet (total column); although only one comparison - between grade 7 and grade 1 on trial 1 - was significant, $p < .05$. In contrast, the number of children who could justify their choice showed a dramatic

Table 10

Number of Children in Prompt Condition who Could Correctly Identify Easy Booklets and Justify Their Choice

	Correct Choice			Incorrect Choice
Grade	With Justific.	Without Justific.	Total	
		Trial 1		
1	1 (6%)	9 (56%)	10 (62%)	6 (38%)
3	9 (56%)	4 (25%)	13 (81%)	3 (19%)
5	11 (69%)	3 (19%)	14 (87%)	2 (13%)
7	15 (94%)	1 (6%)	16 (100%)	0 (0%)
		Trial 2		
1	2 (13%)	9 (56%)	11 (69%)	5 (31%)
3	12 (75%)	2 (13%)	14 (87%)	2 (13%)
5	14 (87%)	1 (6%)	15 (94%)	1 (6%)
7	16 (100%)	0 (0%)	16 (100%)	0 (0%)

increase with age. Comparisons between grades 1 and 3, and between older (grades 5 and 7) and younger (grades 1 and 3) children were significant on both trials 1 and 2 (ps. $< .05$ or better). An examination of Table 10 also illustrates that the level of knowledge children demonstrated was consistent over trials.

The first three metamemory questions were designed to examine knowledge of children in both groups with respect to allocating more time to difficult material. The first two questions dealt with knowledge useful to the ability to allocate study time differentially in the present task; namely, the ability to identify the easy booklet, and knowledge that the harder booklet should be studied longer. The third question was included to determine whether some young children who did not know that the harder booklet should be studied longer nevertheless knew that in general studying longer led to increased recall.

Table 11 sets out the number of children at each age level who correctly or incorrectly identified the easier booklet, and the number who could adequately explain why one booklet would be easier to remember (Question 1). The same scoring criteria that were used for the prompt questions were used for children's explanations. As indicated in Table 11, approximately two thirds of the grade 1 children and virtually all of the grade 3 or older children correctly identified the easy booklets (correct choice - total column). This observed difference between grade 1 and grade 3 or older children was statistically significant, $p < .05$.

Similar to the results of the prompt questions, very few of the grade 1 children who could correctly identify the easier booklet could justify their answer. The difference between grade 1 and grade 3 or older children's justifications was significant, $p < .05$. Approximately one half of the grade 3 children who correctly selected the easy pairs explained their choice by saying "Because I know them," or similar responses.

The types of strategies suggested by children for studying the harder booklets (Question 2) were categorized as: elaboration, self-testing, study hard pairs more, and other strategies. Children who gave no response or who did not suggest any task relevant response were categorized as "other response". Children who suggested more than one strategy were assigned a score for each of the strategy categories their responses fell into. Answers were scored as elaboration if the child explained either a verbal or pictorial elaboration strategy. Answers were scored as self-testing if the child mentioned using a self-testing strategy, such as covering the response picture with your hand and trying to guess what the response was, or if they mentioned the use of cumulative rehearsal, which includes a self-testing component. The study hard pairs more category was a broad category that included responses that the hard

Table 11

Number of Children who Could Correctly Identify Easy Booklet and Justify Their Choice

Grade	Correct Choice: With Justific.	Correct Choice: Without Justific.	Correct Choice: Total	Incorrect Choice
1	3 (9%)	18 (56%)	21 (66%)	11 (44%)
3	25 (78%)	5 (16%)	30 (94%)	2 (6%)
5	29 (91%)	3 (9%)	32 (100)	0 (0)
7	32 (100)	0 (0)	32 (100)	0 (0)

book should be studied longer, or that some form of rehearsal should be used more with the hard book. Responses describing any other appropriate study strategy, such as "Write it down," were categorized as "other strategies." If children's responses were categorized into any one of the above four categories, (elaboration, self-testing, study hard book more, or other strategies), they were also placed into the category of "At Least One" Strategy. This category was developed to assess whether children would be able to suggest at least one reasonable study strategy to use to help remember the hard booklet.

As seen in Table 12, there was a significant increase with age in the number of children who were able to suggest at least one strategy (grade 3 vs. grade 1, $p < .05$, and grades 5 and 7 vs. grades 1 and 3, $p < .01$) to study the hard booklet. The pattern of age-related differences observed for the specific strategies (i.e., elaboration, self-testing) however, varied from one category to the other. While it was at the grade 3 level that frequent reference to the study more strategies began to emerge (grades 3 vs. 1, $p < .01$), it was at the grade 5 level that reference to the self-testing and elaboration strategies began to appear (grades 7 and 5 vs. grades 3 and 1, $p < .05$).

The number of children who knew both which booklet was harder and that the harder booklet should be studied longer (or higher knowledge such as elaboration or self-testing)

Table 12

Number of Children who Suggested Different Types of Strategies for Studying Hard Pairs

Grade	Type of strategy: Elaboration	Self Testing	Study Hard Pairs More	Other Strategies	At least One	Other Response
1	1 (3%)	0 (0)	12 (38%)	2 (6%)	15 (47%)	17 (53%)
3	1 (3%)	0 (0)	21 (66%)	3 (9%)	25 (78%)	7 (22%)
5	7 (22%)	3 (9%)	21 (66%)	7 (22%)	30 (94%)	2 (6%)
7	16 (50%)	5 (16%)	21 (66%)	8 (25%)	32 (100%)	0 (0%)

showed a significant increase with age, as illustrated in Table 13. Both the comparison between the number of grade 1 vs. grade 3 or older children who had such knowledge, and between grade 3 vs. grade 5 or older children were significant ($p < .05$).

Children's answers to the third question, which dealt with the benefits of increased study time in general, are summarized in Table 14. As expected, the number of children who correctly stated that the child who studied for 5 minutes would remember more than the one who studied for 1 minute was consistently high (80% or better). No age differences were observed. Slightly fewer of the grade 1 children were able to adequately justify their choice. (An answer was scored as an adequate justification if it contained some statement that studying longer leads to improved recall.) The number of children in grades 5 or 7 who gave an adequate justification of their choice was significantly greater than the number of first graders who could justify their choice, $p < .05$.

Table 13

Number of Children Who Knew Both Which Booklet was Harder and that Harder Booklet Should be Studied Longer

	Level of knowledge		
Grade	Knowledge of Both	Partial Knowledge	No Knowledge
1	10 (31%)	14 (44%)	8 (25%)
3	20 (63%)	12 (37%)	0 (0%)
5	28 (88%)	4 (12%)	0 (0%)
7	31 (97%)	1 (3%)	0 (0%)

Table 14

Number of Children who Chose Longer Time as Leading to Better Recall, and Justification for Choice

	Correct Choice			Incorrect Choice
Grade	With Justific.	Without Justific.	Total	
1	23 (72%)	3 (9%)	26 (81%)	6 (19%)
3	27 (84%)	1 (3%)	28 (87%)	4 (13%)
5	31 (97%)	0 (0%)	31 (97%)	1 (3%)
7	30 (94%)	1 (3%)	31 (97%)	1 (3%)

Knowledge of Strategies for Terminating Study.

The purpose of Questions 4, 5, and 6 was to examine children's knowledge about strategies for terminating study. In question 4, information was saught as to how children terminated their study in Trial 1 and 2. The category of "self-testing for paired-associate items" was used for responses that described some strategy such as covering the response picture with one hand and trying to guess what the stimulus picture was. Answers were categorized as general self-testing if they described a more general type of self-testing strategy such as closing the book and checking how many of the pairs you can recall. All the remaining responses were classified as "other responses". The majority of children who were categorized as other responses gave answers such as "When I knew them," or "When I was finished studying."

As indicated in Table 15, the number of children who described the use of one of the self-testing strategies increased with age, although even at the oldest age level less than half of the children reported using a self-testing procedure to terminate their study time. Combining adjacent age groups, the number of older children who described either type of self-testing was significantly higher than the number of younger children, $p < .01$.

In question 5, children were asked what they would tell someone to do if the person really wanted to make sure

Table 15

Number of Children who Described Self-Testing Strategies or Other Responses in Relation to How They Terminated Study Time

	Strategy to terminate study			
Grade	Self-Testing for P-A items	General Self-Testing	Combined	Other Responses
1	0 (0%)	0 (0%)	0 (0%)	32 (100%)
3	1 (3%)	3 (9%)	4 (12%)	28 (88%)
5	2 (6%)	6 (19%)	8 (25%)	24 (75%)
7	3 (9%)	10 (31%)	13 (41%)	19 (59%)

he/she remembered all the partners perfectly. Children's responses were classified as self-testing for paired-associate items, general self-testing, study more, or other responses. The first two categories for self-testing strategies are the same as described for Question 4. Responses in the study more category included answers such as "Study them again," "Look them over again." As seen in Table 16, more of the older children (grades 5 and 7) than younger children (grades 1 and 3) described a self-testing strategy. Whether we use the description of self-testing for paired-associate items, or the description of either type of self-testing ("combined" category) as the dependent measure, older children (grades 5 and 7 vs. grades 1 and 3) demonstrated a higher degree of knowledge of self-testing than younger children, $\underline{p}$s $<.01$.

As the strongest prompt, the experimenter partly demonstrated the self-testing procedure and asked children to explain why a child would do this (Question 6). At all grade levels, at least 50% or higher of the children could accurately describe the self-testing procedure when it was partly demonstrated for them. The number of children at grades 1, 3, 5, and 7 who could accurately describe the self-testing procedure after the demonstration was 16 (50%), 19 (59%), 25 (78%), and 32 (100%), respectively. Again combining adjacent age groups, more of the older (grades 5 and 7) as compared to the younger (grades 1 and 3) children

Table 16

Types of Responses Suggested by Children to Check How Well Learned Material Is

	Suggested strategy				
Grade	Self-Testing	General Self-Testing	Combined	Study More	Other Responses
1	0 (0%)	1 (3%)	1 (3%)	22 (69%)	9 (28%)
3	4 (12%)	6 (19%)	10 (31%)	16 (50%)	6 (19%)
5	13 (41%)	9 (28%)	22 (69%)	8 (25%)	2 (.6%)
7	16 (50%)	10 (31%)	16 (81%)	6 (19%)	0 (0%)

could accurately describe self-testing when this strong prompt was given.

Relationships Among Metamemory, Study Behaviours, and Recall

The purpose of this section of the analysis was to examine the relationships among children's verbalized knowledge related to allocation of study time, their study behaviour, and their recall scores. (One of the study behaviours deliberately assessed was the amount of study time allocated. Data concerning the relationship between study time scores and recall scores can be found in Appendix D.) As a preliminary indication of the relationship between metamemory knowledge and study behaviours, correlations between metamemory scores and the proportion of study time spent on hard pairs, as well as the absolute amount of study time spent on hard pairs, was calculated. For this purpose, it was necessary to assign numerical scores to children's metamemory answers. The metamemory questions were designed to tap two general areas of children's knowledge: (a) knowledge relating to allocating study time differentially according to task difficulty, and (b) knowledge of strategies for terminating study. Therefore, in addition to a total metamemory score (i.e., a + b), each child was assigned a score for each of these separate areas: (1) knowledge of differential allocation, and (2) knowledge of self-testing.

For the knowledge of differential allocation score, answers to questions 1, 2, and 3 were used. Because these questions could be considered as examining separate components of knowledge related to allocating more time to difficult material, each question was assigned a score, and the scores were added to calculate the score for differential allocation of time. Scores were assigned for the three questions on the following basis:[2]

Identification of Easy Pairs.

Correct choice and justification - 2 points

Correct choice, no justification - 1 point

Other answers - 0 points

Strategies for studying hard book.

Elaboration - 4 points

Self-testing - 3 points

Study more - 2 points

Other strategies - 1 point

Other answers - 0 points

Knowledge that studying longer leads to improved recall.

Correct choice and justification - 2 points

Correct choice, no justification - 1 point

Other answers - 0 points

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[2] In Question 2, higher scores were assigned for elaboration and self-testing than for study more because research has demonstrated that these strategies emerge later in children (e.g., Pressley & Levin, 1977).

The metamemory - self-testing score was based on the answers to questions 4, 5 and 6. Since these questions related to one area of knowledge, namely, self-testing, but gave increasingly strong prompts, the answers were scored together as follows:

Self-testing for P-A items - spontaneous (Q. 4)	- 7 points
General self-testing - spontaneous (4), plus self-testing for P-A with prompt (5)	- 6 points
Self-testing for P-A items with prompt (Q. 5)	- 5 points
General self-testing - spontaneous (Q.4) plus self-testing for P-A with demonstration (6)	- 4 points
General self-testing with prompt (5) plus self-testing for P-A with demonstration (6)	- 3 points
Self-testing for P-A with demonstration (6)	- 2 points
General self-testing with prompt (5)	- 1 point
Other answers	- 0 points

Knowledge of either area of metamemory knowledge might be hypothesized to lead to differential allocation of study time. Knowledge tapped by the metamemory - differential allocation score might lead to using the strategy of allocating more study time to the hard material. Knowledge of strategies for terminating study might also lead a person to spend more time on the hard material if such knowledge leads this person to monitor how well learned the material is while studying, thereby realizing that the difficult material is not well learned and should be studied longer. A one-to-one relationship between metamemory scores and study time scores was not expected since higher proportion scores (e.g., .90 vs. .70) do not always indicate that a person was better able to allocate study time differentially. Also, after some point higher metamemory scores do not necessarily indicate that a higher level of knowledge that is required for differential allocation is present. (For example, knowledge of elaboration leads to a higher score, but a person with this knowledge would not necessarily be more likely than a person that knows hard booklets should be studied more to allocate more study time to hard pairs). Nevertheless, correlation coefficients were calculated between study time scores and metamemory scores to provide a rough indication of the degree of relationship between these two measures. Since the metamemory scores were ordinal scores, Spearman Rho correlations were calculated.

The correlations between the two separate metamemory scores as well as the combined metamemory scores and two separate study time scores for all grades combined appear in Table 17. As seen in Table 17, significant correlations were observed between metamemory scores and two types of study time scores, suggesting that children with higher metamemory scores tended to allocate a greater proportion of their study time to the hard pairs, and also a greater amount of study time to the hard pairs. The extent of the relationship with study time scores was similar for all three metamemory scores.

The correlational data summarized above tends to confirm the results described in the previous two sections. Older children usually spent a greater proportion of time on hard pairs and also spent a greater absolute amount of study time on hard pairs. Older children also tended to know more about all metamemory questions relevant to allocation of study time. Therefore, the correlations observed were likely largely due to these observed differences between older and younger children.

Whether children within one grade level who knew more about factors relevant to allocation of study time (as measured by the metamemory questions) also allocated study time more efficiently was also of interest. Consequently, correlations between metamemory scores and allocation of time scores were also calculated for each grade separately. When the data were analyzed separately by grade, there were no significant correlations between metamemory scores and study time scores (using the probability levels suggested by Larzalere & Mulaik (1977) when multiple correlations in a single sample are examined).

To examine how knowledge relates to differential allocation of study time more directly, the study time scores of children with different levels of knowledge

Table 17

Spearman Rho Correlation Coefficients Between

Metamemory Scores and Study Time Scores

Group	Metamemory Score: Differential Allocation	Self-Testing	Combined
Trial 3			
Proportion	.42 *	.34 *	.43 *
Time - Hard	.43 *	.38 *	.45 *
Trial 2			
Proportion	.49 *	.44 *	.51 *
Time - Hard	.30 *	.32 *	.35 *
Trial 1			
Proportion	.45 *	.38 *	.47 *
Time - Hard	.21	.28 *	.28 *

*$p < .001$

Note. Only correlations that are significant according to the recommendations of Larzelere & Mulaik (1977) are identified with asterisks.

relevant to allocating study time differentially were examined to see whether they actually allocated more time to the hard booklet. The number of children who knew both which booklet was harder and that the hard booklet should be studied longer was previously illustrated in Table 11, as was the number of children who appeared to allocate more time to difficult material (Table 6). These two variables are integrated in Table 18, which illustrates how children with various levels of metamemory knowledge allocated their study time. Because almost all children in grades 5 and 7 knew both which booklet was harder and that the harder booklet should be studied longer, only the data for grades 3 and 1 are presented. In addition, because the booklets for Trial 3 were utilized in the metamemory questions, only the data for Trial 3 are presented.

Table 18 reveals that most of the young children spent approximately the same amount of time on hard pairs as they did on easy pairs, regardless of their level of knowledge. Only one of the ten children (10%) in grade 1 who knew both which booklet was harder and that harder booklets should be studied longer actually spent more time on hard pairs. There were more children in grade 3 who spent more time on the hard booklet, but this was true for both children who had knowledge of both metamemory questions, and those who had only partial knowledge (i.e., knowledge of only one question). In grade 3, 30% of the children who correctly

Table 18

Differential Allocation of Study Time for Children in Grades 1 and 3 with Different Levels of Metamemory Knowledge

Group	Allocation of study time: Less Time on Hard	About the Same	More on Hard	Total
Grade 1				
Knowledge of Both	1	8	1	10
Partial Knowledge	1	12	1	14
No Knowledge	1	5	2	8
Grade 3				
Knowledge of Both	0	14	6	20
Partial Knowledge	0	8	4	12
No Knowledge	0	0	0	0

answered the two differential allocation questions actually spent more than 60% of their study time on the hard pairs. This percentage increased to 71% for grade 5's, and 87% for grade 7's.

