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ABSTRACT

This paper reports three experiments concerning methodological issues in studies on incidental learning performance which use verbal and nonverbal procedures and which appear to be hampered by differences in stimulus materials, learning opportunities, and dependent measures. The first study, using 128 children from grades 3, 5, 7, and 9, attempted to determine if differences in developmental trends using paired associate and memory tasks can be attributed to methodological differences between the tasks. The second study, using 120 children from the same grades, attempted to see whether invariance in incidental performance across age with paired associate tasks is peculiar to a criterion level of intentional performance. The third study, using a sample of 80 children, examined whether observed developmental trends in incidental learning may be affected by the degree of difficulty of the task as defined by memory load. General findings are examined to determine if the decline in incidental performance around 11 or 12 years is related (1) to the nature of the intentional task, (2) to minimal learning conditions, (3) to relatively unrelated intentional and incidental independent measures, and (4) to a moderately difficult or demanding intentional task. It is suggested that the decline can be eliminated by criterion levels of learning and by use of a very easy intentional memory task. A viable theoretical explanation for the decline is that at this age children focus on intentional material at the expense of incidental information. (GO)

A Developmental Investigation of Verbal and Nonverbal Methodologies in Incidental Learning

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Studies using nonverbal tasks heavily dependent on memory (Druker & Hagen, 1969; Hagen & Sabo, 1967; Maccoby & Hagen, 1965) have shown that children between the ages of 10 and 13 years show an age-related improvement in performance on an intentional learning task but a decline or absence of improvement in incidental learning performance. The results of these studies have been interpreted as being due to a developmental improvement in the subject's ability to selectively attend to what is task relevant. Younger children's poorer performance in intentional learning but better performance in incidental learning relative to that of children 10 to 13 years of age, has been attributed to their "labeling and making note of everthing at once" (Maccoby & Hagen, 1965), i. e., their inability to distinguish between the relevant and irrelevant aspects of the task.

Studies using paired associate (PA) tasks have reported that intentional (S-R) learning improves with age through the middle childhood years while incidental performance (recall of R-S associations) is invariant over the same age span (Kausler & Gotway, 1969; Cole &

Kanak, 1972). Cole & Kanak (1972) suggested that the invariant relationship for R-S learning across grade levels, as opposed to the curvilinear relationship across grade levels for incidental learning in nonverbal tasks, argues against R-S learning being a form of incidental learning in children.

Meaningful comparisions of incidental learning performance in studies using verbal and nonverbal methodologies are hampered by difference in stimulus materials, learning opportunities, and dependent measures. Three experiments are reported bearing on this general issue. The first study makes a comparison of incidental performance in the "memory" and PA tasks under conditions of a common methodological base. The aim of this first study was to help to resolve whether differences in developmental trends observed using these two tasks are partially due to methodological differences between the tasks.

A second problem concerns the relationship of the degree of mastery in the PA task to incidental performance. Previous research has examined incidental performance at criterion level of intentional performance (e. g., Cole & Kanak, 1972.) A second study will attempt to see whether invariance in incidental performance across age with paired-associate tasks is peculiar to a criterion level of intentional performance.

A third study focuses on the relationship of the degree of difficulty of the memory task to incidental performance. Previous investigations have presented subjects of varying age the same intentional

(memory) task and a constant number of trials (e. g., Hagen, 1967.) The question to be answered is whether observed developmental trends in incidental learning may be affected by the degree of difficulty (memory load) of the task.

Experiment I

In nonverbal tasks which depend heavily on memory factors, a decline in incidental performance around age 11 or 12 typically is found (e. g., Maccoby & Hagen, 1965; Hagen and Sabo, 1967; Druker & Hagen, 1969). In verbal tasks which involve the learning process, the decline usually is not found (Palermo, 1961; Kausler & Gotway, 1969; Cole & Kanak, 1972). The discrepancy between findings with verbal and nonverbal tasks may simply reflect that these two tasks tap different processes.

