THE EFFECT OF REPETITION
ON ICONIC MEMORY

A Thesis

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for the Degree of Master of Arts

by

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ABSTRACT

The effect of repetition on iconic memory was examined using both partial and whole report procedures. In whole report Ss were to report as many letters as possible from a 3 by 5 letter display. The estimate of information available to Ss from whole report was the number of letters correctly recalled in their proper position. In partial report the Ss were cued to report as many letters as possible from only one row of the display. The number of correctly reported letters from that cued row was multiplied times three to yield an estimate of the information available by the partial report procedure.

In Exps. I and II 8 Ss were presented 160 3 by 5 letter displays. Every other presentation was a repeated display, yielding 80 repeated and 80 unique presentations. Recall was tested either 0, 300, 700, 1000 or 2000 msec. after the termination of the stimulus display.

The results indicated that partial report was higher than whole report when recall was immediately after the stimulus terminated. However, this difference decreased as the cue to recall was delayed. Whole report was low and constant across all retention intervals, and partial report dropped to that level after an interval of a second or two.

Although overall performance improved with repetition, the index of iconic memory (partial report minus whole report) was not different for the repeated and nonrepeated conditions. Using only partial report and retention intervals of 0, 300 and 700 msec., Turvey (1967) found that the repetition condition was not different from the non-repetition condition. Exp. III replicated the results of Turvey (1967). The difference in results between Exps. I and II on the one hand and Exp. III and Turvey (1967) on the other may be due to the inclusion of whole report and longer retention intervals in Exps. I and II. These conditions were absent in Exp. III and Turvey (1967).

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INTRODUCTION

Visual Memory

Since Volkman (1859) first reported research in which he used a tachistoscope, a great many researchers have used that instrument to present stimulus materials. Recently it has been used by psychologists to investigate the processes of human memory. In these studies the primary concern has been the assessment of information which is available to Ss after brief visual exposures of stimuli.

In 1960 Sperling proposed a methodology for studying brief visual memory of stimuli that were presented tachistoscopically. He first tested immediate memory for stimuli presented briefly and found that Ss were able to recall only about five items regardless of the number, class or arrangement of the items in the display. However, Ss often reported seeing much more than they were able to recall. Based on the fact that Ss report seeing more than they recall, Sperling (1960) hypothesized that the limit was on the memory not the perception of the items. To circumvent this limit Sperling introduced the partial report procedure in which he reduced the amount the S had to report from a display.

In partial report an S was to report only a designated portion of a matrix, but he did not know which portion until the time for recall. Since all parts of the display were sampled, and the S did not know which part of the display would be cued until after the stimulus terminated, it was assumed that what he recalled actually represented only a portion of what was available to him. If, for example, an S was cued to recall one third of the display, then three times the mean amount recalled represents an estimate of the total amount of information available to the S.

The purpose of partial report is to estimate the total information available to an S after brief visual stimulation. Since the S is required to report only a portion of the display in partial report, the total amount of information available must be inferred from what the S actually reports. That is, if an S is to recall only one third of the display then his total score is three times the amount recalled. Therefore, the score an S receives is merely an estimate of the total information available to him. It would be incorrect to assume that partial report represents all the information available to the S.

In the whole report procedure Ss are asked to report all that they are able to recall from the display. As mentioned previously, Ss typically report only four or five items. That level of report is assumed to represent information available in a more permanent memory system estimated by the whole report procedure.

The estimate of information available to the S obtained by the partial report procedure is normally greater than that obtained when the S is required to report all of the items in the display in the whole report procedure. However, when the cue to recall is delayed, the partial report scores drop to the level of whole report within seconds (Sperling, 1960).

The main results of Sperling (1960) were summarized in his monograph:

> A large amount of information becomes available to observers of a brief visual presentation; this information decays rapidly; the final level is approximately equal to the span of immediate memory. (p. 26)

Averbach and Coriell (1961) reported studies in which they used a method similar to Sperling (1960). They used a visual cue to designate the portion of the display to be reported, whereas, Sperling used a tone. Averbach and Coriell (1961) exposed a 2 by 8 letter matrix for 50 msec. and shortly thereafter presented a black bar marker over one of the letter positions. The S was to recall the letter that appeared below the bar marker. The results resembled Sperling (1960) in that Averbach and Coriell (1961) reported rapidly declining retention functions as the poststimulus recall cue was delayed.