Because the above analysis indicated that young children (grades 1 and 3) tended to allocate approximately the same amount of study time to easy and to hard pairs even when they had knowledge of two components relating to differential allocation, no further analysis was performed on the data from the prompt group concerning which children could distinguish between easy and difficult materials. A further reason why no analysis was done comparing study times of children who knew the difference in difficulty versus those who did not was because some of the groups were too small to permit a meaningful analysis to be done (e.g., only one child in grade 1 correctly chose easier book and could justify their choice on trial

<u>Knowledge of Self-Testing Strategies and Recall</u>

Of the two components of allocation of study time examined, the one that should be most highly correlated with recall scores when an unlimited amount of study time is given is the ability to assess recall readiness. The second set of metamemory questions was designed to assess children's knowledge relating to the use of self-testing strategies to terminate study activities. To determine how verbally reported knowledge of such strategies related to recall performance, Spearman Rho correlation coefficients were calculated for each grade separately, and are set out in Table 19. The only significant correlations between metamemory - self-testing and recall were observed for grade 3 children's recall on Trial 3, and grade 7 children's recall on Trial 1.

Although the correlations between knowledge of self-testing strategies and recall were generally nonsignificant, the actual use of self-testing strategies might better determine recall performance. Children who used self-testing strategies for a paired-associate task were identified from the videotapes. Only the children who used the strategy of covering up the response picture before looking at the picture were categorized as self-testers. Because it is difficult to identify children who use a general self-testing strategy from behavioural observations, no attempt was made to do so. The number of children who used a self-testing strategy for paired-associate items on each of the three trials is set out in Table 20. On trial 1 and 2, very few children at any age level used a self-testing strategy for paired-associate items. On trial 3, a significantly higher number of older (grade 5 and 7) as compared to younger (grades 1 and 3) children used a self-testing strategy for paired-associate items. (Recall that the metamemory questions preceded Trial 3, where a partial demonstration was given of the self-testing procedure.)

Table 19

Correlation Coefficients between Metamemory - Self-Testing and Recall for Hard Pairs

	Trial		
Grade	1	2	3
1	.30	.22	.40
3	-.19	.13	.44 *
5	.12	.14	-.23
7	.48 **	.25	.07

* $p < .01$

** $p < .001$

Note. Only correlations that are significant according to the recommendations of Larzalere & Mulaik (1977) for multiple correlations using a single sample are identified with asterisks.

Table 20

Number of Children in each Grade who Used a Self-Testing Strategy for Paired-Associate Items

	Trial			
Grade	1	2	3	Any Trial
Grade				
1	0 (0%)	0 (0%)	1 (3%)	1 (3%)
3	0 (0%)	0 (0%)	6 (19%)	6 (19%)
5	3 (9%)	4 (13%)	14 (44%)	14 (44%)
7	3 (9%)	5 (16%)	11 (34%)	12 (38%)

To examine the question of whether children who actually used self-testing strategies showed better recall than those who did not, an analysis of variance was performed. Because only one child from grade 1 used a self-testing strategy, the data for grade 1 children were not included in this analysis. Only the data for trial 3 were used since it was only in trial 3 that there were a sufficient number of children using self-testing to make the analysis meaningful. Since there were a different number of subjects in the self-testing as opposed to the non-self-testing group, the analysis was carried out using the general linear model procedure. A 2 (self-testers vs. non-self-testers) x 3 (grade - 3, 5, 7) analysis performed on the recall data revealed that the self-testers, irrespective of grade levels, recalled significantly more hard items ($\bar{X}$ = 80%) than the nonself-testers ($\bar{X}$ = 67%), $F(1, 90) = 4.46$, $p < .05$.

The mean recall scores for self-testers and non-self-testers are presented in Table 21 for each grade separately. The significant effect for strategy users is illustrated by the means, combined across age groups, for self-testers, $\bar{X}$ = 80%, as compared to non-self-testers, $\bar{X}$ = 67%. Although the interaction between grade and strategy users was not significant, an examination of Table 21 reveals that for grade 7 children, recall scores for both self-testers and non-self-testers was high, and the use of self-testing did not result in higher recall scores for these children.

Table 21

Mean Recall Scores for Children who Used Self-Testing Strategies and Those who Did Not Use Self-Testing

Grade	Mean Recall Score	
	Self-Testers	Non-Self-Testers
3	75% (n=6)	51% (n=26)
5	83% (n=14)	70% (n=18)
7	78% (n=11)	84% (n=21)

CHAPTER IV

General Discussion

Allocation of Study Time

The first major purpose of the present research was to examine two components of children's spontaneous allocation of study time. The results of the present investigation suggest that as children grow older, they become increasingly proficient at: (a) allocating more study time to more difficult material (differential allocation), and (b) determining when they have studied sufficiently to meet the recall goal (sufficient allocation). (Although this does not suggest that all older children are entirely successful at allocating sufficient time, since approximately one half of the oldest group of children, grade 7, did not do so.)

Supportive evidence for the first part of the conclusion (i.e., a above) comes from the analyses of study time scores. Thus, only grades 5 and 7 children in both studies 1 and 2 allocated significantly more study time for hard booklets than for easy booklets, whereas grades 1 and 3 children spent approximately the same amount of time on the hard pairs as they did on the easy pairs. An examination of the number of children in each grade who allocated more time to the hard pairs also confirmed this conclusion: approximately 75% of the older children (grades 5 and 7 combined) expended more study time on difficult units of material while only about 20% of the younger children (grades 1 and 3 combined) studied in this manner.

Two sources of evidence are relevant to the second part of the conclusion (b above) that concerns allocation of a sufficient amount of time: recall scores, and the use of self-testing strategies. An examination of the recall scores indicated that, although recall scores at all age levels were below the 100% recall criterion for the hard items, grades 5 and 7 children's recall for hard items was significantly greater than the recall of grades 1 and 3 children.[3] Also, the number of children who actually met the recall goal (100%) was significantly higher for older children (grades 5 and 7) than it was for younger children on the second and third trials. These data indicate that

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[3] One puzzling finding is that the grade 5 children in Study I did not perform better on the recall test than the younger children did, whereas the grade 5 children in Study II had higher recall scores than younger children on all three trials. The poorer recall performance of grade 5 children in Study I cannot be explained by the amount of study time expended since the mean study time for hard pairs was higher for grade 5 children in Study I than in Study II. Although it seems an unlikely explanation, the grade 5 children in Study II were a few months older, and also further along in the school year than the children in Study I. Another possible explanation is that the children in Study I, in contrast with those in Study II, were required to learn paired-associate material using a standard study-test method prior to the self-terminated study trial. Perhaps this initial experience somehow affected the manner in which the children in Study I studied the booklets in the subsequent self-terminated trial.

older children have greater ability than younger children to regulate their study behaviour so that the recall goal is met. Even the older children, however, are not entirely successful at allocating sufficient time to meet the recall goal.

These conclusions regarding the ability to allocate sufficient time are further supported by the evidence regarding children's use of self-testing strategies. Whereas none of the grade 1 children reported using such strategies, the reported use of self-testing strategies steadily increased to the point where 40% of the grade 7 children reported using these strategies. In addition, observational data showed that a significantly greater number of the grades 5 (44%) and 7 (33%) children as compared with the grade 3 (20%) or grade 1 (3%) children used a self-testing strategy for paired-associate items on the last trial.

The demonstration in the present studies that young children are relatively inefficient at allocating study time provides one more piece of evidence to add to the large volume of research that indicates that much cognitive development occurs during childhood that leads children to become more effective learners. (See, for example, Brown, Bransford, Ferrara, & Campione, 1983; Flavell & Wellman, 1977; Hagan & Stanovich, 1977, for reviews.) There does, however, appear to be some discrepancy in the findings as to the age at which the two components of allocation of study time begin to develop in children. Previous research suggested that the ability to allocate study time differentially under "list learning" situations begins to develop in children in approximately the third grade (Masur, McIntyre, & Flavell, 1973; Rogoff, Newcombe, & Kagan, 1974). Because the task in the present studies was designed so that the distinction between easy and hard tasks would be a simple one to make, we expected that grade 3 children would be able to allocate study time differentially in this task as well. The results, however, revealed that only the grade 5 or older children distributed study time in this way. Closer examination of the tasks used in the various studies may explain the apparent differences in findings. In the present research, the ability of children to spontaneously distribute more study time to more difficult units of material was examined. In the study by Masur and her colleagues, children were forced to be selective in their choice of material for further study. Rogoff, Newcombe, and Kagan asked children to study only one set of materials, which varied in difficulty across groups of children, and examined whether children given the harder task studied for a longer time.

Taken together, the results seem to suggest that the ability to allocate study time differentially in accordance with the difficulty of materials is only beginning to develop in grade 3 children, and as such, is only utilized by these young children under limited conditions (i.e., when they are forced to be selective). Perhaps grade 3 students would choose to study hard booklets longer if they were explicitly instructed to select only one of the two booklets (hard or easy) for further study. Or if grade 3 students were asked to study easy and hard booklets separately with instructions to recall perfectly, they might study the hard booklet longer than the easy one. Some support for the hypothesis that grade 3 children have some awareness that more effort is required for more difficult tasks comes from the fact that the grade 3 students in Study II allocated more study time on the third trial (perhaps because they realized the task was more difficult than they had anticipated), but rather than spending this extra time on the hard pairs, they studied both the easy and the hard booklets longer.

Different findings have also been reported regarding the age at which the ability to assess recall readiness emerges. These inconsistencies seem largely due to the type of task used. For instance, in serial recall tasks, children as young as 7 can assess recall readiness (Flavell, Friedrichs & Hoyt, 1970); however, even fifth graders have difficulty assessing when they should terminate study when the material involves text (Gettinger, 1985; Owings, Petersen, Bransford, Morris, & Stein, 1980). Although the present task was similar to the type of task used by Flavell et al. in that it also involved list learning and not text, several differences in the present task may have made this task more difficult. For example, the task difficulty was set higher in the present study. In Flavell et al.'s study, the list length was set at the number of items the child recalled after one presentation, whereas in the present study approximately three standard study-test presentations were required to achieve perfect recall of hard items.

This same type of pattern of age-related improvement also seems to appear in studies examining the use of self-testing strategies (Moely, Olson, Halwes, & Flavell, 1969; Flavell, Friedrichs, & Hoyt, 1970). Again, the age at which children begin to use such strategies appears to depend on the type of task, and on how one defines self-testing (e.g., looking away from the pictures and trying to reconstruct items from memory; covering the response picture and trying to guess the response in paired-associate items).

It appears, therefore, that both an examination of recall performance after self-terminated trials, and an assessment of the use of self-testing strategies lead to the conclusion that age-related differences emerge in the ability to allocate a sufficient amount of study time to meet the recall goal. Further, it seems that at least with some tasks (including the present task), some children are not entirely successful at allocating sufficient time even by the time they reach grade 7. Therefore, it appears that the ability to allocate sufficient time appears to develop later than the ability to allocate study time differentially. Although this may be due to the type of task, a similar finding was also reported by Owings et al. (1980) with somewhat different materials.

Metamemory Data

The present research also demonstrated age-related differences in children's metamemory knowledge relating to allocation of study time. With respect to knowledge relevant to differential allocation of study time, the results revealed that by the third grade, most children were aware that because some of the items were related, they would be easier to remember. It is more difficult to make conclusions regarding first-graders' knowledge of the difference in difficulty. Although 66% of the first-graders correctly chose which booklet would be easier to remember, reliance on this figure may be overestimating children's knowledge since the probability of making a correct choice is 50%. When asked to explain their choice, older children were able to justify their choice, but only about 10% of the first graders were able to do so. This much lower figure (10%) may, however, underestimate children's knowledge of the difference in difficulty since many authors have pointed out the pitfalls of relying on young children's verbal responses (e.g., Nisbett & Wilson, 1977; White, 1980). It seems safe to say, though, that the ability to distinguish between easy and hard materials (i.e., related and unrelated pairs) is only beginning to develop in grade 1 children.

The data presented here are consistent with the results of Kreutzer, Leonard, and Flavell (1975) who also found age-related differences in the ability to identify the difference in difficulty in related vs. unrelated pairs, and even more pronounced age differences in the ability to explain the difference. Since young children's knowledge appeared to be the same after they had experience with the task (i.e., metamemory questions in present study) as before they had such experience (prompt questions in present study, and Kreutzer, et al, 1975), it suggests that even when they experience a difference in the ease with which they can recall the items, they do not realize what it is about the materials (or in fact that the materials have anything to do with their poor recall) that makes them more difficult to remember.

Consistent with other findings (Kreutzer, Leonard & Flavell, 1975; Wellman, 1977), children at all age levels were aware that, generally, increased study time leads to better recall (Question 3). However, fewer of the children were able to suggest studying hard material longer as a study strategy (Question 2). In fact, fewer of the grade 1 children, as compared to the grade 3 children, were able to suggest any type of strategy that could be used to study hard materials differently (perhaps because they don't know that hard material should be studied differently, or perhaps because they don't know how it can be studied differently). Although the task was somewhat different, Kreutzer, et al, (1975) also found an increase with grade in knowledge that a more difficult task (i.e., rote-paraphrase) should be studied differently.

There was a notable difference that began to emerge in grade 5 children in the type of study strategies suggested. While the strategies suggested by younger children were restricted mainly to studying the hard booklet more, many of the older children mentioned elaboration or self-testing. These findings suggest that the older children may have a more mature understanding of the role of study time in recall performance; namely, that while the amount of study time may be one factor that can be increased when material is more difficult, other resources, such as the type of mnemonic strategies utilized, can also be manipulated to ensure the recall goal is met.

The remaining questions were more relevant to allocating a sufficient amount of time. Question 4 was designed to provide information with respect to how children terminated their study time, rather than to assess general metamemory knowledge. The reported use of self-testing strategies to terminate study showed the familiar increase with age, although even for the oldest age group, the use of such strategies was not extensive (less than half of the grade 7 children reported using any type of self-testing strategy).

An assessment of children's knowledge of self-testing strategies also revealed age differences. Very few of the younger children (grades 1 and 3) could suggest the use of a self-testing strategy to ensure that the items could be recalled perfectly: most of them suggested that a person should study longer to ensure the goal is met. On the other hand, the majority of the older children (grade 5 and 7) were able to suggest some type of self-testing strategy. As expected, however, a greater number of children were able to describe a self-testing procedure for P-A items when a stronger prompt (including a partial demonstration) was given. Although age differences were maintained, approximately 50% of grade 1 children correctly described the self-testing procedure with this strong prompt. While it has been observed that children younger than grade 3 rarely use self-testing strategies in various memory situations (e.g., Leal, Crays & Moely, 1985; present research), the present data indicate that the awareness of such strategies appears to be present in younger children at least in a rudimentary form.

All in all, the metamemory data discussed above roughly correspond to the data related to study-time allocation.

First, both sets of data demonstrated age-related improvement. Second, it was indicated that the ability to allocate study time differentially probably develops earlier than the ability to allocate time sufficiently. Analogously, virtually all of the grade 7 students had requisite knowledge for differential allocation of study time, but only 50% of them could think about self-testing strategies to terminate study activities. Despite such correspondences, it is interesting to note that the number of children who had knowledge of a particular strategy (e.g., self-testing) was higher than the number of children who utilized that strategy. We will return to these points shortly.

Factors Affecting Children's Allocation of Study Time

The findings with respect to children's study time scores, recall scores, and use of self-testing strategies indicate age-related differences in the ability to allocate study time efficiently, as was indicated previously. Some of the factors that may help explain this developmental trend were explored in the present research.

The question of whether young children do not allocate a sufficient amount of study time because they change the recall goal from perfect recall to some lower criterion was examined. The prediction scores were included to provide some measure of this tendency to change the goal. These data suggested that most children at all age levels in fact were trying to comply with the task, and were not lowering the recall goal. General observations by the experimenter also suggested that the reason children terminate study time prematurely is not because they change the recall goal since many children seemed disappointed or surprised when they could not recall the items.

The effects of experience with the task were also examined in Study II. It is possible that children, especially younger ones, may not allocate time differentially nor allocate sufficient time on the first trial, but do so on the second trial as a result of feedback. Changes in study time from trial 1 to trial 2 are most relevant to this question since metamemory questions were not included between trial 1 and 2. No difference was observed in study time from trial 1 to trial 2 for younger children. Although there was some tendency for the older children (grades 5 and 7) to spend more study time on hard pairs on trial 2 as compared to trial 1, this difference was not statistically significant. Because the data were nonsignificant, it is difficult to draw conclusions regarding the effects of experience with the task on children's allocation of study time.