The memory task typically requires subjects to remember the locations of a series of related intentional stimuli for a few seconds. Exposure to incidental stimuli is simultaneous with that of intentional stimuli. Remembering the incidental stimuli not only is unnecessary to intentional performance but may even interfere with it. In the memory task the serial locations are new on each trial, and their correct identification requires a similar memory effort on each trial. Thus, the opportunity to perceive and learn incidental material probably depends more on the memory-load difficulty (number of stimuli in the series) of the intentional task than on amount of training on the intentional task. On the other hand, the paired-associate (PA) task involves the gradual mastery of a series of paired stimuli. Because

the pairs of stimuli remain constant over trials, intentional learning improves over trials. As trials progress, the opportunity to acquire incidental material increases. Also, the subject must at least recognize the incidental stimuli (S items) in order to perform the intentional task. Thus, with the PA task, the acquisition of incidental material does not usually interfere and may even facilitate intentional learning. A more detailed description of these tasks will be presented in the method section. In addition, these two tasks differ on a wide range of methodological points, e.g., stimulus materials, learning opportunities, relatedness of the incidental material to the intentional task, etc. Thus, it is possible that observed discrepancies between the PA and memory tasks may simply reflect differences in methodology.

The aim of the first study was to examine incidental learning in the PA and memory tasks under conditions of comparable methodology. The most common nonverbal task, serial-location memory (e.g., Hagen, 1967) was compared with the most common verbal task, paired associates, (e.g., Kausler & Gotway, 1969) with equivalent numbers of trials, stimulus materials, and dependent measures. The learning materials were constructed to provide incidental stimuli both relatively related and relatively unrelated to the intentional PA task. In the intentional portion of the paired-associate task, subjects were instructed to associate pairs of objects (S items) with animals (R items), presented on cards having different background colors. The subsequent (incidental) recognition of the color of the card was assumed to be more extrinsic than the

recognition of the object.

It was expected that incidental performance would be better in the PA task as compared to the memory task, at least on recognition of the related dependent measure (object). This prediction was based on the premise that subjects may use incidental stimuli in the performance of the intentional PA task. Similarly, it was predicted that the relatively related incidental dependent measure (object) would be greater than the relatively unrelated incidental measure (color) for the PA task.

For the memory task, no difference between incidental dependent measures was expected since both measures were assumed to be relatively unrelated to the intentional task. This attempt to equate the PA and memory tasks methodogically may work to eliminate performance differences between the tasks. Otherwise, invariance in incidental performance over grades 3, 5, 7, and 9 should be found in the PA task, based upon the results of previous studies (e.g., Cole & Kanak, 1972). A decline in incidental performance at grade 7 and possibly grade 9 should occur in the memory task since the task stimuli and amount of training would be similar to those of previous studies which showed the decline (Maccoby & Hagen, 1965; Hagen, Meacham, & Mesibov, 1970).

Method

Subjects and Design.--The subjects were 128 public school children (64 of each sex). There were 32 subjects (16 males and 16 females) at each of grades 3, 5, 7, and 9 of Norman (Oklahoma) Public Schools. A 2 (type of task) X 2 (orders of testing color and object)

X 4 (grade levels) factorial design was employed with 4 males and 4 females per cell. Sex thus formed a fourth factor in the design.

Stimuli and test materials.--The stimuli were a series of eight cards, each containing black line drawings of an animal and a household object printed on colored paper. The drawings were selected from the Peabody Picture Vocabulary Test and the Stanford Binet Intelligence Test and were essentially the same as those used by Hagen, Meacham, and Mesibov (1970). The eight objects and eight animals were paired in the following manner: telephone-fish, lamp-cat, chair-horse, television-camel, book-monkey, cup-bear, table-dog, clock-deer. The background colors were pink, red, orange, yellow, white, blue, green, and brown, respectively. The drawings were approximately 1½ in. in the longest dimension and centered 2 in. apart and 1 in. from the sides of 4 X 6 in. plastic cards.

Three 8½ X 11 in. boards were used for subsequent testing for incidental learning. One board contained line drawings of the eight animals on a white sheet of paper. Another had line drawings of the eight household objects on a white sheet of paper. The third had eight squares of the background colors on a white sheet of paper. The animal board was used as the cue for the recall of the serial location of the animal in the memory task as well as for naming the animals for the intentional portion of memory and PA tasks. The household object and color boards were used as cues for the incidental recognition test. Additonal cards with individual drawings of each of the eight animals on white paper were also used as cues for the incidental recognition test.

Procedure.--The subjects participated individually in a mobile laboratory trailer. The experimenter and subject sat side by side at a table.