Repetition and Memory Systems

Much of the research on learning has demonstrated that performance improves with practice. In the area of verbal learning, practice in the form of repeated presentations has led to increased recall of repeated items. Cooper and Pantle (1967) have proposed that in a great number of cases this increase in recall is directly related to the total amount of study time on the materials rather than the number of trials. The more time for practice the greater the increase in performance. This relationship between performance and study time is referred to as the total time hypothesis (Cooper and Pantle, 1967).

Bugelski (1962) varied presentation time per trial and found that although the 2 sec. per trial group needed more trials to reach criterion than the 15 sec. per trial group, the total time the two groups had seen the material was not different when they reached criterion.

Some limitations of the total time hypothesis were studied by Johnson (1964), who found that at very fast and very slow presentation rates the relationship between total time and performance breaks down. With study time held constant, performance was lower with either extremely fast or extremely slow presentation rates as compared to moderate (4-sec.) presentation rates. Peterson, Wampler, Kirkpatrick and Saltzman (1963) and Melton (1967) varied the spacing between the occurences of repeated items and found an increase in the probability of a correct response with an increase in the spacing between presentations. In spite of a constant amount of study time performance improved with a separation in repeated presentations.

These studies illustrate that the effect of repetition is not the simple relationship which was presented in the total time hypothesis. Nevertheless, it is apparent that there is some increment in performance due to repeated presentations of material.

One question that was not resolved in the studies cited above was whether the effect of repetition operates in all memory systems. If all memory systems are affected similarly by the same independent variable, such as repetition, similar processes might be operating. Parsimony might, then, dictate the need for assuming only one general memory system instead of several (Melton, 1963). However, if they are differentially affected by the variable, distinct or separate memory systems might be needed to explain the data.

Repetition and Long and Short Term Memory

A great number of studies have documented the effect of repetition in long term memory (LTM). Cooper and Pantle (1967) have presented several of these studies which have used a variety of methodologies. The evidence indicated that repetition does operate in LTM paradigms.

Short term memory (STM) paradigms include the design used by Peterson and Peterson (1959) and its variations. In that design an item is presented, followed by some rehearsal preventing activity, and after several seconds the item is recalled. Peterson and Peterson (1960) modified that method by including repeated presentations of items before recall and varying the spacing interval between the two presentations (1, 3, 6, or 11 sec.). They found that recall increased with repetition as a funciton of the spacing interval. Using other STM procedures Hellyer (1962) and Helms and Kintz (1965) found an increase in the probability of recall as a function of repetitions. However, these studies may not be assessing STM alone; they may involve LTM to some undertermined extent.

Some researchers have defined the recency portion of the serial position curve as representing the information in STM. If these items are affected by repetition, then that portion of the curve might be elevated as the probability of recall increases. Glanzer and Cunitz (1966) studied the effect of repetition on serial position in a free recall task. Their first experiment revealed no significant effect of repetition on any portion of the serial position curve. This result was not predicted and may have been due to the design of the experiment. The repetitions were successive, whereas, spaced repetitions might have revealed an effect.

In the second experiment Glanzer and Cunitz (1966) delayed recall either 10 or 30 sec. in a free recall task. Delayed recall with a counting task during the retention interval reduced the amount of information in the recency portion of the curve, thus affecting only STM. Raymond (1969) found a similar effect with delayed recall in a free recall task; but the failure of repetition to modify the curve in Glanzer and Cunitz (1966) leaves the question of whether repetition affects STM unanswered.

Bartz (1969) presented repeated items to Ss in a serial learning task. Ss recalled either immediately after the last item was presented or after a silent or filled retention interval. He found that the effect of repetition was greatest in the delayed recall condition. This finding suggests that with more time for processing more items are encoded, perhaps in a more permanent memory. However, Bartz (1969) reported an increase in performance across all serial positions which implies that repetition affects STM as well as LTM.