A further possibility that was explored was that some young children do not allocate study time differentially because they cannot distinguish between easy and difficult materials, or that the distinction in difficulty does not occur to them spontaneously. The results of the prompt and metamemory questions indicated that the ability to distinguish between easy and difficult items is only beginning to develop in grade 1 children, which would be at least part of the reason why they do not allocate study time differentially. The majority of the third-graders had knowledge of the difference in difficulty of the materials, yet very few of them allocated more study time to the hard pairs. Apparently, reminding these third graders of the difference in difficulty of materials immediately before they studied was not a sufficient prompt for children to distribute study time differentially since study time scores of children in the prompt group were similar to those in the control group.

In contrast to the variables examined above, the metamemory data showed more promising trends that roughly corresponded to those related to age-associated improvement in allocation of study time. Grades 5 and 7 children demonstrated a higher degree of knowledge than grades 1 and 3 children with respect to both differential and sufficient allocation. More of the older children, as compared to the younger children, knew both which booklet was more difficult and that the hard booklet should be studied longer. These older children also demonstrated a higher level of knowledge of self-testing strategies; more of the older children suggested self-testing strategies to ensure the recall goal is met, and a higher proportion of older children were able to recognize the benefits of a self-testing strategy after a partial demonstration. These findings are in keeping with the age differences observed in children's allocation of study time.

Upon further examination, though, it appears that the metamemory knowledge relevant to study-time allocation would not explain entirely why age-related differences in study behaviour were observed. Thus, for example, while the majority of older children who knew the "requisite" factors for allocating time differentially in fact spent more time on hard pairs, the majority of younger children even with the requisite knowledge spent about the same amount of time on hard pairs as they did on easy pairs. These findings appear to suggest that, although an increase in metamemory knowledge with age may be one factor responsible for age differences in allocation of study time, there are additional variables contributing to age differences.

The present research was not designed to identify what these additional variable might be. Some observations regarding the present research may prove useful, however, to generate hypotheses as to what factors may account for these inconsistencies. The data revealed that the discrepancy between knowledge and behaviour was not limited to younger children. Thus, while more of the older children showed greater knowledge of self-testing strategies and more of the older children also tended to use self-testing strategies, children with the same level of metamemory knowledge (i.e., can recognize benefits of self-testing after partial demonstration) did not always perform in the same manner (i.e., use self-testing strategy). Also, in the majority of cases, these inconsistencies arose because children who were assessed as having a certain level of knowledge regarding how to allocate study time (i.e., requisite knowledge for differential allocation, knowledge of self-testing strategies) did not act in accordance with this knowledge. A few instances did occur where children who did not have the required knowledge in fact allocated study time in a strategic manner (i.e., spent more time on hard pairs), which can be explained by the fact that not all children who spend more time on hard pairs are doing so in an intentional or strategic manner, or, alternatively, that verbal reports may underestimate their existing knowledge. The question of why children who appear to have knowledge regarding allocation of time do not use this knowledge when they study is more puzzling. Several reasons can be suggested to account for this inconsistency.

Firstly, knowledge and behaviour may in fact be consistent, but measurement problems are responsible for the observed inconsistencies. One possible difficulty in measuring knowledge is that the experimenter defines what areas of knowledge are relevant to the behaviour of interest. In doing so, there is a risk that some relevant aspect of children's knowledge will not be assessed that would explain the inconsistency. For example, although a child may realize the benefits of studying in a certain manner (i.e., spending more time on hard pairs), he/she may also believe that another strategy (i.e., looking at each picture once) is equally effective, or at least effective enough to meet the goal.

A second possibility is that certain factors, besides other aspects of metamemory knowledge referred to above, attenuate the relationship between metamemory and study behaviour. For example, children may have knowledge that they should study hard pairs more, but such knowledge does not occur to them when they are studying. Another factor that could be used to explain the inconsistency is motivation - children may be able to use existing knowledge to direct study activities, but elect not to do so. Motivational factors cannot entirely explain why young children do not allocate study time effectively, however, since other researchers have demonstrated that young children do not differentially distribute effort even when monetary incentives are provided for some items (Cuvo, 1974; Cuvo & Witryol, 1971). (The situation was somewhat different in these studies in that presentation rates were set, and therefore differential allocation of effort may be more difficult.)

Most theoretical models now recognize the importance of processes that can be termed "executive processes" (e.g., Brown et al., 1983; Pressley, Borkowski, & Schneider, in press), the absence of which could also explain observed inconsistencies between knowledge and study behaviour (although there is some controversy as to whether these processes should be classified as metamemory knowledge). These executive processes include the ability to plan activities, to analyze the task, to coordinate available resources to meet the task demands. In the present situation, the lack of some ability or process, for instance, the ability to plan (e.g., after briefly reviewing booklets, decide to spend three quarters of study time on hard booklet) and control study activities (e.g., use self-testing method correctly, and respond appropriately to the result of self-testing), may explain why children do not use available knowledge to direct study behaviour.

The factors discussed in the preceeding paragraphs may account for any inconsistency between knowledge and behaviour. In the present investigation, the findings indicated that the majority of older children acted in accordance with their knowledge of differential allocation of time, but were less likely to do so regarding the use of self-testing strategies. On the other hand, younger children showed inconsistency both with respect to differential allocation and sufficient allocation. One possibility that may explain these findings is that inconsistencies are more likely to arise between knowledge and behaviour when knowledge is first developing, and that knowledge with respect to differential allocation develops earlier than knowledge regarding sufficient allocation (at least with this type of task).

At the present time, it appears that further research is needed to investigate developmental factors that lead children to become strategic, self-directed learners. The role of metamemory knowledge in how children allocate study time needs further clarification. Although some of the data examining the link between metamemory and effort allocation appear promising, the link is not as clear in other studies. More specifically, researchers have demonstrated that children direct more retrieval effort when they have a "feeling of knowing," or when they have information about category size (Kobasigawa, 1983; Posnansky, 1978; Wellman, 1977). An awareness of which items were recalled correctly on the previous trial may also lead children to select unrecalled items for further study, although this is not true for all age levels (Masur, McIntyre, & Flavell, 1973; Kelly, Scholnick, Travers, & Johnson, 1976). In other situations, the results suggest that many children do not spontaneously monitor how well learned items are and direct more study time to less well learned items, and also do not utilize available metamemory knowledge (i.e., that hard booklet should be studied longer) to direct study activities (e.g., Owings et al., 1980; present research). As was indicated previously, for example, in addition to assessing children's knowledge of a particular strategy selected by one experimenter, we should assess what else children know related to that strategy (e.g., how, when, and where to use the strategy; relative effectiveness of related strategies).

Research Possibilities

As a final commentary, some further suggestions for future research will be considered. Although several avenues can be explored in research on allocation of study time, only a few will be considered here.

It has been repeatedly shown in the present research that younger children fail to study easy and difficult booklets differently even when they apparently have the prerequisite knowledge. One simple explanation for such findings is that perhaps young children may not have the ability to control their study behaviour to the extent that they can in fact allocate more study time to hard pairs; that is, they do not have the ability to monitor whether they have studied some units more carefully and longer than other units. This possibility needs to be investigated before one can examine the currently popular research question: Can children be trained to utilize study time more effectively using a simple learning situation, and will such training generalize to other situations involving more school-like material?

Another useful avenue of future research is concerned with self-testing procedures. Recall that the most notable change in behaviour from trial 2 to trial 3 was the increase in the number of children in grades 3, 5, and 7 who used a self-testing strategy for paired-associate items. The lack of change in strategy usage from trial 1 to trial 2 suggests that this change was likely due to benefits associated with asking metamemory questions that included a partial demonstration of that strategy. The fact that children began using such strategies after being questioned regarding such strategies and without being told to use them suggests that children could easily be trained to use self-testing strategies (likely with an even higher increase in usage). Such a conclusion is consistent with research that has demonstrated that other types of self-testing strategies can be easily trained in children (e.g., Leal, Crays, & Moely, 1985). In addition, the present research has provided at least some indication of the benefits of self-testing strategies. Given that the present research suggests that self-testing strategies can be easily trained in children and that such training may be beneficial, we may question just what kinds of learning situations (e.g., serial recall, free recall, recognition) and metamemory knowledge are required for young children to become aware of the importance of self-testing strategies, which is the basis for the acquisition of durable and generalizable strategies.

As compared with usual experimenter-paced learning tasks, an investigation of allocation of study time in terms of the present paradigm represents a unique opportunity for researchers to study not only how children become efficient learners (already illustrated in the preceding paragraphs) but also how other factors, such as motivation and self-concept, influence how much effort children allocate. One area of interest in the present research was an examination of children's performance across trials. Any change in behaviour on trial 2 as compared to trial 1 is most relevant to examining the effects of experience with the task. Although there was some tendency for the older children (grades 5 and 7) to spend more study time on hard pairs on trial 2 as compared to trial 1, this difference was not significant. For the younger children, no difference was observed in study time from trial 1 to trial 2. Considering the fact that the older children recalled less than 70% of the hard items and the younger children less than 50% on trial 1, this lack of increase in study time may suggest several possibilities. First, children were insensitive to the feedback that their recall scores were not as high as the criterion and rarely changed their study behaviour. Second, some of the children in fact decided to use a different strategy which would not necessarily result in longer study time. As a consequence, their recall scores showed some slight improvement. (Of course, this improvement may be attributed to what is known as a "learning-to-learn" factor.) Third, as an examination of individual data suggest, there may be individual differences, especially at older age levels, in children's interpretations of and responses to feedback (e.g., "I did not study so hard but still recalled half of the items; perhaps I am good at this game." "I studied so hard but I could recall only half of them; perhaps I am not good at this game."). Such individual differences in interpretations of success and failure might have led some children to increase study time or effort on trial 2, and other children to decrease study time. This third type of analysis illustrates how one can study children's allocation of study time by integrating information-processing approaches (that emphasize metacognitive variables) and motivational approaches (e.g., Covington, 1983).

Appendix A

REVIEW OF THE LITERATURE

Allocation of Time in Effortful Learning

Despite its importance, allocation of time in effortful learning situations has received relatively little attention from researchers. Many examples can be found to illustrate the importance of allocation of study time. For instance, in order to do well on a test, an individual must have the ability to allocate a sufficient amount of time to learn the material well. In addition, he/she will make more effective use of that study time if he/she knows how to distribute the time properly (i.e., study more important, or more difficult, or less well learned material for a longer period of time). The above examples also illustrate one way in which we can conceptualize allocation of study time, that is, as consisting of two interrelated concepts - allocation of a sufficient amount of time for the task, which has been studied under mastery learning conditions in recall readiness studies, and differential allocation of study time, or the ability to distribute study time according to material or task demands. The ability to allocate time effectively can also be important in retrieval situations.

For instance, an individual writing a test will spend his/her time most effectively and do better on the test if he answers all the questions he knows first and then tries to remember further details, rather than spending all his/her time trying to remember one point.

The purpose of this review is to examine what we currently know about allocation of study time and retrieval time, and to explore the areas where further research is needed. The main focus will be on how the ability to allocate time effectively develops in children, although this is not to say that adults have perfected this skill.

Allocation of a Sufficient Amount of Time

The ability to allocate a sufficient amount of time for the task is essential if an individual wants to do well on a subsequent test. This skill is also important where learning involves a series of steps, each subsequent one dependent upon mastery of the previous steps. Several studies have indicated that young children seem less capable than older children or adults of allocating a sufficient amount of study time in order to master the material, and that this skill improves with age.

Flavell, Friedrichs, and Hoyt (1970) asked children in nursery school, kindergarten, grades 2 and 4 to study a set of items for a serial recall test until they could remember all the items perfectly. By asking each child to memorize a list as long as his/her previously assessed recall span, these researchers ensured that the task was appropriate to the participant's ability. Flavell and his colleagues found that there was a marked improvement with age in the recall performance of these children, even though the number of items was equal to the subject's previously assessed memory span. Thus, nursery school and kindergarten children were not proficient at determining when they had studied enough to recall items perfectly. In contrast, children in grades 2 and 4 usually recalled perfectly on all three trials. The authors concluded that, "...there is a very marked improvement over this age range in the child's ability to sense when he has memorized a set of items sufficiently well to recall them perfectly."

Even though children as young as the second grade seem able to allocate a sufficient amount of study time in a serial recall task (Flavell, Friedrichs, & Hoyt, 1970), when the task becomes more complex, even fifth graders seem unable to assess when they have studied sufficiently to be able to recall the material. Owings, Petersen, Bransford, Morris, and Stein (1980) asked grade 5 children to study stories so they could answer all of the questions on a subsequent test correctly. There were two types of stories: difficult stories where the actors were performing acts incongruent with the description of the actors (e.g., "The sleepy boy ate a hamburger") and easy stories where the descriptions of the actors and acts were congruent. Their recall performance, especially for "difficult" stories, was far from perfect (mean recall score for difficult stories = 56.4%).

Similar results were reported by Gettinger (1985). In the Gettinger study, Grades 4 and 5 students were required to memorize perfectly ten pieces of factual information (e.g., how to sail a boat) contained in a passage. To meet this requirement (100% recall), they needed to study the material at least four trials. When students were allowed to self-determine the number of trials, they spent in average between two and three trials, and recalled approximately 85% of the information.

In sum, like many other mnemonic skills, the ability to allocate sufficient time for the task seems to be task dependent. The evidence indicates that children are first able to allocate sufficient time for a task at approximately eight years of age. Whether eight-year-old children are able to allocate sufficient time because they have developed the ability to monitor how well they have learned the material remains questionable. Flavell et al. (1970) used a recall list equal to each child's memory span. Thus, children could recall perfectly without carefully monitoring their recall readiness (Brown, 1978). On the other hand, Flavell may have underestimated children's ability to monitor the contents of memory. Children may have been able to monitor the contents of memory, but did not allocate sufficient time because their recall goal was not the same as the goal provided by the experimenter; namely, perfect recall. The task used by Owings et al (1980) and Gettinger (1985) was clearly beyond subjects' memory span, and therefore they were not likely overestimating children's monitoring ability. However, as will be shown in the next section, subjects in the Owings et al. study were given material to learn that varied in difficulty, which may make it more difficult to monitor how well learned the material is.

Differential Allocation of Study Time

As indicated previously, the ability to differentially allocate study time according to material or task demands enables an individual to use the available time most effectively. In different situations, time may be distributed according to the importance of the material, the difficulty of the material, the recall goal (i.e., gist recall versus verbatim recall), or how well learned the material is. Research has examined the ability to allocate time differentially in children and adults in accordance with many of those variables.

In a relatively simple situation where the amount of study time was measured for a recognition task following different intervals between presentation of the materials and testing (i.e., a few minutes, one day, or seven days), children as young as eight years old spent a greater amount of time studying in anticipation of a longer as opposed to a shorter interval (Rogoff, Newcombe, & Kagan, 1974). However, the announced delay interval between presentation and testing did not have any effect on the study time of 4- and 6-year-olds. It is important to note that each child received only one study and recall task, and the comparison was a between groups comparison. We don't know from this study how children would distribute their study time if they were given both tasks (i.e. one harder and one easier task).

Study time may also be allocated according to how well learned material is. For example, when studying material for a test, after some portion of the material is well learned, further study time would be more wisely utilized if the learner concentrates on the material that is not well learned. Masur, McIntyre, and Flavell (1973) examined how this ability develops by asking children and college students to study a list consisting of line drawings of common objects for a free recall test. The list was 50% longer than each child's previously assessed memory span. On the first trial, children saw all items in the list. The children were informed as to which of their responses were correct. On the second and subsequent trials, children were permitted to select only one-half of the items for further study. Masur and her colleagues were interested in the proportion of items chosen for study that the children had not recalled on the previous recall test. They found that third graders and college students selected more missed items for additional study, but first-graders selected approximately an equal amount of recalled and unrecalled items. Apparently, the problem for the first graders was not in identifying which items they had recalled since, when tested subsequently, these younger children were capable of discriminating recalled from missed items. Masur, et al., also found that, although most third graders strategically selected more missed items, their recall was only slightly better than the third graders who did not select more missed items. Similar findings were reported by Brown and Campione (1977) with educable retarded children. Some of their subjects selected previously missed items for additional study. This use of a "good" strategy was not accompanied by improved recall performance.

The ability to use knowledge of how well learned the material is to distribute study time or processing time was also studied by Bisanz, Vesonder, and Voss (1978). These investigators, however, did not measure study time directly, but inferred from improved recall performance that there was also an increase in processing time. In this study, first, third, fifth graders, and college students were presented with a list of paired-associate items to learn using the standard study-test method to a criterion of one errorless trial. After each trial, subjects were asked to judge which items they had recalled correctly. The results revealed that there was little relationship between postdiction accuracy and acquisition performance for first graders. But a substantial relationship between these variables was obtained for fifth graders and college students. These authors inferred that, although some young children are able to discriminate correct and incorrect responses, they do not use this information to distribute their processing time accordingly; only older children use this ability to discriminate to differentially distribute processing time.