The Memory Task

Subjects were given instructions (see Appendix C) and asked to name the animals as the experimenter pointed to them on the animal board. Then the subjects were presented the series of eight cards, one at a time. Presentation proceeded from the subject's left to his right. The experimenter held each card in view for approximately 2 sec., and then placed it face down. When all cards had been presented, E then indicated, by pointing to one of the animals on the animal board, which animal was to be found on that trial. On each trial, the subject was asked to find a different animal. After the subject indicated his choice, the experimenter picked each card up, exposing it for approximately 2 sec. to the subject. Four orders of presenting the eight cards were used. The orders were constructed so that no card maintained the same ordinal position or followed the same card in any of the four orders. Training on the intentional portion of the memory and PA tasks was equated by means of a yoking procedure. Each memory-task subject was randomly yoked in terms of number of trials to a subject who had reached a criterion of one perfect trial on the PA task.

The Paired-Associate Task

Subjects were given instructions (see Appendix C) and asked to name the animals as the experimenter pointed to them on the animal board.

Presentation of the eight cards was by the anticipation method using a Hunter Card Master (Model 360). The list was presented at a 2:2 sec. rate with a 2-sec. intertrial interval. The same four orders of presentation were used to minimize serial learning that were used in the memory task. Subjects were taken to a criterion of one perfect (errorless) trial or to a maximum of 16 trials.

Incidental Learning

Immediately after the intentional task (either PA or memory) subjects were tested for both object and color recognition. Half of the subjects were individually tested for object recognition first, and half for color recognition first. The incidental test (see Appendix C for instructions to the subject) included the presentation of the board of household objects (or colors) and the individual animal cards. The subject was asked to select the object (or color) from the board which had previously appeared with the animal being presented. There was no time limit.

Results and Discussion

Intentional PA learning (trials to criterion) generally improved across grade levels (Table 1); however, the fifth grade required slightly fewer trials to reach criterion than did the seventh grade ($\bar{X}$s = 6.56 and 7.81 respectively). Table 2 presents the means and standard deviations of the numbers of colors and objects correctly recognized for each task and grade level. An inspection of Table 2 reveals an obvious difference in incidental performance between PA and memory tasks. Even under conditions of equal numbers of training trials, performance in the PA

task was clearly superior to that in the memory task. No change over age is evident in the PA task; however, a slight decline in means occurs at grades 7 and 9 in the memory task. Some differences between means for color and object measures are slightly greater within the PA task than within the memory task with object (O) scores being better in the PA task and color (C) scores being better in the memory task. ($\bar{X}_C$ = 6.13; $\bar{X}_O$ = 7.28; $\bar{X}_C$ = 3.13; $\bar{X}_O$ = 2.74, respectively.)

A 2 (Tasks) X 4 (Grades) X 2 (Orders of testing for color and object) X 2 (Sexes) X 2 (Stimuli: color and object) factorial analysis of variance was performed on the incidental recognition data. The Stimuli factor was analyzed as a within-Ss factor and the others as between-Ss factors. The Task effect, $F(1,96) = 215.14$, $p < .001$, and the Stimuli effect, $F(1,96) = 6.14$, $p < .001$ were both highly significant.

The main effect of Order of testing for color and object was not significant, $F < 1.00$. However Order did interact with Task and Stimuli. Table 3 gives the means for color and object scores within the two orders (object first and color first) for the PA and memory tasks. The analysis of variance revealed a significant Task X Order X Stimuli interaction, $F(1,96) = 5.28$, $p < .02$. The Task X Stimuli interaction was also significant, $F(1,96) = 22.39$, $p < .001$. In the PA task, as may be seen in Table 3, object scores were generally better than color scores, but order of testing did not make much difference. In the memory task, on the other hand, there was not much overall difference between color and object scores. Under these conditions, the subjects

showed better incidental recall of the first items, whether color or object, but with color scores being more affected by order than object scores. Tukey's pairwise comparison between color scores for each order of testing was significant ($q = 3.828$, $p < .01$) for the memory task data but nonsignificant for the PA data.

The absence of a Grade effect is consistent with earlier studies of incidental learning using PA tasks (Cole & Kanak, 1972; Kausler & Gotway, 1969). The mean differences in the memory task over age may have been masked by the invariance over age in the PA task. The large difference in incidental performance between the PA and memory tasks indicates the effect of the intentional task itself upon incidental learning.