A more definitive experiment to localize the effect of repetition was reported by Lewis and Bartz (1970). Ss were presented with an 18 word list in a free recall task, followed by another 18 word list. In the second list nine of the words were repeated from the first list. If learning (improved recall) occurred then the probability of recalling a repeated item on the second list, if it were correctly recalled on the first list, should be greater than the overall probability of correct recall of repeated items on the second list:

$$P(C_2 | C_1) > P(C_2)$$

The results indicated that any items presented last in the first list showed the smallest difference between the probabilities. The most dramatic example of this effect was the case in which items presented last in the first list were also last in the second list. There was almost no difference between the conditional probability and the probability of correct recall on the second list. However, when the items which were presented first on the first list were also presented first on the second list, the difference between the probabilities was the greatest. The items at the end of the lists did not seem to be processed very throughly. Thus, repetition was not able to enhance the memory traces of those items. Repetition seems to affect LTM primarily, but additional data is needed to justify that conclusion.

Repetition and Iconic Memory

There is some ambiguity with respect to the effect of study time on visual memory. For example, Sperling (1960) varied exposure duration from 15 to 500 msec. and found no significant increase in the number of items reported. On the other hand, when Sperling (1963) increased exposure time in 10 msec. increments, followed immediately by a field which contained visual noise, he found that one additional item was reported for each 10 msec. increase in exposure duration. This increment in recall leveled off at about 50 msec. and additional stimulus exposure to 100 msec. accounted for only 1 or 2 more items. After 100 msec. the rate of acquisition was minimal.

The apparent discrepancy may be resolved if the methods used in each case are examined more closely. In Sperling (1960) both the pre- and post-exposure fields were dark, i.e., no visual noise followed the stimulus. In this case Ss were able to read out items from the rapidly fading visual representation of the stimulus which normally exceeds the stimulus exposure duration. Since the items can be read out even after the stimulus exposure has terminated, processing time and exposure time are not isomorphic. Therefore, the 15 msec. and the 500 msec. exposure may be functionally equivalent.

However, if processing time was made equivalent to exposure duration by presenting noise immediately after the termination of the stimulus, as in Sperling (1963), then a relationship between recall and study time emerges; as study time increases, recall increases. The level of recall asymptotes at the level of whole report.

There is very little data concerning the effect of repetition in iconic memory. The lack of evidence, coupled with inadequate designs in the existing data, make it difficult to state how repetition affects iconic memory. Previous studies have ignored the importance of including both partial and whole report conditions.

Since whole report is low and constant over various retention intervals (Averbach and Sperling, 1961), it may be assumed to represent a memory system somewhat more permanent than the system assessed by partial report. If that assumption is true, and partial report does assess information in addition to what appears in whole report, then the difference between whole and partial report represents the information in iconic memory. Therefore, the effect of repetition must be studied using that difference measure to determine its effect on the icon; not partial report alone.

Standing and DaPolito (1968) presented a 3 by 3 letter matrix in which one line was repeated in 1, 3 or 6 successive presentations. When recall was delayed until after the last repetition, there was an increment in the letters reported as a function of repetition.

Although repetition did affect recall, no information is available concerning the effect of repetition on iconic memory. Standing and DaPolito (1968) lacks the necessary conditions for measuring iconic memory, a measure of the difference between partial and whole report.

Turvey (1967) examined the influence of repetition on iconic memory, but he included only the partial report procedure. He found that the level of partial report did not increase with repetition and he concluded that repetition did not influence iconic memory. If the information in the icon is assessed by the difference between whole report and partial report, he cannot draw that conclusion, because a whole report condition was not included. For example, if for some reason the level of whole report had dropped with repetition the difference would have increased, even though partial report remained unchanged. It would be necessary to conclude that the icon was influenced by repetition.

The present experiment reexamined the repetition issue studied by Turvey (1967) and a whole report condition was included. It was hypothesized that the overall level of recall would be influenced by repetition because that would be determined by the information available in a more permanent memory system assessed by whole report. At the same time, however, the difference between whole report and partial report (i.e., the estimate of information in the icon should not be influenced by repetition).

EXPERIMENT I

The present experiment deals with two issues, one of them is empirical and the other is methodological. The empirical point is whether repetition has an effect on iconic memory. The methodological point is to emphasize the distinction between the nature of the information assessed by whole report and that assessed by partial report. In that whole report is relatively low and remains constant over prolonged retention intervals, it seems reasonable to assume that it assesses information in a memory system somewhat more permanent than that assessed by partial report. If that is the case, and the partial report procedure does assess iconic information, then the difference between whole and partial report may be used to determine the information that is in the icon. Likewise, if we are interested in determining the influence of repetition on iconic memory, we must examine its influence on that difference rather than its influence on either whole report or partial report alone.