In summary, the studies reviewed thus far indicate that knowledge about differential allocation of study time develops around grade 3 when simple list-learning tasks are used. They also indicate that there is a time lag between when children can identify unrecalled items correctly and when they select such items for further study. Recently, many researchers have been concerned with "ecological" validity of studies involving rote-learning of a list of unrelated items. Thus, investigators assessed children's knowledge of time allocation strategies in school-like situations. We will now examine two such studies.

Owings, Petersen, Bransford, Morris, and Stein (1980) were interested in whether children would spontaneously spend more time studying stories that were incongruent with their current knowledge, thus more difficult to learn, and whether this ability to distribute time was related to academic achievement. The subjects consisted of two groups of grade 5 children - academically successful and academically unsuccessful (measured by teacher ratings and an achievement test). Children were given two types of stories to study: "easy" stories that contained information that was readily understandable in terms of what the children already knew, for instance, "The hungry boy ate a hamburger," and "difficult" stories, where the predicates were arbitrarily re-paired with sentence subjects, for instance, "The hungry boy took a nap." The subjects were also asked to rate the difficulty of the stories after the study but prior to a recall test and to justify their answer. The successful students were aware that they had had more difficulty learning some stories than others, and they spent more time studying the difficult stories than the easy stories. In contrast, the unsuccessful students were much less aware of the difference in difficulty between the two stories, and tended to distribute their time equally between easy and difficult stories. The usefulness of differential time allocation is illustrated in this study by the higher recall scores of the successful students, even though total time spent was approximately equal between the two groups. However, as was indicated previously, even the successful students did not allocate a sufficient amount of time for the task - their recall for difficult stories was far from perfect.

Brown and Smiley (1978) also used more school-like material to examine whether children could distribute study effort in accordance with the importance of units to the text. In this study, students in grade 5, 7, 12, and in college were asked to read a story that was approximately 400 words long, and then half of the subjects were given an additional 5 minutes to study the story. Prior to the outset of this investigation, the story was divided into linguistic subunits, and independent groups of college students rated the structural importance of these subunits for the main theme of the story using a 4-point scale. These researchers measured both the behaviour of the subjects during the study time (i.e., underlining, taking notes) and their subsequent recall performance. The results indicated that twelfth graders and college students were most likely to underline and write down important passages, usually ignoring relatively unimportant ones, indicating an awareness of the importance of units to the text. Also these older subjects showed an improvement in recall for the most important idea units over the subjects that did not receive the additional study time. Children in grade 5 and 7 who spontaneously underlined also showed some improvement in recall for the most important idea units. The remaining children in grade 7 showed less improvement, and the remaining children in grade 5 showed no improvement in recall. Although Brown and Smiley did not measure study time apportionment directly, one can infer that the older subjects and the spontaneous underliners in the younger groups spent more time studying the most important idea units, and showed a corresponding improvement in recall performance.

What may be some of the differences between list learning tasks and tasks employing more school-like material that seem, from the above studies, to make it more difficult for children to allocate study time with school-like material? When asked to recall stories, literal recall of individual pictures, words, or sentences is not the objective. Instead, the purpose is to recall the gist of passages. To accomplish this goal, the learner has to (a) discriminate main ideas in the text from those trivial points, and (b) organize those important ideas into a meaningful format. When these are required, as Brown and Smiley's findings indicate, even grade 5 students are not proficient at allocating study time. The findings of Owings et al. also confirm this conclusion.

Allocation of Retrieval Time

As with differential allocation of study time, retrieval time can be allocated according to knowledge of or sensitivity to various person or task variables. For instance, when answering a question on a test, information may be given that five points should be indicated in the answer. Therefore, after five points are recalled, retrieval efforts may be stopped (task variable). In another situation, a "feeling of knowing", in other words, a feeling that you know the answer to the question but can't recall it should lead to further retrieval efforts. But a feeling that you never did know the answer should not lead to further retrieval efforts (e.g., What is Beethoven's telephone number?).

Two studies have examined the ability of children to use information about category size to allocate time to retrieval efforts. Kobasigawa (1983) presented lists consisting of line drawings of objects in 6 different categories to children, and then asked children to recall the items. The items in each category were presented along with a picture cue for that category. These picture cues were then presented to the child for the recall test. Kobasigawa found that both grade 1 and grade 3 children, regardless of whether they were prompted to think about the category size or not, used their knowledge about the category size to conduct their memory search; in other words, the children spent more time trying to recall further items when all items in a category had not been recalled than when all items for that category had been recalled. Posnansky (1978) found that third graders made use of category size information spontaneously to guide the time they spent searching memory, but kindergarten children used category size information only when they were required to make size judgments or when they were provided with category size information.

It seems that the link between memory monitoring and allocation of time has been more clearly demonstrated in studies on allocation of time in retrieval situations than in acquisition situations. Researchers have demonstrated that even grade 1 children differentially allocate search time monitoring how many items they have stored. In contrast, as was summarized previously, Bisanz et al. (1978) have shown that, even though grade 1 children can recognize which items they have and have not learned on a given trial (i.e., memory monitoring), they do not use that information for distributing processing efforts on the subsequent acquisition trial. Thus, Kobasigawa (1983) concluded that monitoring retrieval processes may be easier than monitoring effort while acquiring information.

Training Studies

Useful information may be gained from studies on allocation of time as to how children or adults may be trained to allocate their time in learning situations. Training individuals how to allocate time may be especially important since it would seem that all individuals do not pick up this ability in the natural course of events. Also, through training studies, we can assess the relevance of factors that are previously hypothesized to be responsible for mature use of study time.

Brown and Campione (1977) attempted to train educable retarded children to distribute further study time in accordance with how well they had learned the material. The task was adapted from the Masur, McIntyre, and Flavell (1977) study. The task was a multi-trial free recall task in which subjects were only permitted to study one half of the items during the study periods for the second and subsequent trials. In one training condition, the experimenter selected the items for the child for further study he/she had missed on the previous recall test (standard training). Recall that this is the strategy regarded as mature by Masur, McIntyre, and Flavell (1973). For another group of children, the experimenter selected the items the child had recalled plus one missed item (creeping condition). Recall also that in the Masur et al. study grade 3 students did not benefit from the "mature" strategy of studying missed items further. The creeping strategy allowed children to review previously recalled items plus one extra item. For the last group of children, half of the items selected by the experimenter were missed items and half were recalled items (random condition). During the training sessions, the results revealed that young children performed better in the creeping condition, and older children performed better in the standard training condition. Upon completion of the training sessions, posttests were given to children in which they were free to select any items for further study. Only the older children who were forced to study only missed items during training (standard training) showed a tendency to choose previously unrecalled items for additional study (differential allocation), and recall rose dramatically for these children. Older children in the other two conditions showed no change in strategy use nor in recall at posttest. Although younger children's recall benefitted most from the creeping strategy during training, they did not retain this strategy at posttest, nor did their recall improve at posttest. Younger children in the other two conditions showed a similar pattern during posttest - they did not show any strategic selection of items and their recall did not improve. Despite the fact that younger children did not show a significant improvement at posttest, their recall during training indicated that the creeping strategy was more appropriate for the younger children. Brown and Campione concluded that for strategy training to be successful, the imposed strategy should be compatible with the cognitive competency of the children.

Factors Affecting the Ability to Allocate Time

Several factors have been suggested to explain why young children fail to allocate their time in learning situations effectively. One factor that has become the focus of much research is metamemory, or knowledge about the factors affecting memory processes, or more generally, metacognition, or knowledge about one's cognitive processes. Metacognition has become the focus of interest not only for researchers studying allocation of study time, but also for researchers studying mnemonic strategies, communication skills, reading comprehension, and social competence.

Although there is not widespread agreement as to what factors should be included under the term metamemory and how these factors can be conceptualized, it seems useful for the present discussion to distinguish between two aspects of metamemory: general metamemory knowledge and monitoring or sensitivity. General metamemory knowledge can be defined as knowledge in long-term memory about the factors that affect memory processes. Flavell's (1977, 1985) distinction among person, task, and strategy variables is a useful way to conceptualize general metamemory knowledge. These three types of variables will be illustrated shortly. Monitoring or sensitivity, on the other hand, can be defined as a current experience. For the present discussion, monitoring will be defined as an awareness of the current contents of one's own memory. Sensitivity will be used here in the sense of a current awareness of the difficulty of the materials or the task demands, or of the usefulness of a particular strategy. In addition to metamemory knowledge, a learner must also be able to use his/her metamemory knowledge to direct his/her activities (Brown's (1978) executive processes).

An example will help illustrate how metamemory knowledge relates to allocation of time. If a child fails to allocate his/her study time effectively, several factors may explain this failure. He/she may be lacking one or more essential pieces of information that can be described as general metamemory knowledge. For instance, he/she may not be aware that there are limitations to his/her memory - I can remember everything just by looking at it once (a person variable), so I don't have to study. Or he/she may not know that verbatim recall is a difficult task that requires more study time (a task variable). Or the individual may not know that because he/she is not using categorization this time to help recall, it will take longer to learn the material (a strategy variable). The child may also be lacking the ability to effectively monitor memory; in other words, the child does not know how long to study because he/she is not aware of how well the material he/she has been studying has been learned. Or the child may not be sensitive while studying to the difficulty of the materials or the tasks. To illustrate the child may not be attending to a particular dimension that makes tasks easy or hard while he/she is studying (although he/she may have that knowledge), and therefore cannot spend more time on difficult stories. Lastly, a child may be unable to use his/her metamemory knowledge to direct his/her study behaviour (executive processes).

We will now illustrate how the concept of metamemory has been used in this area. Researchers studying allocation of time in learning situations have concentrated mostly on how the ability to monitor memory and how sensitivity to the material or the task affects children's allocation of time. In the research concerning allocation of a sufficient amount of study time for perfect recall, or recall readiness, the authors (e.g., Flavell, Friedrichs, & Hoyt, 1970) have generally concluded that a failure to use this strategy represents an inability to monitor the contents of one's memory (e.g., "Have I learned enough?"). However, other factors may also be involved: namely, a difficulty in using the knowledge about the contents of current memory (i.e., memory monitoring) to direct study activities. Another possibility is that perhaps young children may forget the task requirement (perfect recall) or may have a more modest goal to learn only a portion of the list. In addition, motivation may be an important factor in allocating a sufficient amount of study time. Many college students are able to monitor how well learned material is, but do not allocate a sufficient amount of time to get an A on the test, often because of motivational factors.

The main interest of some researchers studying differential allocation of study time has also been how the ability to monitor the contents of memory affects allocation of study time. In the study by Masur, McIntyre, and Flavell (1973), the results seemed to indicate that although first graders were able to monitor which items they had recalled, they did not use this knowledge to distribute further study time until the third grade. These findings indicate the importance of factors other than the ability to monitor memory in allocation of study time. More specifically, the following additional metamemory skills may be involved: (a) the strategic knowledge that it is useful to study previously unrecalled items more but (b) reviewing previously recalled items as well. Perhaps grade 1 children's problem consisted in both a and b, while grade 3 children's problem, in b.

Closely related to memory monitoring is sensitivity to material or task variables. The study by Owings, et al., (1980) illustrates how sensitivity to the difficulty of materials may relate to allocation of study time. The results indicated that at least one difference between the students who allocated more time to difficult stories than to easy stories and the students that did not do so was that the students who used this strategy could accurately rate the difficulty of the stories and justify their answer, while the students who did not allocate time properly could not discriminate between easy and difficult stories.

In the case of the Owings et al. study, again the sensitivity to the nature of material alone is not the only responsible factor. To allocate study time differentially, children need to: (a) assess what they already know to determine which task is more difficult (information incongruent with the existing knowledge is difficult to learn), (b) have the knowledge that the difficult task requires more time to learn, (c) use the skill to allocate more study time in response to b, and (d) have the strategy to check if all information is well learned.

In this section, the concept of metamemory was defined and its various components were illustrated in the context of allocation of study time. It was shown that the strategic use of study time involves complex coordinations of several metamemory skills. Because of this complexity, effective strategies of allocation of study time may develop gradually.

Concluding Remarks

Efficient allocation of study time is a skill that all individuals can benefit from. Especially today with the increase in the amount of information there is to learn, knowledge of how much time to spend learning the material to satisfy the goal, and knowledge of how to best distribute the time spent on the material to be studied is very helpful.

At the outset of this review, the present author made a distinction between differential allocation of study time and allocation of a sufficient amount of time to the task. This way of conceptualization of utilization of study time appears to be useful since there is some evidence that these two abilities emerge at different ages (Owings, et al., 1980). However a learner must be proficient at both skills in order to use time effectively in learning situations.

Allocation of a sufficient amount of time for the task is first observed in children at approximately the age of eight (Flavell, Friedrichs, & Hoyt, 1970). Although eight-year-old children are able to predict their readiness for recall in simple situations, in more complex situations even older children may not allocate a sufficient amount of time (Gettinger, 1985; Owings, et al., 1980). It should be pointed out that subjects were always explicitly told to study for perfect recall. We have no data concerning whether under ordinary learning situations children study spontaneously thinking about perfect recall.

The ability to allocate time differentially also seems to emerge in children at approximately the age of eight. However, this conclusion is tentative since the two studies that demonstrated this ability in eight-year-old children were not examining the spontaneous ability to use this strategy. In the Masur, et al., (1973) study, for example, children were permitted to select only one-half of the items for further study. Children may behave differently if they are allowed to distribute further processing efforts in a spontaneous fashion. In Rogoff, Newcombe, and Kagan's (1974) study, each child received only one task, and the comparison was made between groups. Children may behave differently if they are given two tasks which vary in difficulty.

There has been only one study that has examined whether the ability to allocate sufficient time and the ability to allocate time differentially are both present in children in relation to particular task requirements. Owings, et al., (1980) found that although some grade 5 children demonstrated the ability to allocate time differentially, these children did not allocate sufficient time for the task. Of course, different findings may emerge when different tasks are used.

We will now explore the areas where further research is needed. It was pointed out previously that training individuals how to utilize study-time might be important. In the available study, the researchers simply imposed a "mature" strategy of time allocation on children (Brown & Campione, 1977). Apparently, metacognitive awareness of how to use a given cognitive strategy is insufficient for an individual to maintain and generalize that strategy to a wider range of situations (e.g., Kuhn, 1984). In addition to teaching major component skills of allocation of time (e.g., "Study those items that you missed previously"), it may be equally important to teach children metacognitive awareness of when and why such component skills are important (Paris & Jacobs, 1984).

What aspects of metacognitive awareness should be included in training procedures to develop highly generalizable strategies in children? Several authors have suggested the importance of the memory monitoring aspect of metamemory to allocation of study time. Two studies indicated that although memory monitoring may be important, other factors seem to be involved as well. The Masur, et al., study demonstrated that although first-graders knew which items they had recalled correctly, they failed to use this information to direct further study activities. Flavell, et al.'s, study also demonstrated that at least one aspect of memory monitoring (or more accurately, in this case, an ability to predict memory span) is not related to the ability to allocate a sufficient amount of time to the task. In light of this evidence, an examination of metamemory factors other than memory monitoring would seem to be one avenue where further research is needed.

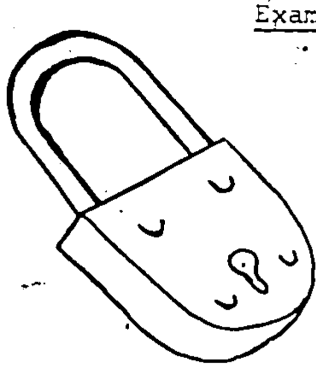
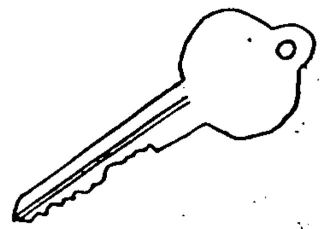
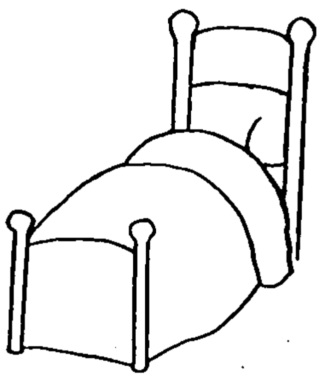
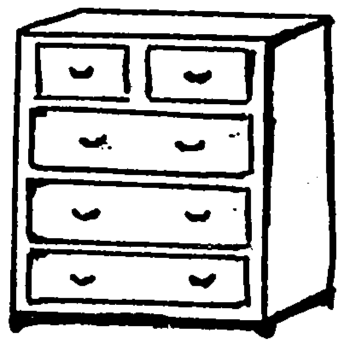
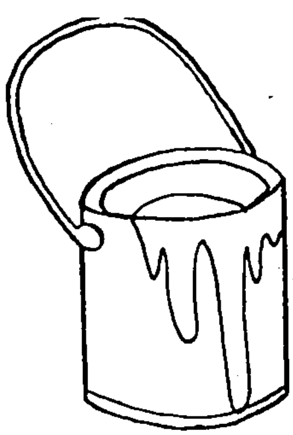
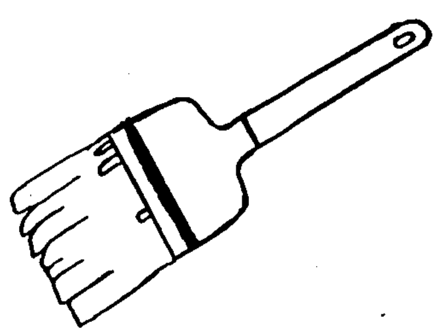
Flavell's (1977) model states that the quality of learning depends on the characteristics of the learner, the nature of task demands and material, and the kinds of strategies the learner uses. At this stage, the attention has been most focused on task variables, the nature of task demands and materials. Relatively little attention has been given to the role of other variables. In the context of Flavell's model, interesting questions would be: Do children recognize that they need more study time when they use Strategy A but require less time when instructed to use Strategy B? How do learners' characteristics (self-concept about learning; locus of control; past experiences of achievements) interact with the current task demands in determining the selection of different strategies of allocation of study time, and in the subsequent achievement? These are just a sample of questions that should lead to fruitful research.