The PA data and the memory data were analyzed separately by means of two 4 (Grades) X 2 (Orders of testing for color and object) X 2 (Sexes) X 2 (Stimuli: color and object) analyses of variance. For the PA data, only the stimuli main effect was significant, $F(1,48) = 37.21$, $p < .001$, with object scores being higher than color scores. For the memory data, none of the main effects were significant. Only the Order X Stimuli interaction was significant, $F(1,48) = 5.77$, $p < .01$, confirming that performance was better in the memory task on the measure first tested, with the color scores most affected. See Table 3 for the mean color and object scores according to testing order. Thus, the significant interaction between Order and Task in the initial analysis was primarily due to the memory data. The absence of a Grade effect

for the PA task, $F < 1.00$, is consistent with the findings of previous research (e.g., Cole & Kanak, 1972). Also, as may be seen in Table 1, a decline in incidental performance at grades 7 and 9 may be seen in the means of the color and object scores in the memory task. The decline is primarily due to color scores. In the analysis of the memory data the Grade main effect was also nonsignificant, $F < 1.00$. The seventh grade had more intentional training than the fifth and ninth graders due to the yoking procedure. Additional intentional training may have tended to cancel the decline expected at the seventh grade.

Correlations between intentional and incidental performance for both the PA and memory tasks were nonsignificant. The absence of such correlations is consistent with previous research for both tasks (e.g., Druker & Hagen, 1969; Kausler & Gotway, 1969).

Experiment II

Studies using the PA task typically have tested for R-S (incidental) learning after subjects reached criterion performance on the intentional S-R task (e.g., Palermo, 1961; Kausler & Gotway, 1969; Cole & Kanak, 1972). Increments in degree of mastery on an intentional task (serial learning) has been shown to produce increments in incidental performance with adults (e.g., Bahrick, 1957). Further, Bahrick (1957) has shown that the rate of incidental learning is faster in the early and late stages of training on the intentional task.

This study investigated the developmental relationship between degree of mastery on the intentional task and subsequent incidental

learning performance. The PA task with the same materials and dependent measures as the first study was used. Three levels of training (2, 4, and 6 trials) were examined over the age span including grades 3, 5, 7, and 9. The chief aim of this study was to see if the degree of mastery on the intentional task is related to incidental performance in general and specifically to the decline which is typically observed at adolescence with nonverbal tasks. It was expected that a decline in incidental performance might be observed at grades 7 or 9 at low levels of training (2 trials), especially for the less relevant color scores. This prediction was based on a possible similarity between the memory task and the PA task at low levels of training. That is, given the minimal opportunity for learning and the general unrelatedness of incidental and intentional stimuli in the memory task, it was expected that the PA task at low levels of intentional S-R acquisition should yield incidental performance more like that found with the memory task, particularly if the incidental material were relatively unrelated to the intentional task. More specifically, a decline in incidental learning was expected with the relatively unrelated color scores. With more related incidental stimuli and increasing levels of intentional practice, the greater should be the tendency toward age invariance typically found in verbal learning studies.

Method

Subject and Design.--The subjects were 120 public school children (60 of each sex) selected from grades 3, 5, 7, and 9 of the Noble (Oklahoma)

Public Schools. A 3 (Numbers of Trials) X 4 (Grades) factorial design was employed with 5 males and 5 females per cell. Sex thus formed a third factor in the design.

Materials and Procedure.--The instructions, materials, and general procedure were the same as those for the PA task in Experiment I except one third of the subjects at each grade level received either 2, 4, or 6 trials of intentional practice before the test for incidental learning was given.

Results and Discussion

The means and standard deviations of correct numbers of responses for the intentional task are presented in Table 4. Inspection of the means shows improved performance over age for 4 and 6 trials. At 2 trials improvement is not as clear. The means and standard deviations of numbers of correct recognitions of colors and objects are presently separately for each grade and level of training in Table 5. As may be seen, the means for incidental color and object scores improved at each grade level with increased amount of training. An inspection of the means (Table 5) for total incidental performance (combined color and object scores) at two trials at grade 7 showed a decline in comparison with performance at grades 5 and 9. Since the object scores at two trials tended to increase across grades, the decline in Total scores was primarily due to color scores. These data support the idea that unrelated incidental measures and low levels of learning may be partly responsible for the decline typically found in developmental studies using nonverbal learning and memory tasks. As expected, the decline was less evident at four and six trials, and more nearly like the PA data at the criterion of one perfect trial.