Method

<u>Task</u>. The <u>S</u>s were seated in a dimly illuminated room seven feet from a white display field. An "X" in the pre-exposure field served as a fixation point and also centered the stimulus displays.

The displays consisted of 3 rows of 5 letters and covered an area 6" X 10". A slide projector with a shutter over the lens presented each matrix for 50 msec. after which a tone was presented as a cue to recall. The tone occurred either 0, 300, 700, 1000, or 2000 msec. after the termination of the display.

Two methods of recall were used, partial report and whole report. In whole report the Ss were to recall all 15 letters in the display, and in partial report they were to recall all the letters in one row of the display. Prior to the presentation of the display the E said "whole report, ready" if the S was to recall all 15 letters, and he just said "ready" if the S was to recall only one row (partial report).

The cue to recall in partial report was either a high, medium or low tone. If the top row of the matrix was to be recalled a high tone was presented; medium and low tones cued the middle and low rows, respectively. The tones were adjusted for each S to avoid any discrimination errors in tone identification. In whole report the Ss were to recall when they heard a middle tone. In all conditions the S controlled the switch that initiated the display.

Materials. Forty practice and 80 test displays were constructed for the experiment. The 80 test displays included 40 unique slides and one other slide reproduced 40 times. In an attempt to minimize meaningful associations, low frequency single letter associations (Underwood and Shulz, 1960) were used to generate the rows. Meaningful associations beyond contiguous letters were eliminated by inspection.

Procedure. Ss served one hour per day for four days. At the beginning of the first day Ss were familiarized with the task in a four step process. First, the E presented a random series of tones which the S identified as either high, medium or low. After they mastered tone discrimination, the Ss initiated the tone by pressing the switch when the E said "ready". They were then given experience watching a display slide while still identifying tones. The display slide included the letters A-O arranged in a 3 by 5 matrix. Finally, the Ss wrote the letters from the cued row of the A-O matrix (partial report). Whole report was also tested using the matrix described above.

Following the initial practice Ss were given 80 practice trials on all five retention intervals in both partial and whole report (10 conditions presented 8 times each). The 80 practice trials consisted of the 40 practice matrices presented twice in random order.

On day two the Ss were reacquainted with the tones and procedure, followed by 130 practice slides. Seventy practice slides were presented on the third day followed by 60 critical test slides. On the final day the Ss were given 20 practice and 100 test slides. Only the scores from the final 160 test slides were used in the tabulation of results. Ss were encouraged to guess when not certain that their choice of letter was correct.

Repetition. The twenty experimental conditions included all possible combinations of the five retention intervals, two types of report and repeated versus nonrepeated items. They were randomly presented across the 160 trial list such that each condition occurred 8 times. The exception to randomness was that the repeated slide occurred as every other display. Therefore, within the list of 160 presentations, 80 were repeated presentations of a particular slide. The repeated matrix was the same for all Ss and the Ss were not informed that items would be repeated.

Since the test list included 160 presentations the 80 test slides were presented twice. It was assumed that the nonrepeated displays would show no increment in recall the second time through the list since Sperling (1960) found no such effect when he reused test materials. Also 80 items intervened between presentations (about 20 mins. elapsed time) which should have provided sufficient interference.

Scoring. The *S*s wrote their responses on sheets that contained a 3 by 5 grid. For whole report the score used to estimate the amount of information available from the display at the time of recall was the number of letters recalled correctly in their proper positions. The partial report score was three times the number of letters recalled in their correct positions from the cued row.

Apparatus. The tones that were used as recall cues were generated by a Jackson model 655 audio-oscillator. The *S*s received the tones through earphones. A Tektronic type 160 A power supply operated a Tektronic type 162 wave form generator and a Tektronic type 160 pulse generator which controlled the various delays of the cue. The same power supply operated a Tektronic type 163 wave form generator which controlled a Ledex solenoid switch to which the shutter was attached. A Hunter timer was used to check the accuracy of the shutter speed and the delays of the cues.