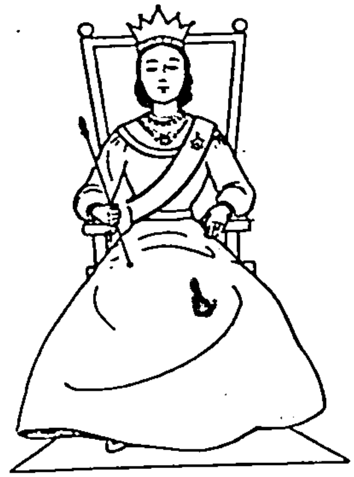
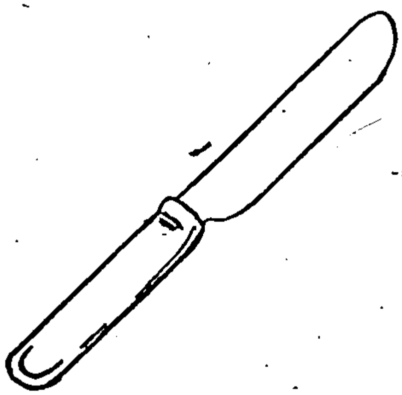
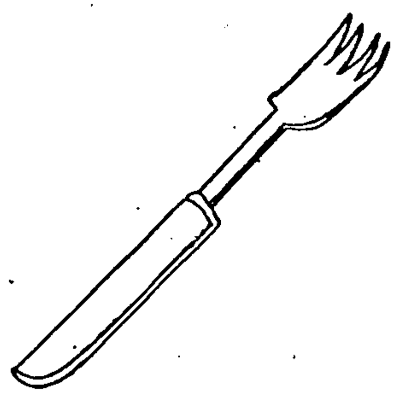
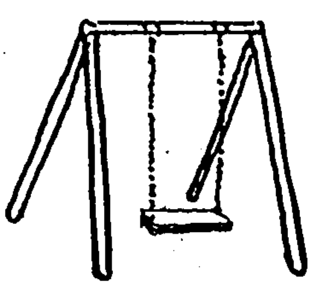
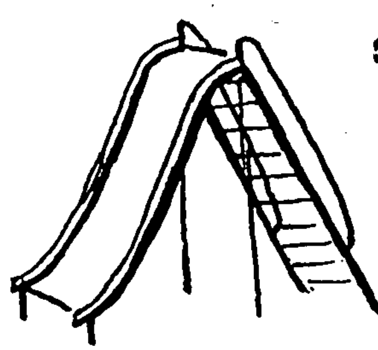
In summary, although we have a beginning understanding of how learners allocate their time in effortful learning situations, many questions remain unanswered. Not only will this area of research contribute to our understanding of how people learn most efficiently, it may also provide information regarding the much larger question of how people deal with the limited amount of time we all have available.

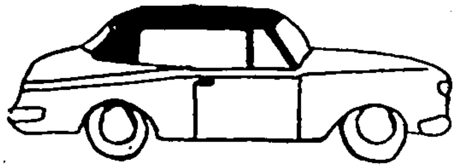
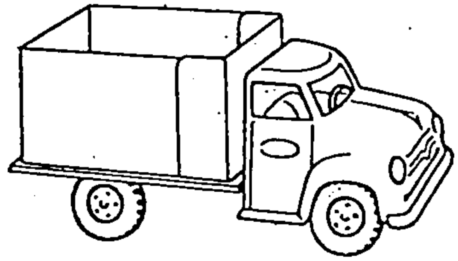
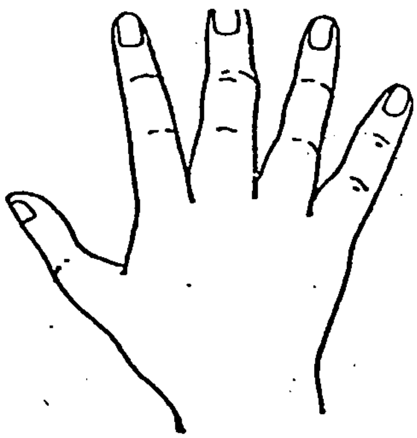
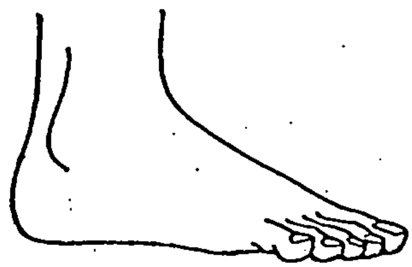
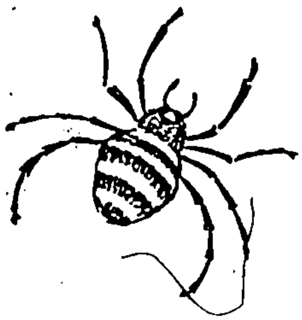
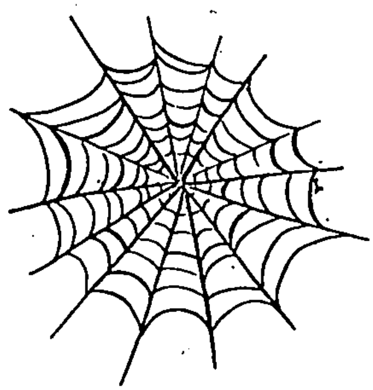
Appendix B

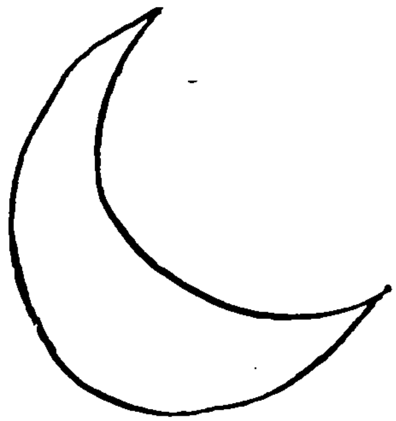
Examples of Paired-Associate Items

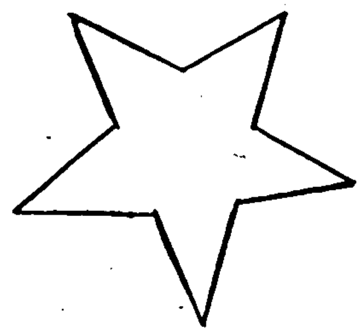
Easy Items

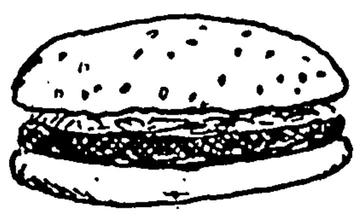







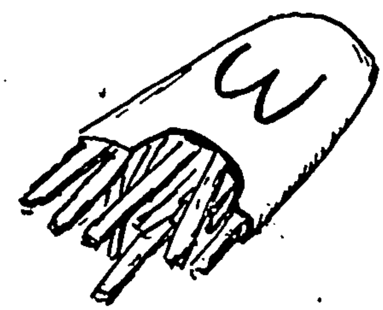







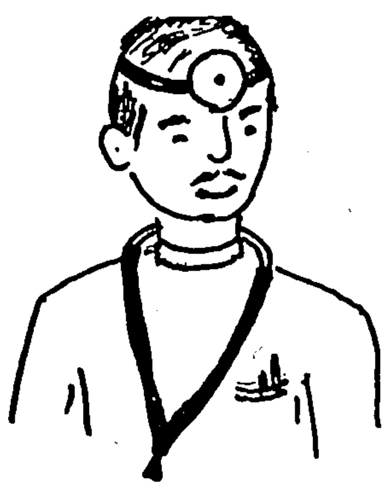







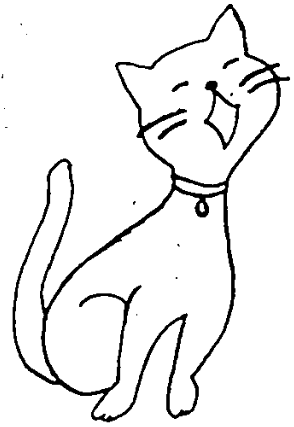


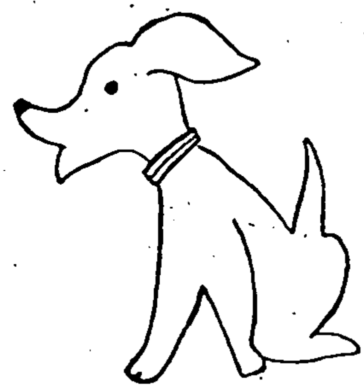


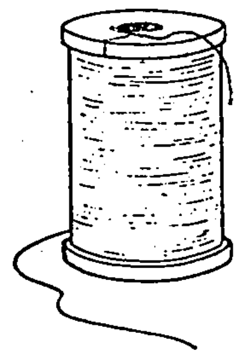


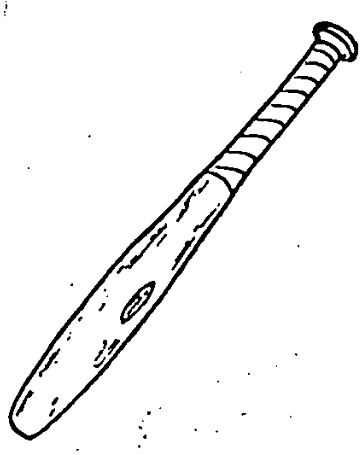


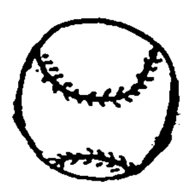


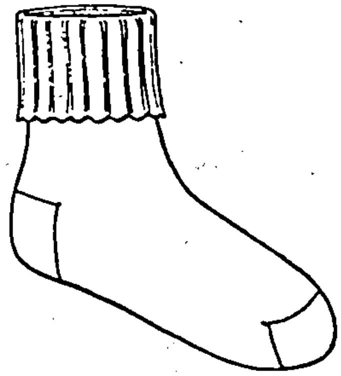
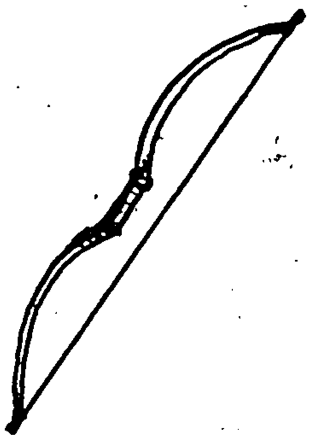
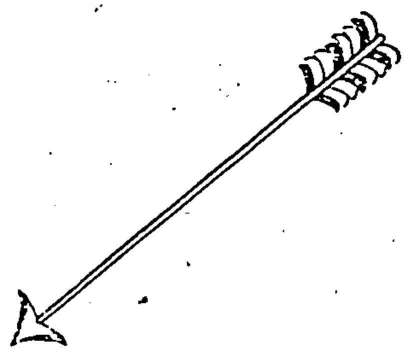
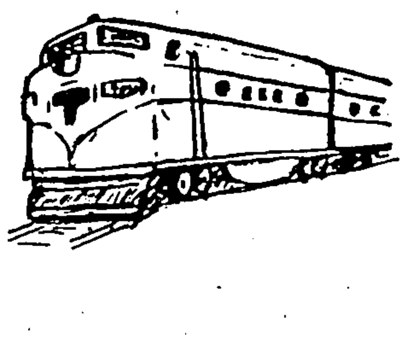
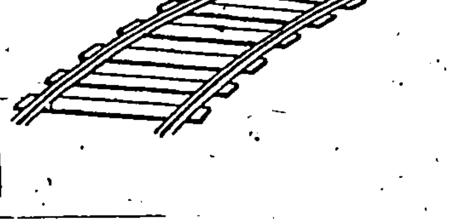










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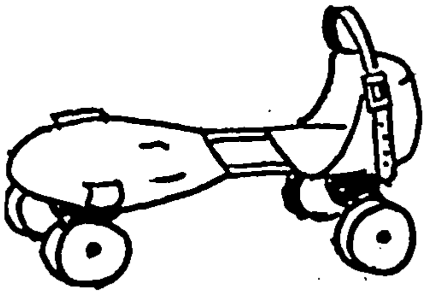