A 3 (numbers of Trials) X 4 (Grades) X 2 (Sexes) X 2 (Stimuli: color and object) factorial analysis of variance was performed on the data. As in Experiment I the Stimuli factor was analyzed as a within-S variable and the others as between-S effects. The Trials effect, $F(2,96) = 28.87$, $p < .001$, Sex effect, $F(1,96) = 5.94$, $p < .001$, and Stimuli effect, $F(1,96) = 43.57$, $p < .001$ were significant. These findings confirm that amounts of training on the intentional task were associated with improved incidental performance. Considerable opportunity was given to subjects in the memory task in the first experiment ($\bar{X}$ number of trials = 7.22); however, incidental performance was relatively poor. Apparently it is not simply the amount of opportunity but also the requirements (e.g., memory load) of the intentinal task that is important to the acquisition of incidental material. The significant Stimulus effect supports the idea that object (S item) learning was greater because of its interrelatedness with the requirements of the intentional task. The significant Sex effect was due to the superior performance of males (overall $\bar{X}$s = 3.175 for males and 2.625 for females).

A 4 (Grades) X 2 (Sexes) X 2 (Stimuli: color and object) analysis of variance was performed on the two-trial data (where grade changes were most evident). The Grade effect was only marginally significant, $F(3,32) = 2.41$, $p < .08$. The Stimuli effect, $F(1,32) = 15.26$, $p < .001$ and Stimuli X Grade interaction, $F(3,32) = 5.03$, $p < .05$ were significant. Tukey's pairwise comparison on color scores between grades 5 and 7 was highly significant ($q = 2.89$, $p < .01$). Other comparisons between color

scores by grade were nonsignificant. Comparisons between object scores by grade were nonsignificant except between grades 3 and 9, $q = 3.61$, $p < .05$, confirming an upward trend in object scores over grade levels.

Experiment III

Previous studies using the memory task have typically used a common number of items (Usually 6 cards) for subjects ranging from grade 3 to grade 7. It is apparent that this procedure results in differential task difficulty at widely separated ages. The third study attempted to determine the extent to which task difficulty (memory load) affects incidental performance in the age range for which the decline has been observed. In contrast to Experiment I, which employed an array of 8 cards, this third study investigated two less demanding levels of difficulty (arrays of 4 and 6 cards).

Greater incidental learning was expected with an array of 4 than with an array of 6 cards. A decline in incidental performance at grade 7 or 9 was predicted for the array of 6 but not for the array of 4. This prediction was based on the assumption that subjects from grades 7 and 9 should be able to perform the relatively easy intentional task (array of 4) and also acquire the incidental material. Thus, no decline in incidental performance at grades 7 and 9 was predicted for the easier task (array of 4).

Method

Subjects and Design.--Subjects were 80 public school children from grades 3, 5, 7, and 9 of Norman Public Schools, Norman, Oklahoma. A 2 (Arrays) X 4 (Grades) factorial design was employed with 5 males and 5 females per cell. Sex was included as a third factor within the design.

Stimuli and Test Materials.--These were the same as for the memory task in the first study except that a set of four cards (chair-horse, cup-bear, television-camel, table-dog) and a set of six cards (the 4-card array plus telephone-fish and clock-deer) were taken from the original set of eight cards to form the arrays. The boards of animals, household objects and colors, were reduced to the same four or six stimuli, depending upon the length of the array.

Procedure.--The procedure was the same as for the memory task in the first study. Three orders were used for the presentation of the cards. Within the orders, no stimulus card maintained the same ordinal position or followed the same cards. All subjects received eight trials.

Results and Discussion

Means and standard deviations for correct numbers of responses for the intentional task are presented in Table 6. As may be seen, performance for both arrays improved over age. The percentages correct for color and object scores for an array of 4 and an array of 6 for each grade level are presented in Table 7. The difference in percentages correct for an array of 4 as compared to an array of 6 was greater at grades 7 and 9 than at grade 3. At grade 5 the percentage correct was greater for an array of 6 than for an array of 4, but the difference was minimal. Generally for all grade levels the total percentage correct for incidental performance for an array of 4 was 64% as compared to 54% for an array of 6. Table 8 contains means and standard deviations of absolute color, object, and total scores for each grade level for arrays

of 4 and 6 cards. Inspection of the total scores reveals a curvilinear trend for the array of 6. The slight decline occurred at grade 7 and a subsequent increase in incidental performance occurred at grade 9. The means for color and object were not different for either array.