Subjects. The *S*s were eight introductory psychology students who participated as part of a course requirement.

Results and Discussion

The results, presented in Fig. 1, replicated results reported by others who have used the partial report procedure. The significant effects of the type of report, $F(1,7)=84.40; p < .01$, delay of cue, $F(4,7)=34.10; p < .01$, and Type of Report by Delay interaction, $F(4,28)=30.63$; $p < .01$, indicate that partial report was elevated over whole report but fell to the level of whole report with increased delays of recall. The Ss apparently had more information available to them immediately after the termination of the display than was reflected in whole report but that information was lost very quickly.

The main consideration of the experiment was the effect of repetition which was significant at the .05 level, $F(1,7)=9.78$. For both partial and whole report the repeated items were clearly elevated above the nonrepeated items at all delays of the poststimulus cue.

The critical issue was whether the amount of information in the icon was affected by repetition. Since the amount of information in the icon was defined as the difference between partial and whole report, the effect of repetition is assessed by the Repetition by Report and the Repetition by Report by Delay interactions. In both cases the F was less than one. The insignificant first-order interaction indicates that the mean difference between partial and whole report was the same for both repetition conditions. The absence of a significant second-order interaction indicates that the pattern of recall for both partial and whole report was the same for the repeated and nonrepeated items across the retention intervals. Therefore, the amount on information in the icon was not affected by repetition, although overall performance improved.

The significant Delay by Repetition interaction $F(4, 28)=7.05; p < .05$, reflected an increasing difference between repeated and nonrepeated items across the retention interval. There appears to be more processing of repeated items as the retention interval increases. This is similar to results reported by other investigators (Bartz, 1969 and Fritzen, 1970). In spite of the tendency to lose items after longer retention intervals, the repetition effect is enhanced by delaying recall even a fraction of a second.

EXPERIMENT II

While the results of the first experiment seem clear, the fact that all Ss received the same repeated slide restricted the sample of materials in the repetition condition. To improve the design of the study it would be necessary to present a different repeated slide to each S. Also, Exp. I was a random list design which precluded any analysis of changes in performance that might have occurred across blocks of trials. Finally, since the previous experiment showed no effect of repetition on the icon it seemed important to replicate the experiment.

Method

Procedure. Exp. II was a replication of the design of Exp. I with the following exceptions: (a) the random list was changed to four blocks of forty trials with each of the twenty experimental conditions represented twice within a block and (b) each S had a different repeated slide during test trials.

Subjects. Ss were eight introductory psychology students who participated as part of a course requirement.

Results and Discussion

The results are presented in Fig. 2. The number of items reported in all conditions was lower than the first experiment and the functions were not as smooth, but it is apparent that the same effects were obtained. The partial report curve was higher than whole report, $F(1,7)=16.03$; $p < .01$, and that curve dropped with a delay in the cue to recall, $F(4,28)=7.82$; $p < .01$. The Type of Report by Delay interaction, $F(4,28)=20.34$; $p < .01$, reflected the declining function of partial report to the level of whole report as recall was delayed.

The effects of repetition were similar to the first experiment. Repeated items were recalled significantly better than nonrepeated items, $F(1,4)=6.94$; $p < .05$ and the critical interactions, (i.e., the Repetition by Type of Report and the Repetition by Type of Report by Delay) were both insignificant. In both cases the F was less than one. Because of the absence of significance it cannot be concluded that there was an effect of repetition in iconic memory.

An analysis across the four blocks of trials (Fig. 3) revealed a significant effect of blocks of trials, $F(3,21)=6.12$; $p < .01$. More salient, however, was the significant Repetition by Blocks Interaction, $F(1,3)=5.57$; $p < .01$, which indicates an increasing difference in recall of repeated and nonrepeated items as trials progressed.

Again, the critical issue was whether the icon differed across trials as a results of repetition. This issue was assessed by the Repetition by Report by Blocks interaction which was insignificant, $F(3,21)=1.14; p > .05$. The mean difference between partial and whole report in both repetition conditions did not vary across blocks of trials.