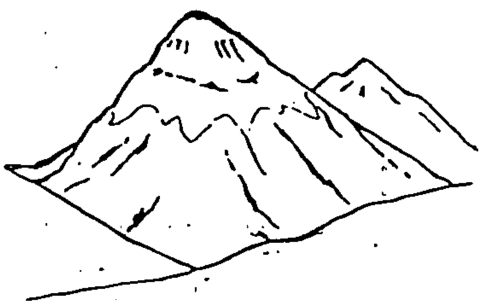

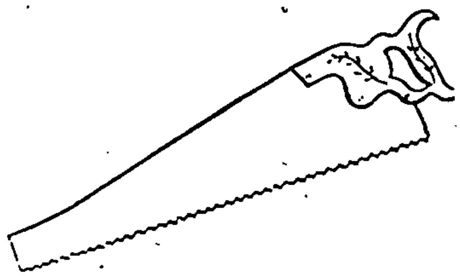

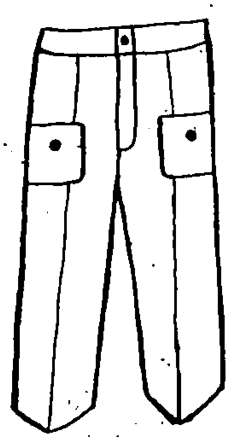

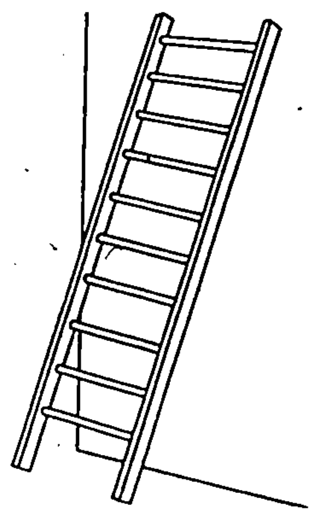

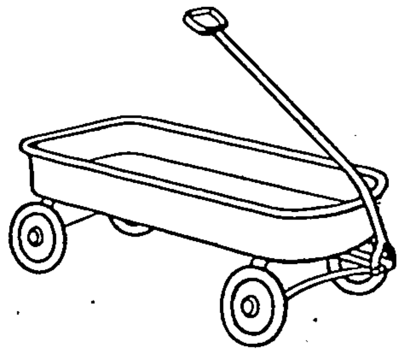

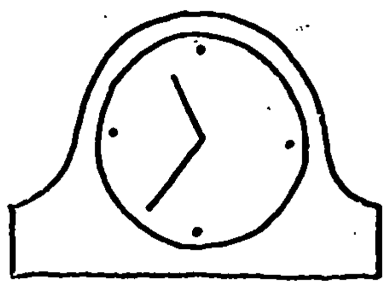

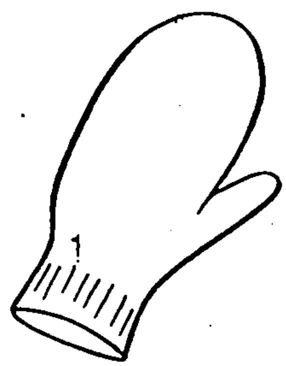

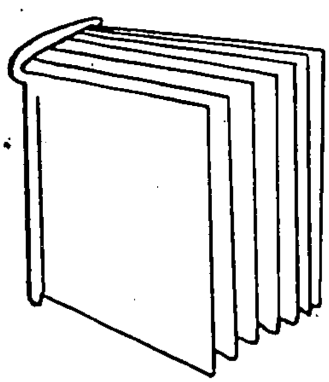

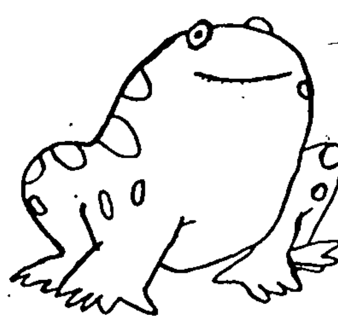


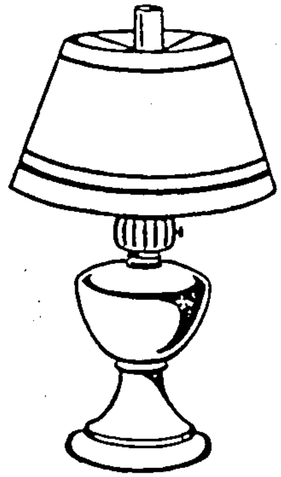
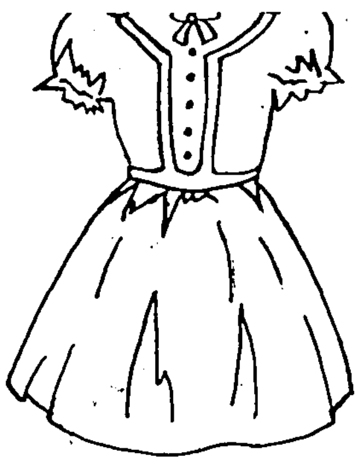
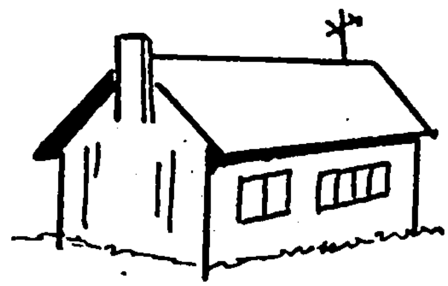
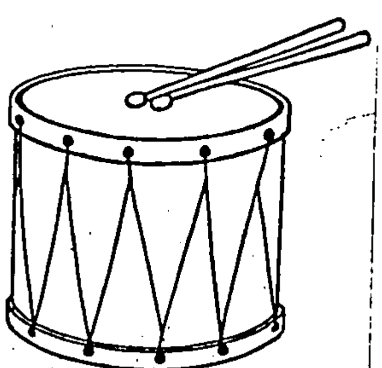
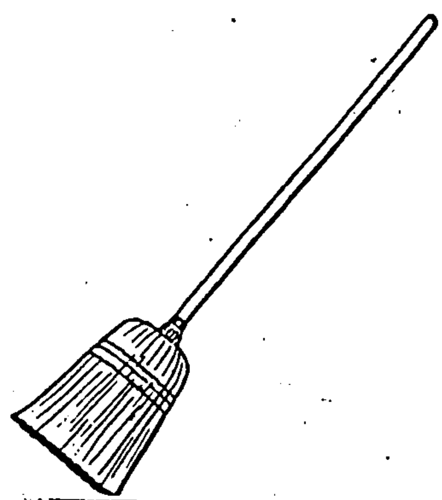

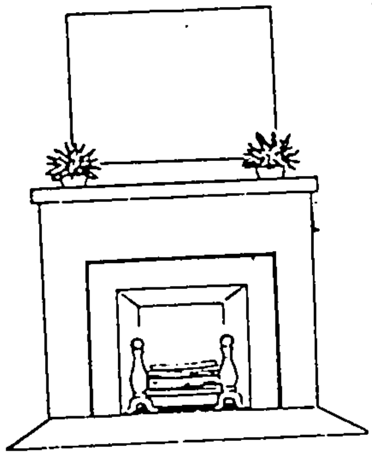

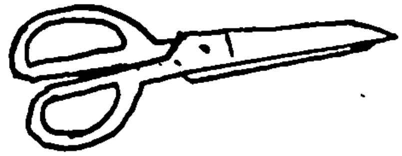

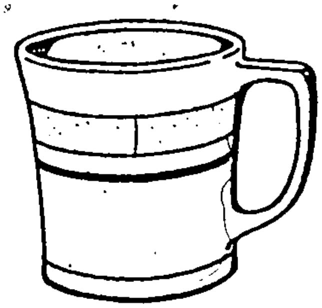

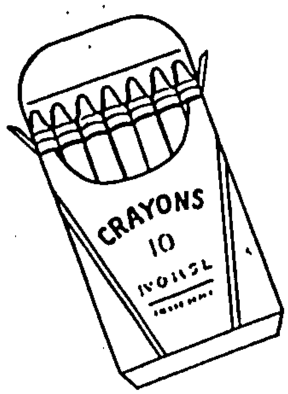
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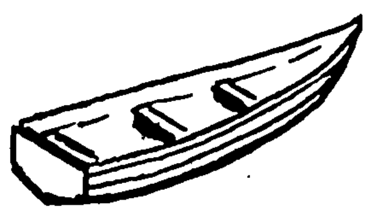

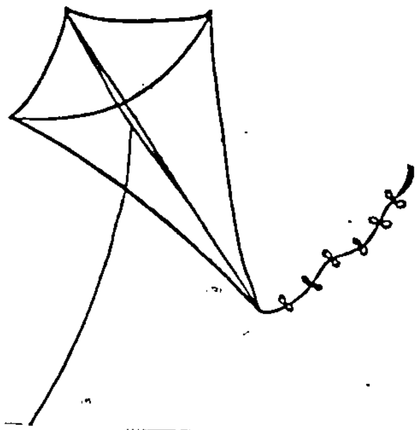

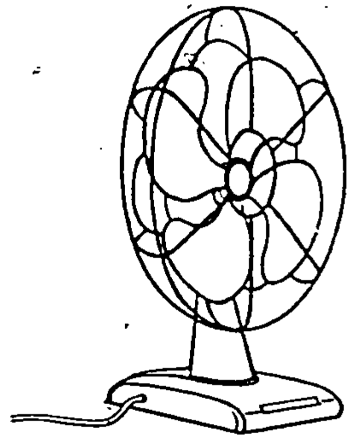

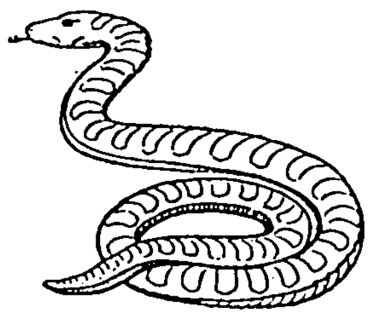

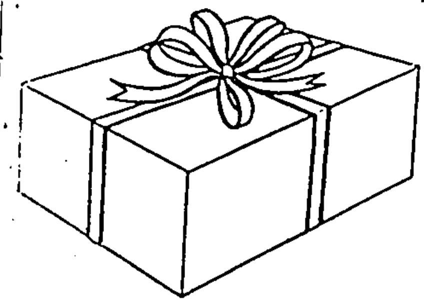

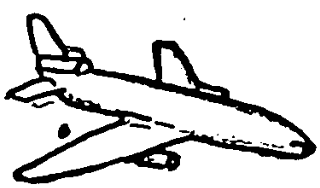

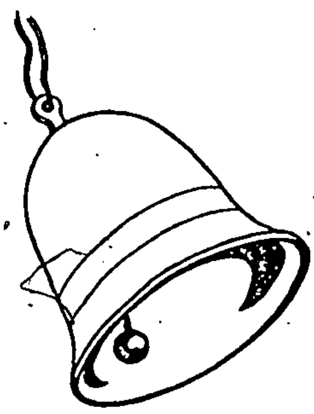

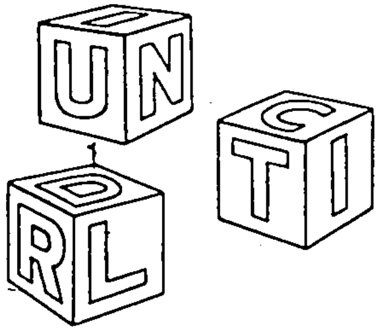
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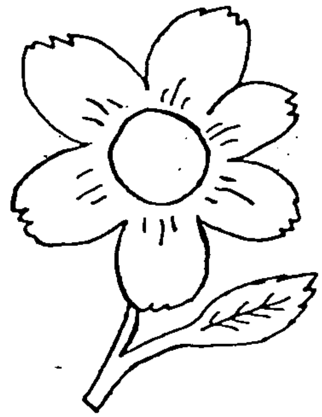
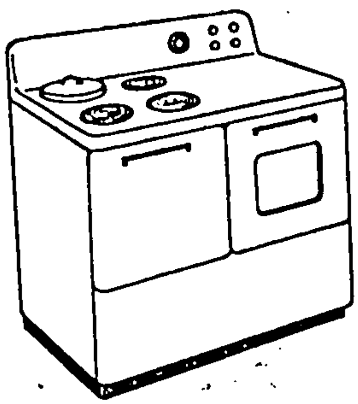
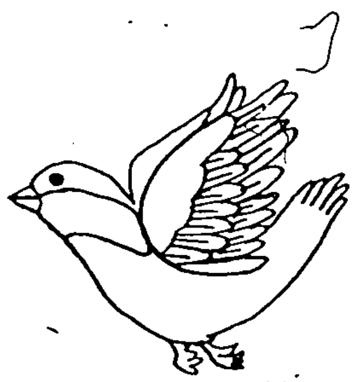
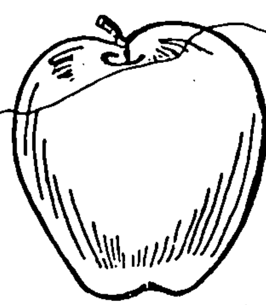
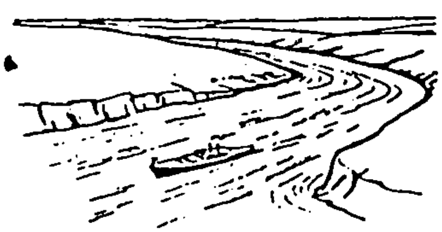










Appendix C

Analyses of Extraneous Variables

Although they did not provide the major focus of the present study, the effects of some additional variables, such as sex, presentation order for easy and hard booklets, were also examined. The significant findings with respect to these analyses will be reported in this section.

Sex Effects

The effects of sex on study time scores and recall scores were analyzed by means of separate 2 (Sex) x 4 (Grade) x 2 (Group - (Group - control vs. prompt) x 2 (Type of Task - easy vs. hard) x 3 (Trial) analyses of variance on each of the dependent measures. The analysis of study time scores revealed a significant interaction between sex and grade, F (3, 112) = 2.69, $p < .05$. The mean study time scores relevant to this interaction are presented below.

Mean Study Time Scores

	Grade 1	Grade 3	Grade 5	Grade 7
Females	5.07	6.95	7.62	8.36
Males	5.55	5.60	4.43	8.56

An examination of the means reveals that the differences in study time scores across grade levels were not statistically different for females, although there was a trend for study time to increase with age. The pattern was somewhat different for males. Fifth-grade males showed the lowest mean study time among all grade levels, although only the comparison between grade 5 and grade 7 boys was significant, $p < .05$. None of the comparisons between males and females within one grade were significant.

A significant interaction was also observed between sex and trial for the study time scores, $F(2, 224) = 3.23$, $p < .05$. This interaction can be explained by the fact that females showed a significant increase in mean total study time from trial 2 to trial 3, $p < .05$, whereas study times were not significantly different across trials for males. The mean study times across trials, which are presented below, illustrate these effects.

Mean Study Time Scores

	Trial 1	Trial 2	Trial 3
Females	6.09	6.46	8.50
Males	5.75	5.76	6.85

No significant main effects of sex, or interactions with this variable emerged in the analysis of the recall scores.

Order of Presentation Effects

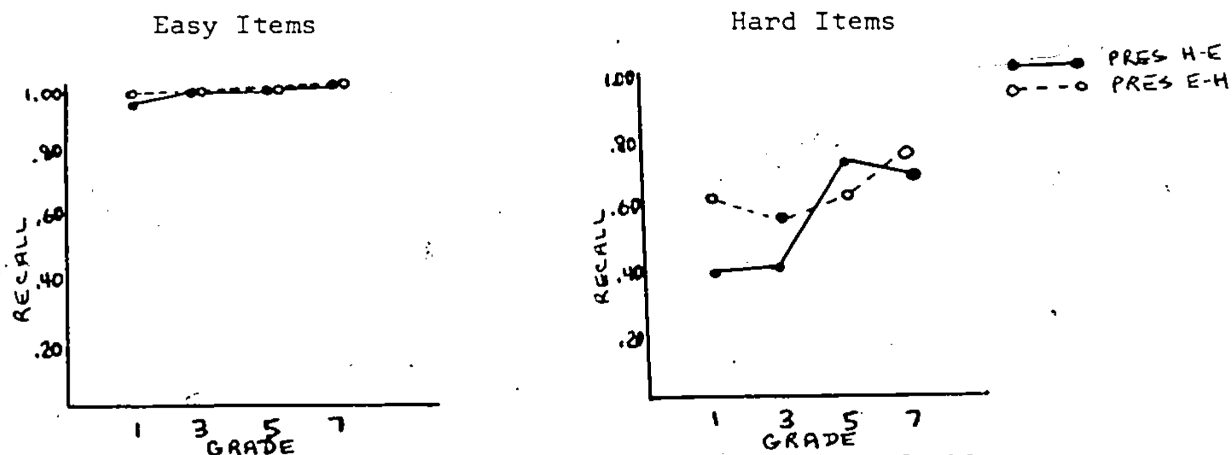
As indicated in the Method Section, each set of study booklets (one easy and one hard) were presented side by side on the table in front of the child. For one half of the children, the easy booklet was presented to the left side and the hard booklet to the right side, with the remaining children receiving the reverse order. Two (Order of Presentation) x 4 (Grade) x 2 (Group - control vs. prompt) x 2 (Type of Task - easy vs. hard) x 3 (Trial) analyses of variance were conducted on study time scores and recall scores to examine the effects of presentation order.

A significant interation between order of presentation and type of task was observed in the analysis of study time scores, F (3, 112) = 21.92, $p < .001$. Follow-up Tukey analyses revealed that, with all grades combined, children who were presented the booklets with the hard booklet to the left side (hard easy presentation) spent more time studying the hard booklets than children who received the reverse order of presentation, p .01. The study times for the easy booklets were not significantly different for children receiving different presentation orders. In addition, with all grades combined, only children who received the hard easy order of presentation spent significantly more study time on the hard booklet as compared to the easy booklet, $p < .01$. These effects can be illustrated with the following mean scores.

<u>Mean Study Time Scores</u>

	Easy Items	Hard Items
Presentation		
Easy-Hard	5.74	6.34
Hard-Easy	4.06	9.20

The analysis of the recall scores revealed a triple interaction between order of presentation, grade, and type of task, F (3, 112) = 5.29, $p < .01$. This interaction is represented graphically below.

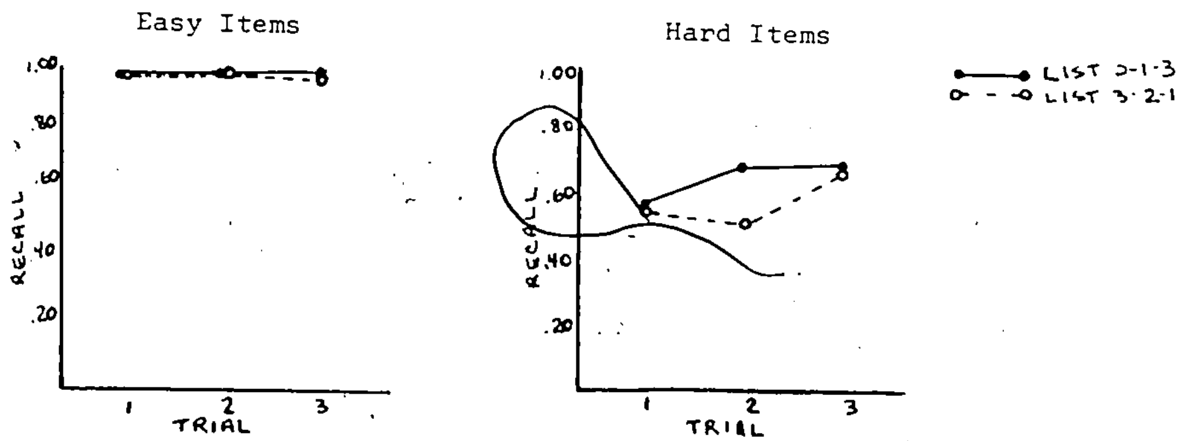


As can be seen from the above graphs, there was no double interaction for recall of the easy items. The interaction between order of presentation and grade was, however, significant for the hard items. This interaction, which is illustrated on the right (above), can be explained by the fact that grade 1 children showed higher recall scores for hard items when the booklets were presented with the easy booklet to the left than when the hard booklet was presented on the left side, $p < .01$.

<u>List Order Effects</u>

Although all children studied the same three sets of study booklets over three trials, one half of the children studied the booklets in one order (i.e., set 2, 1, 3) and the other half received a different order (i.e., set 3, 2, 1). The effect of list order was examined by separate 2 (List Order) x 4 (Grade) x 2 (Group - control vs. prompt) x 2 (Type of Task - easy vs. hard) x 3 (Trial) analyses of variance on time scores and recall scores.