A 2 (Arrays) X 4 (Grades) X 2 (Sexes) X 2(Stimuli: color and object) analysis of variance was performed on absolute color and object scores. The stimuli factor was analyzed as a within variable and the others as between variables. Only the main effect for Array was significant, $F(1, 64) = 4.97$, $p < .03$, indicating that as opportunity increased, absolute incidental performance also increased. More specifically, absolute performance was greater for an array of 6 than for an array of 4. A 2 (Arrays) X 4 (Grades) X 2 (Sexes) X 2 (Stimuli: color and object) analysis of variance was performed on the proportion of correct color and object recognitions. None of the effects were significant, although the main effect for Array was marginally significant, $F(1, 64) = 2.78$, $p < .10$. Thus, there was a slightly greater proportion of correct incidental recongitions for an array of 4 as compared to an array of 6.

An inspection of the means for the array of 8 from Experiment I (Table 2) and the array of 6 (Table 8) indicated that absolute incidental performance is not much greater for the array of 8 than for the array of 6. The more difficult intentional task (array of 8) did not result in improved incidental performance. An inspection of the means for the array of 4 (Table 8) show that incidental performance is less than for the arrays of 6 and 8 than for the array of 4. Opportunity for incidental performance made a difference when the intentional task was relatively easy.

The slight curvilinear trend in incidental performance, found with

the array of 6, is consistent with previous research (e.g., Maccoby & Hagen, 1965). In addition, the relatively easy intentional task (array of 4) tended to eliminate the decline at grade 7 and improve performance at grade 9. The greater total proportions correct for incidental performance in an easier rask as compared to a more difficult task suggests that incidental performance was related to the difficulty of the intentional task. When the intentional memory load became lighter, incidental performance improved because more attention could be devoted to incidental material.

General Conclusions

The decline in incidental performance around 11 or 12 years appears to be related to several factors. One of the msot important of these concerns the nature of the intentional task. Incidental learning is greater in a learning (PA) task where intentional performance gradually improves over trials, making the intentional task progressively easier and the incidental material more likely to be learned. Another factor contributing to incidental performance is the relatedness of the incidental and intentional dependent measures. Apparently, the more related the intentional and incidental measures are, the more incidental learning that occurs. Within a task where intentional learning improves over trials and the intentional and incidental measures are highly related greater amounts of training on the intentional task were found to facilitate incidental performance (i.e., the PA data in Experiment I). Within the memory task, where constant intentional effort is required on each trial and where incidental and intentional measures are relatively unrelated, the demand characteristics of the intentional task appear to partially determine the extent of incidental learning

(i.e., the memory data in Experiment III). That is, with easier tasks there may be no age differences or even increments in incidental performance across age. As the intentional task becomes more difficult, the older subjects (age 11 or 12 years or older) selectively attend to what appears to be relevant to the intentional task at expense of reduced incidental learning.

The reason for the decline at 11 or 12 years has not been provided in the present data. From a strictly methodological point of view, it appears that the conditions which are most likely to generate the decline are those of minimal learning (e.g., memory task or low levels training in a PA task), relatively unrelated intentional and incidental dependent measures, and a moderately difficult or demanding intentional task for the 11- or 12-year old. It is not so much whether an intentional task is verbal learning or nonverbal memory as whether is possesses certain characteristics. A learning task could be made to show the decline (as shown by the PA two-trial data in Experiment II), given minimal learning. A memory task could be made to eliminate the decline (as shown by the memory data in Experiment III), given a relatively easy intentional task. Thus, the decline is eliminated by criterion levels of learning, especially where the relationship between incidental and intentional learning is great. The decline also seems to be eliminated with a very easy intentional memory task.

Theoretical explanations for the decline are still not definitive, but the typical explanation of the 11- or 12-year-old ignoring incidental information because he is focusing on intentional material remains viable. Relatively unimportant material, given certain methodological conditions, is ignored by the 11- or 12-year-old, and a decline in incidental performance is reliably observed.

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Table 1

Experiment I

Mean Numbers of Trials Required to Reach Criterion[a] and Standard Deviations for the PA Task

		$\bar{X}$	S.D.
GRADES	3	8.50	4.21
	5	6.56	3.22
	7	7.81	3.43
	9	5.88	2.66

a Because of the yoking procedure, these figures also represent the mean number of training trials given on the memory task at each of the four grade levels.