EXPERIMENT III

The results of Exps. I and II raised questions concerning the repetition effect in light of the absence of any repetition effect reported by Turvey (1967). He studied repetition using a design similar to the experiments reported here except (a) he did not use whole report, (b) he only included retention intervals of 0, 300 and 700 msec., (c) he presented 108 trials (54 repetitions), and (d) he used matricies composed of letters and numbers. Turvey (1967) found no difference in recall of repeated and nonrepeated items, whereas, Exps. I and II showed an overall increase in recall as a result of repetition. Because of the apparent inconsistency in results, the Turvey (1967) experiment was replicated.

Method

Procedure. Partial report was tested at three retention intervals, 0, 300 and 700 msec. One hundred and eight trials (54 repetitions) were presented using letter matricies as in Exps. I and II. In other respects the experiment was the same as Exps. I and II.

Ss served one hour per day for three days. On the first day Ss became familiar with the complete task and were given 80 practice slides. On day two 130 practice displays were presented, and on the final day 20 practice and 108 critical test slides were given.

Subjects. The Ss were eight introductory psychology students who served as part of a course requirement.

Results and Discussion

The results are presented in Fig. 4. While the repeated items appear to be higher than the nonrepeated items, the difference is insignificant ($F < 1.00$). There was a significant Repetition by Delay interaction which was not predicted nor easily explained. However, the absence of the significant main effect of repetition does replicate Turvey (1967).

The most obvious explanation for the discrepancy between the first two experiments on the one hand and Exp. III and Turvey (1967) on the other is the difference in the number of repetition trials. Exps. I and II had 80 repetitions, whereas, Exp. III and Turvey (1967) included only 54 repetitions.

In order to compare the two sets of experiments the number of repetitions should be held constant. To accomplish this comparison an analysis of variance was computed on partial data from Exp. II. Included in the analysis were the first three blocks of 40 trials and only the 0, 300 and 700 msec. retention intervals. The data was extracted only from partial report scores. These scores from Exp. II approximate Exp. III except that the three blocks of 40 trials from Exp. II included 60 repetitions compared to 54 in Exp. III and Turvey (1967).

The analysis of variance computed on the abbreviated data from Exp. II revealed an insignificant effect of repetition, $F(1,7)=2.35; p > .05$, as well as an insignificant effect of blocks of trials ($F < 1.00$). Therefore, as in Exp. III and Turvey (1967), the mean number of repeated items recalled was not greater than nonrepeated items after 60 repetitions. Also, the number of items recalled across blocks of trials did not increase with repeated presentations.

However, an inspection of Fig. 5 does reveal some divergence of the repetition and nonrepetition functions across blocks of trials. This Repetition by Blocks interaction was significant at the .05 level, $F(2,14)=4.23$, which indicates that the slopes of the two functions differ. Turvey (1967) found no such significant interaction.

If it is assumed that the insignificant main effect of repetition may have been due to the fact that the curve for the repetition condition started below that of the nonrepetition condition, then the Repetition by Blocks interaction represents an important difference between Turvey (1967) and the comparable data points in Exp. II. It may be attributable to conditions that appeared in Exp. II but were absent in Turvey (1967), i.e., whole report and longer retention intervals. Perhaps Ss must detect the repeated items for repetition to have an influence. In that case the whole report condition may be necessary for Ss to notice the repeated items. Also the longer retention intervals may provide more time for processing material which would enhance the repetition effect.

CONCLUSION

The results of the first two experiments suggested that repetition does not affect iconic memory, if the limits of iconic memory are operationally defined as the difference between partial and whole report. However, there was an overall effect of repetition in both experiments.

There are two aspects of the overall repetition effect which merit discussion. One issue concerns the locus of the overall effect of repetition. It may be reasonable to assume that the information available in the whole report condition came from a more permanent memory system. The fact that the level of whole report does not drop over prolonged retention intervals is consistent with that interpretation. Based on the results of Lewis and Bartz (1970), which stated that repetition affected LTM to a much greater extent than STM, whole report may be the only information that was influenced by repetition. The additional information available from the icon was not increased as a result of repetition.