The analysis of recall scores revealed a significant interaction between list order, type of task, and trial, *F* (2, 224) = 6.03, *p* < .01. This interaction is presented graphically below.



The above graph reveals that recall scores for the easy items were similarly high, regardless of list or trial. The double interaction between list and trial for the hard items, illustrated above (right), can be explained by the finding that recall of hard items was higher on trial 2 for children who received list order 2-1-3 than for children who received the other list order.

Appendix D

Relationship Between Study Time and Recall Scores

It was assumed in the present research, as supported in phase 1 of Study I, that "harder" items require additional study time and effort (basic assumption). In addition, there were several implicit assumptions, including: (a) As shown in Study I, there are individual differences in the amount of study time needed to master the hard lists; some children need two trials to learn, others need three trials, and so forth. (b) The amount of study time needed to learn the hard task presumably depends on the nature of the strategies children use; the use of a naming strategy may require more study time to learn the hard list than the use of an effective elaboration strategy. Despite the basic assumption of the present research, because of such additional assumptions, an explicit hypothesis was not advanced that study time scores would positively correlate with recall scores. For this reason, the data depicting the relationship between study time and recall scores are reported as ancillary data here rather than primary data in the major text.

Do children recall more hard items when they study them for a longer period of time than when they study them for a shorter period of time? Recall that there were three study-recall trials. The above question was examined by determining whether or not children's recall would be higher on a particular trial (be it trial 1, 2, or 3) on which they allocated the highest amount of time than on a trial (be it trial 1, 2, or 3) on which they allocated the least study time. To illustrate, child A allocated 40 sec., 50 sec., and 30 sec. study times on trials 1, 2, and 3, respectively. The question is: Were child A's recall scores highest on trial 2 (most allocated trial) than on trial 3 (least allocated trial)?

A 3 (Time Allocated - most, intermediate, and least) x 4 (Grade) analysis of variance was performed on the recall scores revealed a significant main effect for time allocated, $F(2, 248) = 6.67$, $p < .01$. and for grade, $F(3, 124) = 11.89$, $p < .001$, but no significant interaction. The significant effect for time allocated is of most interest to the question of whether children recall more items when they study longer. This analysis indicates that, in general, children show better recall on trials that they allocated a greater amount of study time to. More specifically, recall was significantly higher on "most allocated" trials ($\bar{X} = 66\%$) as compared to either "intermediate" ($\bar{X} = 59\%$) or "least allocated" ($\bar{X} = 57\%$) trials, $p < .05$.

Appendix E

Raw Scores

STUDY I
PERFORMANCE IN STANDARD STUDY-TEST PRESENTATION

------GRADE=1------

OBS	GRADE	SEX	TRIALS-TO-CRIT EASY ITEMS	TRIALS-TO-CRIT HARD ITEMS
1	1	1	2	4
2	1	2	1	2
3	1	1	1	5
4	1	2	2	5
5	1	2	2	5
6	1	1	1	5
7	1	1	1	2
8	1	1	1	2
9	1	2	1	3
10	1	1	2	4
11	1	2	1	3
12	1	1	1	5
13	1	2	2	5
14	1	1	2	3
15	1	2	1	2
16	1	2	1	2
17	1	1	1	4
18	1	2	1	1
19	1	1	1	3

STUDY I
PERFORMANCE IN STANDARD STUDY-TEST PRESENTATION

---------------------------------GRADE=3---------------------------------

OBS	GRADE	SEX	TRIALS-TO-CRIT EASY ITEMS	TRIALS-TO-CRIT HARD ITEMS
20	3	2	1	3
21	3	1	1	2
22	3	1	1	2
23	3	2	1	2
24	3	2	1	2
25	3	1	1	5
26	3	2	1	5
27	3	1	1	5
28	3	2	1	3
29	3	1	1	4
30	3	1	1	4
31	3	1	1	3
32	3	2	1	3
33	3	1	1	3
34	3	2	2	3
35	3	1	1	3
36	3	1	1	3
37	3	1	1	3

STUDY I
PERFORMANCE IN STANDARD STUDY-TEST PRESENTATION

---------------------------------GRADE=5---------------------------------

OBS	GRADE	SEX	TRIALS-TO-CRIT EASY ITEMS	TRIALS-TO-CRIT HARD ITEMS
38	5	2	2	4
39	5	2	2	3
40	5	1	1	3
41	5	2	1	3
42	5	2	2	5
43	5	1	1	4
44	5	2	1	3
45	5	2	2	2
46	5	1	1	3
47	5	1	1	3
48	5	1	1	3
49	5	1	2	2
50	5	1	1	2
51	5	2	1	3
52	5	2	1	2
53	5	2	2	5
54	5	1	1	2
55	5	1	2	3
56	5	2	1	5
57	5	2	1	4

STUDY I

PERFORMANCE IN SELF-TERMINATED TRIAL

GRADE=1

OBS	GRADE	SEX	STUDY TIME HARD	STUDY TIME HARD	% RECALL EASY	% RECALL HARD
1	1	1	6.2	4.2	100	80
2	1	2	12.6	15.4	100	40
3	1	1	4.4	10.4	60	0
4	1	2	7.6	7.8	100	60
5	1	2	13.6	9.8	100	40
6	1	1	3.8	6.6	100	0
7	1	1	11.4	9.4	100	40
8	1	1	17.6	13.6	100	40
9	1	2	9.4	9.2	100	40
10	1	1	7.8	17.6	100	40
11	1	2	9.6	7.2	100	0
12	1	1	3.4	3.0	100	40
13	1	2	7.0	9.2	80	20
14	1	1	15.4	6.0	80	40
15	1	2	4.6	6.6	100	60
16	1	2	6.8	8.8	100	20
17	1	1	15.2	37.4	100	20
18	1	2	4.8	6.4	80	80
19	1	1	3.4	3.0	100	20

PERFORMANCE IN SELF-TERMINATED TRIAL

GRADE=3

OBS	GRADE	SEX	STUDY TIME HARD	STUDY TIME HARD	% RECALL EASY	% RECALL HARD
20	3	2	9.1667	11.0000	100	17
21	3	1	2.8333	6.5000	100	83
22	3	1	9.0000	6.6667	100	100
23	3	2	5.3333	6.8333	100	83
24	3	2	6.5000	6.0000	83	50
25	3	1	8.8333	7.1667	83	33
26	3	2	3.6667	3.3333	83	17
27	3	1	2.8333	3.3333	100	33
28	3	2	6.8333	7.3333	100	50
29	3	1	9.1667	11.5000	100	33
30	3	1	13.6667	12.8333	100	50
31	3	1	1.8333	6.6667	100	67
32	3	2	3.3333	3.3333	100	0
33	3	1	5.3333	4.1667	83	33
34	3	2	2.5000	2.5000	83	17
35	3	1	3.6667	2.0000	100	17
36	3	1	5.5000	6.0000	100	83
37	3	1	4.6667	9.0000	100	17

STUDY I
PERFORMANCE IN SELF-TERMINATED TRIAL

GRADE=5

OBS	GRADE	SEX	STUDY TIME HARD	STUDY TIME HARD	% RECALL EASY	% RECALL HARD
38	5	2	2.8571	5.0000	100	0
39	5	2	6.4286	11.5714	86	57
40	5	1	10.0000	15.0000	100	0
41	5	2	3.8571	11.4286	100	57
42	5	2	8.1429	12.2857	86	14
43	5	1	4.7143	7.8571	100	57
44	5	2	10.4286	23.5714	100	86
45	5	2	13.2857	42.5714	100	86
46	5	1	7.8571	10.7143	100	29
47	5	1	5.7143	6.5714	100	71
48	5	1	5.2857	17.7143	100	43
49	5	1	4.2857	3.4286	86	0
50	5	1	5.7143	6.7143	100	29
51	5	2	6.4286	18.1429	100	86
52	5	2	3.5714	11.1429	100	100
53	5	2	10.4286	12.2857	100	0
54	5	1	3.2857	6.8571	71	57
55	5	2	12.5714	17.7143	100	29
56	5	2	8.7143	8.5714	100	14
57	5	2	9.1429	6.4286	100	57

STUDY II
"IDENTIFICATION VARIABLES"

GRADE=1

OBS	SCHOOL	GRADE	SEX
1	1	1	1
2	1	1	2
3	1	1	2
4	1	1	1
5	1	1	2
6	1	1	2
7	1	1	1
8	1	1	2
9	1	1	1
10	1	1	1
11	1	1	1
12	1	1	2
13	1	1	1
14	1	1	1
15	1	1	1
16	1	1	2
17	1	1	2
18	1	1	1
19	1	1	2
20	1	1	1
21	1	1	2
22	2	1	1
23	2	1	2
24	2	1	2
25	2	1	2
26	2	1	1
27	2	1	2
28	2	1	2
29	2	1	1
30	2	1	2
31	2	1	1
32	2	1	1

OBS	GROUP	LIST	PRES
1	2	2	2
2	2	1	2
3	2	2	2
4	1	1	1
5	1	1	1
6	1	1	2
7	1	1	2
8	1	2	2
9	2	2	1
10	2	1	2
11	1	2	1
12	1	2	2
13	1	2	2
14	2	1	1
15	1	1	2
16	1	1	1
17	2	1	1
18	2	2	2
19	2	2	1
20	1	1	1
21	2	2	2
22	2	1	2
23	1	1	1
24	1	2	1
25	2	1	1
26	2	2	1
27	2	2	1
28	2	2	2
29	1	2	2
30	2	1	1
31	1	2	1
32	1	1	2

STUDY II
"IDENTIFICATION VARIABLES"

---GRADE=3---

OBS	SCHOOL	GRADE	SEX
33	1	3	1
34	1	3	2
35	1	3	1
36	1	3	1
37	1	3	1
38	1	3	2
39	1	3	1
40	1	3	2
41	1	3	1
42	1	3	1
43	1	3	2
44	1	3	2
45	1	3	2
46	1	3	1
47	1	3	2
48	1	3	1
49	1	3	2
50	2	3	2
51	2	3	2
52	2	3	1
53	2	3	1
54	2	3	2
55	2	3	1
56	2	3	1
57	2	3	1
58	2	3	2
59	2	3	1
60	2	3	1
61	2	3	2
62	3	3	2
63	3	3	2
64	3	3	2

OBS	GROUP	LIST	PRES
33	2	2	2
34	1	1	2
35	1	2	1
36	1	1	1
37	2	2	1
38	2	2	2
39	1	2	2
40	2	1	1
41	1	1	1
42	2	2	1
43	2	1	2
44	1	1	2
45	1	2	2
46	2	1	1
47	1	2	1
48	2	1	1
49	2	1	1
50	1	2	2
51	1	1	1
52	1	1	2
53	1	2	2
54	2	2	1
55	2	1	2
56	1	1	2
57	2	2	2
58	1	2	1
59	2	1	2
60	1	1	1
61	1	2	1
62	2	2	2
63	2	2	1
64	2	1	2

STUDY II
"IDENTIFICATION VARIABLES"

GRADE=5

OBS	SCHOOL	GRADE	SEX
65	1	5	1
66	1	5	1
67	1	5	1
68	1	5	1
69	1	5	2
70	1	5	1
71	1	5	1
72	1	5	1
73	1	5	2
74	1	5	1
75	1	5	2
76	1	5	1
77	1	5	2
78	1	5	2
79	1	5	1
80	1	5	2
81	2	5	2
82	2	5	1
83	2	5	1
84	2	5	1
85	2	5	1
86	2	5	1
87	2	5	1
88	2	5	1
89	2	5	1
90	2	5	1
91	3	5	2
92	3	5	2
93	3	5	2
94	3	5	2
95	3	5	2
96	3	5	2

OBS	GROUP	LIST	PRES
65	1	1	1
66	2	2	1
67	1	2	2
68	2	1	2
69	2	2	2
70	1	1	2
71	2	2	1
72	1	1	1
73	2	2	1
74	1	1	2
75	1	1	2
76	1	2	2
77	1	2	1
78	2	1	1
79	2	2	2
80	2	1	1
81	1	2	1
82	2	1	2
83	2	2	1
84	2	2	2
85	1	1	1
86	2	2	2
87	1	1	1
88	1	2	1
89	2	1	1
90	1	2	2
91	1	2	2
92	2	1	2
93	2	1	2
94	1	1	1
95	2	2	1
96	1	2	2

STUDY II
"IDENTIFICATION VARIABLES"

GRADE=7

OBS	SCHOOL	GRADE	SEX
97	1	7	2
98	1	7	1
99	1	7	2
100	1	7	1
101	1	7	1
102	1	7	2
103	1	7	2
104	1	7	1
105	1	7	2
106	1	7	1
107	1	7	1
108	1	7	2
109	1	7	2
110	1	7	1
111	1	7	2
112	1	7	1
113	2	7	2
114	2	7	1
115	2	7	2
116	2	7	2
117	2	7	2
118	2	7	2
119	2	7	1
120	2	7	2
121	2	7	1
122	2	7	1
123	2	7	1
124	2	7	2
125	2	7	1
126	2	7	1
127	2	7	1
128	2	7	2

OBS	GROUP	LIST	PRES
97	2	2	1
98	2	1	2
99	2	2	2
100	1	1	2
101	1	2	2
102	2	1	1
103	1	1	1
104	2	1	1
105	1	1	2
106	2	2	1
107	1	2	1
108	2	2	2
109	1	2	2
110	2	1	2
111	1	1	1
112	1	2	1
113	2	1	2
114	1	1	1
115	1	1	2
116	1	2	2
117	2	2	1
118	1	2	1
119	2	2	2
120	2	2	1
121	2	2	1
122	1	1	1
123	2	2	2
124	2	1	2
125	1	2	2
126	1	1	2
127	2	1	1
128	1	1	1

STUDY II
PERFORMANCE ON TRIAL 1

GRADE=1

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
1	44	34	3	2	5	1
2	15	27	5	5	5	0
3	28	21	5	3	5	2
4	25	17	5	5	5	1
5	30	23	2	2	4	1
6	31	30	5	2	5	5
7	20	19	4	5	5	1
8	43	42	4	3	5	1
9	25	20	4	4	4	1
10	25	49	3	2	4	2
11	15	13	5	4	5	4
12	27	30	5	4	5	2
13	9	9	5	5	5	2
14	49	41	3	4	4	3
15	13	15	4	3	4	1
16	25	17	2	1	5	4
17	19	18	5	5	5	5
18	16	22	3	2	5	1
19	68	73	5	2	5	3
20	35	18	1	1	5	1
21	19	15	4	3	5	3
22	24	31	4	4	4	1
23	25	23	5	5	5	5
24	31	25	5	5	5	3
25	33	40	5	5	5	3
26	32	18	5	5	5	1
27	53	26	4	3	5	4
28	15	16	5	4	5	1
29	19	21	5	5	4	1
30	19	15	5	5	5	4
31	19	15	5	5	5	4
32	16	16	5	5	5	5

PERFORMANCE ON TRIAL 1

GRADE=3

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
33	16	24	6	6	6	3
34	35	46	6	6	6	2
35	39	24	6	5	6	4
36	41	52	4	4	6	3
37	19	23	4	3	6	4
38	17	29	6	6	6	2
39	36	52	6	6	5	3
40	28	17	4	3	6	3
41	35	27	6	6	6	1
42	32	30	5	5	6	2
43	19	20	6	6	6	1
44	25	51	6	3	6	2
45	16	26	6	5	6	3
46	41	41	4	3	5	2
47	66	47	5	4	6	1
48	26	38	6	4	6	5
49	45	52	6	6	6	5
50	19	18	6	6	6	5
51	16	15	6	6	6	4
52	13	36	6	4	6	2
53	17	42	6	6	6	1
54	31	49	3	4	6	6
55	21	55	6	6	6	4
56	23	37	4	5	6	4
57	16	28	5	4	5	0
58	28	24	3	3	6	4
59	16	22	6	4	6	1
60	40	36	4	3	6	4
61	17	21	4	5	6	2
62	17	22	6	6	6	2
63	16	16	6	6	5	4
64	25	36	6	4	6	4

STUDY II

PERFORMANCE ON TRIAL 1

GRADE=5

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
65	46	51	7	5	7	3
66	44	71	7	7	7	4
67	24	32	7	5	7	4
68	50	117	7	7	7	6
69	20	23	6	4	7	3
70	23	44	7	5	7	3
71	63	61	7	6	7	4
72	32	62	5	3	7	6
73	58	50	7	7	7	3
74	48	46	5	4	7	4
75	30	31	7	7	7	3
76	29	90	7	5	7	6
77	19	27	7	6	7	2
78	29	26	6	4	7	6
79	0	59	7	4	7	4
80	19	57	7	6	7	4
81	27	24	7	6	7	6
82	23	58	6	6	7	1
83	69	64	7	5	7	5
84	31	80	7	4	7	5
85	60	26	7	7	7	4
86	27	50	7	3	7	6
87	40	76	7	7	7	4
88	26	59	7	4	7	4
89	31	44	2	1	7	2
90	19	112	7	7	7	5
91	72	84	6	6	7	7
92	17	39	4	4	7	7
93	0	46	7	7	7	7
94	24	21	7	7	7	4
95	0	39	7	3	7	3
96	17	52	7	5	7	6