Table 2

Experiment I

Means and Standard Deviations of Number of Correct Recognitions of Colors and Objects

	Grade Level											
	3			5			7			9		
	Color	Object	Total	Color	Object	Total	Color	Object	Total	Color	Object	Total
PA TASK												
$\bar{X}$	5.88	7.31	13.19	5.81	7.38	13.19	6.50	6.81	13.31	6.13	7.81	13.94
S.D.	1.93	1.14	2.56	1.52	1.02	2.17	1.46	1.68	2.80	1.67	.54	1.81
MEMORY TASK												
$\bar{X}$	3.38	2.94	6.31	3.06	3.13	6.19	2.88	2.88	5.75	3.19	2.00	5.19
S.D.	1.78	1.69	2.77	2.38	2.50	4.62	2.28	1.50	2.41	2.29	1.41	3.15

Table 3

Experiment I

Means Numbers of Correct Recognitions of Colors and Objects for each Order of Testing

PA TASK

Order of Testing	Color	Object
Object First	6.25	7.38
Color First	5.90	7.28

MEMORY TASK

Order of Testing	Color	Object
Object First	2.53	2.81
Color First	3.71	2.66

TABLE 4

EXPERIMENT II

Means and Standard Deviations for Correct Numbers of Response in the Paired-Associate Task for 2, 4, and 6 Trials

		TRIALS		
		2	4	6
3rd Grade	$\bar{X}$	1.40	3.00	5.40
	S.D.	.84	2.00	2.22
5th Grade	$\bar{X}$	2.40	4.60	5.60
	S.D.	1.17	1.51	1.78
7th Grade	$\bar{X}$	1.70	4.50	6.50
	S.D.	1.06	1.51	1.65
9th Grade	$\bar{X}$	2.50	4.70	6.20
	S.D.	1.78	1.42	1.81

Table 5

Experiment II

Means and Standard Deviations of Numbers of Correct Recognitions of Colors and Objects

Number of Trials		Grade Level 3 Color	Object	Total	5 Color	Object	Total	7 Color	Object	Total	9 Color	Object	Total
2	$\bar{X}$	2.1	2.9	5.0	3.7	3.7	7.4	1.0	3.6	4.6	2.0	4.8	6.8
	S.D.	1.45	1.45	1.83	1.95	2.11	3.27	1.15	1.84	2.41	1.56	1.03	2.04
4	$\bar{X}$	3.6	3.9	7.5	3.1	5.7	8.8	4.8	5.0	9.8	3.9	5.0	8.9
	S.D.	1.51	2.33	3.24	1.66	1.83	3.22	1.81	2.26	2.39	2.23	2.67	3.70
6	$\bar{X}$	5.3	5.5	10.8	5.2	6.5	11.7	4.5	7.2	11.7	5.3	6.7	12.0
	S.D.	2.63	2.92	5.37	2.15	2.17	4.11	1.27	.92	2.06	2.83	2.26	4.32

TABLE 6

EXPERIMENT III

Means and Standard Deviations for Correct Numbers of Responses in the Memory Task for Arrays of 4 and 6

		Arrays	
		4	6
3rd Grade	$\bar{X}$	5.10	4.10
	S.D.	1.20	1.37
5th Grade	$\bar{X}$	5.90	3.80
	S.D.	.99	2.25
7th Grade	$\bar{X}$	7.30	4.30
	S.D.	.82	2.31
9th Grade	$\bar{X}$	6.60	5.90
	S.D.	1.07	1.60

Table 7

Experiment III

Mean Percentages of Correct Recognitions

of Colors and Objects

	Array of 4			Array of 6		
	Color	Object	Total	Color	Object	Total
3	.600	.500	.550	.433	.551	.492
5	.525	.475	.500	.584	.565	.575
7	.825	.675	.750	.549	.449	.499
9	.775	.775	.775	.699	.517	.608

Table 8

Experiment III

Means and Standard Devisions of Numbers of Correct Recognitions of Colors and Objects

Grade Level		3		5		7		9	
Arrays		4	6	4	6	4	6	4	6
Color	$\bar{X}$	2.4	2.6	2.1	3.5	3.3	3.3	3.1	4.2
	S.D.	1.17	1.15	1.60	2.01	.95	2.16	1.52	1.99
Object	$\bar{X}$	2.0	3.3	1.9	3.4	2.7	2.7	3.1	3.1
	S.D.	1.83	2.11	1.66	1.65	1.42	2.11	1.20	1.97
Total	$\bar{X}$	4.4	5.9	4.0	6.9	6.0	6.0	6.2	7.3
	S.D.	2.59	2.96	2.71	2.64	1.56	3.56	1.40	3.43