PERFORMANCE ON TRIAL 1

GRADE=7

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
97	54	90	8	6	8	7
98	29	57	8	6	8	3
99	17	91	8	7	8	7
100	20	36	8	7	8	3
101	17	193	8	7	8	7
102	79	140	8	5	8	6
103	66	56	7	6	8	5
104	23	34	8	5	8	8
105	16	62	8	6	8	4
106	24	48	8	5	8	6
107	23	23	8	5	8	3
108	29	83	8	8	8	7
109	66	113	8	8	8	6
110	22	174	8	5	8	8
111	27	51	8	8	8	6
112	41	39	6	5	8	5
113	42	104	7	5	8	8
114	57	73	6	4	8	6
115	29	69	6	5	8	7
116	40	93	8	5	8	1
117	59	154	8	8	8	8
118	31	73	8	6	8	1
119	22	169	8	5	8	6
120	44	39	5	5	8	4
121	15	20	8	7	8	4
122	62	68	8	8	8	7
123	27	197	6	3	8	6
124	0	52	7	4	8	2
125	29	150	5	3	8	5
126	22	39	7	5	8	1
127	43	63	7	5	8	8
128	12	67	8	6	8	8

STUDY II
PERFORMANCE ON TRIAL 2

GRADE=1

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
1	54	59	5	4	5	1
2	27	24	4	5	5	2
3	31	38	4	2	3	0
4	21	18	5	5	5	4
5	38	34	3	3	4	2
6	29	31	2	2	5	3
7	16	24	5	4	5	4
8	33	33	5	3	5	2
9	25	20	4	4	5	1
10	20	47	2	4	5	3
11	14	13	5	5	5	3
12	24	25	5	4	5	2
13	22	32	5	5	5	1
14	26	21	5	5	5	4
15	15	14	5	5	3	3
16	23	12	2	2	4	3
17	18	23	5	5	5	4
18	16	20	2	5	5	0
19	23	18	5	5	5	2
20	38	19	1	2	5	2
21	14	23	4	4	5	2
22	11	10	4	5	5	2
23	21	19	5	5	5	4
24	27	18	5	5	5	4
25	44	47	5	5	5	5
26	44	32	5	5	5	3
27	57	29	5	5	5	4
28	12	17	5	5	5	3
29	22	24	5	5	5	1
30	15	12	5	5	5	4
31	19	22	5	5	5	3
32	15	12	5	5	5	3

PERFORMANCE ON TRIAL 2

GRADE=3

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
33	16	20	6	5	6	0
34	30	48	6	6	6	2
35	57	53	6	6	6	4
36	65	59	5	4	6	1
37	17	21	5	4	6	1
38	22	43	5	4	6	3
39	52	45	6	6	6	4
40	23	24	5	6	6	3
41	42	26	6	6	6	4
42	21	27	5	6	6	2
43	18	36	6	4	6	4
44	26	36	6	4	6	3
45	36	45	4	6	6	1
46	35	35	5	4	6	0
47	92	42	6	5	4	1
48	12	27	6	3	6	5
49	23	24	6	6	6	3
50	15	18	6	6	6	3
51	18	19	6	4	6	6
52	14	40	6	5	6	4
53	13	46	6	5	6	2
54	38	34	4	3	6	4
55	25	28	6	5	6	4
56	20	42	5	6	6	1
57	22	20	4	3	6	2
58	18	15	4	2	6	4
59	17	28	5	5	6	5
60	31	30	5	4	6	4
61	29	20	6	4	6	3
62	20	15	6	5	6	2
63	16	13	5	5	5	0
64	21	53	6	6	6	5

STUDY II
PERFORMANCE ON TRIAL 2

GRADE=5

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
65	45	50	7	4	7	6
66	47	121	7	6	7	5
67	20	34	7	5	7	3
68	44	114	7	6	7	6
69	22	27	7	5	7	3
70	21	50	7	7	6	2
71	68	48	7	6	7	5
72	31	75	6	5	7	7
73	21	55	7	7	7	4
74	41	65	6	5	7	5
75	32	41	6	6	7	3
76	[illegible]	56	7	5	7	5
77	12	26	7	7	7	3
78	25	22	7	6	7	5
79	11	57	7	5	6	6
80	20	52	7	5	7	5
81	17	21	7	6	7	3
82	18	43	7	6	7	4
83	46	52	6	5	7	6
84	25	69	7	5	7	7
85	24	61	7	6	7	5
86	29	42	7	4	7	7
87	21	83	7	6	7	4
88	24	44	7	4	7	4
89	20	39	3	1	7	0
90	14	258	7	6	7	4
91	42	41	6	6	7	5
92	25	41	6	6	7	7
93	22	37	7	7	7	7
94	19	25	7	6	7	4
95	0	37	7	5	6	3
96	14	28	7	6	7	6

PERFORMANCE ON TRIAL 2

GRADE=7

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
97	59	85	7	7	8	8
98	33	75	8	5	8	8
99	17	107	7	6	8	7
100	20	54	8	6	8	7
101	17	344	8	7	8	7
102	37	212	8	8	8	5
103	53	101	8	7	8	2
104	27	47	8	6	7	8
105	17	60	8	6	8	4
106	21	69	8	6	8	3
107	31	45	8	6	8	6
108	52	119	8	7	8	3
109	33	97	8	7	8	5
110	35	142	8	8	8	7
111	31	46	8	7	8	7
112	37	39	7	5	7	6
113	54	117	8	7	8	5
114	62	77	6	4	8	8
115	28	72	7	5	7	6
116	26	124	8	3	8	1
117	65	208	8	8	8	8
118	30	160	8	5	8	4
119	26	239	8	5	8	5
120	42	42	6	6	8	5
121	0	29	8	6	[illegible]	2
122	85	93	8	8	8	8
123	35	150	6	4	8	8
124	0	32	8	4	7	2
125	17	112	4	2	8	2
126	24	65	5	5	7	8
127	27	58	8	6	8	8
128	23	63	7	6	8	8

STUDY II
PERFORMANCE ON TRIAL 3

GRADE=1

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
1	26	23	5	5	5	1
2	19	37	5	5	4	1
3	18	22	1	3	3	0
4	27	19	5	5	5	4
5	24	21	5	5	5	4
6	43	47	4	0	5	4
7	29	45	3	4	4	1
8	50	46	3	4	5	2
9	32	26	5	5	5	2
10	25	26	3	4	5	3
11	23	18	5	5	5	3
12	48	55	5	5	5	4
13	21	46	5	3	5	5
14	24	26	5	5	4	2
15	23	38	5	5	5	1
16	18	17	2	3	5	3
17	47	18	5	5	5	3
18	24	26	1	1	5	2
19	21	20	5	5	5	4
20	25	19	5	5	5	4
21	19	25	3	5	5	1
22	17	21	5	5	5	3
23	19	25	5	5	5	3
24	23	26	5	5	5	2
25	27	21	5	5	5	3
26	55	43	5	5	3	4
27	54	28	5	5	5	4
28	14	16	5	5	5	3
29	32	33	5	4	5	2
30	15	21	5	4	5	2
31	33	22	5	5	5	5
32	36	39	5	5	5	3

PERFORMANCE ON TRIAL 3

GRADE=3

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
33	24	35	6	5	6	4
34	62	81	6	5	6	2
35	155	158	6	6	6	5
36	183	228	6	5	6	6
37	47	48	6	4	6	5
38	30	52	4	4	6	3
39	42	99	6	6	6	3
40	20	16	4	4	6	3
41	64	65	6	6	6	4
42	50	48	6	3	6	3
43	18	30	6	3	6	3
44	18	121	6	4	6	1
45	35	51	6	5	6	4
46	43	39	5	3	6	4
47	114	86	4	5	6	2
48	21	28	5	5	6	5
49	37	64	6	6	6	5
50	18	17	6	6	6	4
51	24	21	6	6	6	1
52	14	60	6	5	6	3
53	33	75	5	5	6	2
54	67	77	4	4	6	5
55	34	56	6	6	6	2
56	64	77	4	5	6	2
57	27	20	1	1	4	2
58	18	16	6	4	6	4
59	16	20	6	6	6	3
60	34	55	5	4	6	4
61	33	33	6	4	6	5
62	16	21	6	4	5	1
63	30	28	[illegible]	4	6	3
64	40	96	[illegible]	6	6	4

STUDY II
PERFORMANCE ON TRIAL 3

GRADE=5

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
65	53	61	6	5	7	7
66	38	128	7	6	7	5
67	18	50	7	6	7	7
68	41	95	7	7	7	7
69	20	59	7	3	7	6
70	22	54	7	5	7	2
71	52	72	7	6	7	4
72	23	72	7	6	7	6
73	21	44	7	6	7	6
74	52	121	5	5	7	6
75	33	43	6	6	7	3
76	65	121	7	6	7	7
77	31	31	7	7	7	4
78	26	25	7	6	7	6
79	32	82	7	7	6	7
80	46	42	7	7	7	7
81	21	29	7	5	6	6
82	20	87	7	6	7	4
83	55	73	7	6	7	4
84	33	124	7	5	7	7
85	31	35	7	5	7	3
86	27	53	7	5	7	7
87	46	73	7	6	7	3
88	31	98	7	5	7	2
89	23	46	5	2	6	2
90	11	144	7	7	7	7
91	20	48	7	6	7	6
92	18	39	5	5	7	7
93	23	38	7	7	7	6
94	26	23	7	6	7	5
95	0	87	7	6	6	6
96	16	34	7	6	7	5

PERFORMANCE ON TRIAL 3

GRADE=7

OBS	STUDY TIME EASY	STUDY TIME HARD	PREDICTION EASY	PREDICTION HARD	RECALL EASY	RECALL HARD
97	38	65	8	8	8	8
98	28	69	8	6	8	8
99	27	115	8	8	8	7
100	24	45	8	8	8	8
101	34	339	8	8	8	8
102	36	218	8	8	8	6
103	52	216	8	6	8	5
104	35	38	8	7	8	8
105	19	105	8	7	8	8
106	33	105	8	6	8	5
107	40	82	8	7	8	8
108	45	125	8	7	8	4
109	64	124	8	8	8	8
110	42	142	8	7	8	5
111	39	60	8	6	7	6
112	33	33	7	6	8	4
113	30	189	8	6	8	7
114	75	84	7	6	8	8
115	30	86	7	4	8	5
116	21	89	8	3	8	2
117	96	179	8	8	8	8
118	24	80	8	5	8	5
119	24	183	8	6	8	8
120	47	48	8	6	8	7
121	57	97	8	6	8	5
122	95	81	8	8	8	8
123	26	237	6	5	8	8
124	5	35	8	2	7	6
125	13	113	4	2	8	3
126	22	61	6	6	8	8
127	80	60	8	6	8	8
128	31	82	8	8	8	8

BIBLIOGRAPHY

Bisanz, G. L., Vesonder, G. T., & Voss, J. F. (1978). Knowledge of one's own responding and the relation of such knowledge to learning. Journal of Experimental Child Psychology, 25, 116-128.

Brown, A. L. (1978). Knowing when, where, and how to remember: A problem of metacognition. In R. Glaser, (Ed.), Advances in instructional psychology (Vol. 1). Hillsdale, NJ: Erlbaum.

Brown, A. L., Bransford, J. D., Ferrara, R. A., & Campione, J. C. (1983). Learning, remembering and understanding. In J. H. Flavell & E. M. Markman (Eds.), Handbook of child psychology: Cognitive development (Vol. 3). New York: Wiley.

Brown, A. L., & Campione, J. C. (1977). Training strategic study time apportionment in educable retarded children. Intelligence, 1, 94-107.

Brown, A. L., & Smiley, S. S. (1978). The development of strategies for studying texts. Child Development, 49, 1076-1088.

Covington, M. V. (1983). Motivated cognitions. In S. Paris, G. Olson, & H. Stevenson (Eds.), Learning and motivation in the classroom. Hillsdale, NJ: Erlbaum.

Cuvo, A. J. (1974). Incentive level influence in overt rehearsal and free recall as a function of age. Journal of Experimental Child Psychology, 18, 167-181.

Cuvo, A. J., & Witryol, S. L. (1971). The influence of incentives on memory stages in children. Journal of Genetic Psychology, 119, 289-300.

Flavell, J. H. (1985). Cognitive development. Englewood Cliffs, NJ: Prentice-Hall.

Flavell, J. H. (1977). Cognitive development. Englewood Cliffs, NJ: Prentice-Hall.

Flavell, J. H., Friedrichs, A. G., & Hoyt, J. D. (1970). Developmental changes in memorization processes. Cognitive Science, 1, 324-340.

Flavell, J. H., & Wellman, H. M. (1977). Metamemory. In R. V. Kail & J. W. Hagen (Eds.) Perspectives on the development of memory and cognition. Hillsdale, NJ: Erlbaum.

Gettinger, M. (1985). Time allocated and time spent relative to time needed for learning as determinants of achievement. Journal of Educational Psychology, 77, 3-11.

Hagan, J. W., & Stanovich, K. G. (1977). Memory: Strategies and acquisition. In R. V. Kail & J. W. Hagen (Eds.) Perspectives on the development of memory and cognition. Hillsdale, NJ: Erlbaum.

Hertzog, C., & Rovine, M. (1985). Repeated-measures analysis of variance in developmental research: Selected issues. Child Development, 56, 787-809.

Kelly, M., Scholnick, E. K., Travers, S. H., & Johnson, J. W. (1976). Relations among memory, memory appraisal, and memory strategies. Child Development, 47, 648-659.

Kobasigawa, A. (1983). Monitoring retrieval processes by children. The Journal of Genetic Psychology, 142, 259-269.

Kreutzer, M. A., Leonard, C., & Flavell, J. H. (1975). An interview study of children's knowledge about memory. Monographs of the Society for Research in Child Development, 40 (1, Serial No. 159).

Kuhn, D. (1984). Cognitive development. In Bornstein, M. H., & Lamb, M. E. (Eds.), Developmental psychology. Hillsdale, NJ: Erlbaum.

Larzelere, R. E., & Mulaik, S. A. (1977). Single-sample tests for many correlations. Psychological Bulletin, 84, 557-569.

Leal, L., Crays, N., & Moely, B. E. (1985). Training children to use a self-monitoring study strategy in preparation for recall: Maintenance and generalization effects. Child Development, 56, 643-653.

Mainland, D., & Murray, I. M. (1952). Tables for use in fourfold contingency tests. Science, 116, 591-594.

Masur, E. F., McIntyre, C. W., & Flavell, J. H. (1973). Developmental changes in apportionment of study time among items in a multitrial free recall task. *Journal of Experimental Child Psychology, 15,* 237-246.

Moely, B. E., Olson, F. A., Halwes, T. G., & Flavell, J. H. (1969). Production deficiency in young children's clustered recall. *Developmental Psychology, 1,* 26-34.

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know. Verbal reports on mental processes. *Psychological Review, 84,* 231-259.

Ornstein, P. A., & Naus, M. J. (1978). Rehearsal processes in children's memory. In P. A. Ornstein (Ed.), *Memory development in children.* Hillsdale, NJ: Erlbaum.

Owings, R. A., Petersen, G. A., Bransford, J. D., Morris, C. D., & Stein, B. S. (1980). Spontaneous monitoring and regulation of learning: A comparison of successful and less successful fifth graders. *Journal of Educational Psychology, 72,* 250-256.

Paris, S. G., & Jacobs, J. E. (1984). The benefits of informed instruction for children's reading awareness and comprehension skills. *Child Development, 55,* 2083-2093.

Posnansky, C. J. (1978). Age- and Task-related differences in the use of category-size information for the retrieval of categorized items. *Journal of Experimental Child Psychology, 26,* 373-382.

Pressley, M., Borkowski, J. G., & Schneider, W. Cognitive strategies: Good strategy users coordinate metacognition and knowledge. In R. Vasta & G. Whitehurst (Eds.), *Annals of child development, Vol. 4.* Greenwich, CT: JAI Press.

Pressley, M., & Levin, J. R. (1977). Developmental differences in subjects' associative-learning strategies and peformance: Assessing a hypothesis. *Journal of Experimental Child Psychology, 24,* 431-439.

Rogoff, B., Newcombe, N., & Kagan, J. (1974). Planfulness and recognition memory. *Child Development, 45,* 972-977.

Rohwer, W. D., Jr. (1973). Elaboration and learning in childhood and adolescence. In H. W. Reese (Ed.), *Advances in child development and behavior (V. 18)* New York: Academic Press.

Thorndike, E. L., & Lorge, I. (1972). *The teacher's word book of 30,000 words.* New York: Teachers College.

Wellman, H. M. (1977). Tip of the tongue and feeling of knowing experiences: A developmental study of memory monitoring. *Child Development, 48,* 13-21.

White, P. (1980). Limitations on verbal reports of internal events: A refutation of Nisbett and Wilson and ~~of Bem~~. *Psychological Review, 87,* 105-112.

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