Another issue concerns the Repetition by Delay interaction which was significant in the first two experiments. The divergence of the repetition functions across the retention interval is apparent in Figs. 1 and 2. However, there appears to be a greater divergence of the partial report functions. That is, the repeat and nonrepeat partial report curves seem to diverge more than the repeat and non-repeat whole report curves. The interaction of the partial report curves with the retention interval may be critical since it may indicate that the amount of information in the icon differs between the repetition conditions. This interpretation would be tenable only if the interaction of the partial report function with the retention interval was significantly greater than that of the whole report functions with the retention interval. If that were the case, a significant Repetition by Report by Delay interaction would be predicted, indicating that the mean difference between partial and whole report for the two repetition conditions was different across the retention interval. In both Exps. I and II this interaction was insignificant. The interaction between the partial report curves with the retention interval was not different from that of the whole report curves with the retention interval. Therefore, the information in the icon was not affected by repetition.

APPENDIX A

FIGURES

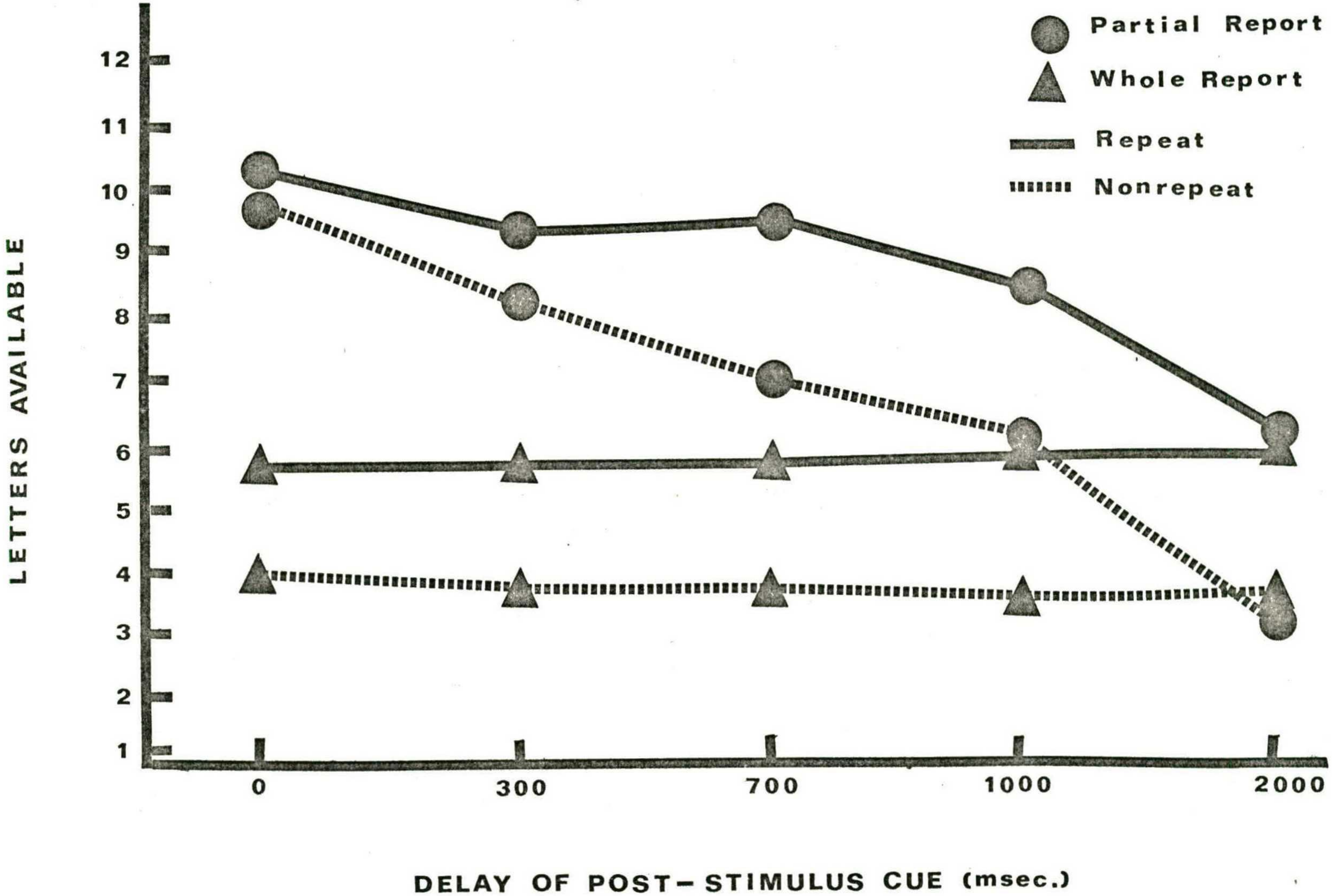

Fig. 1. Letters available across retention intervals: Experiment I

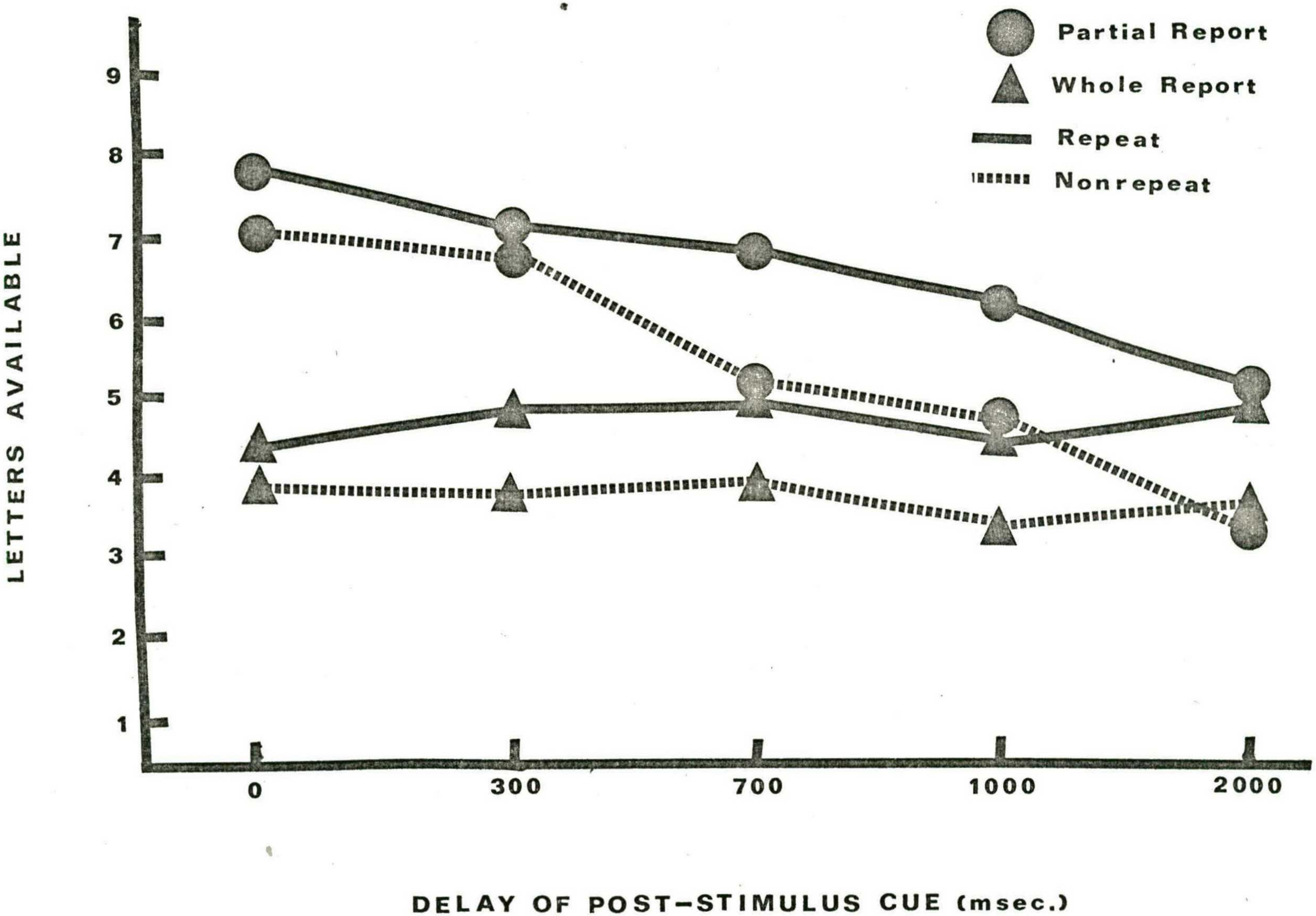

Fig. 2. Letters available across retention intervals: Experiment II

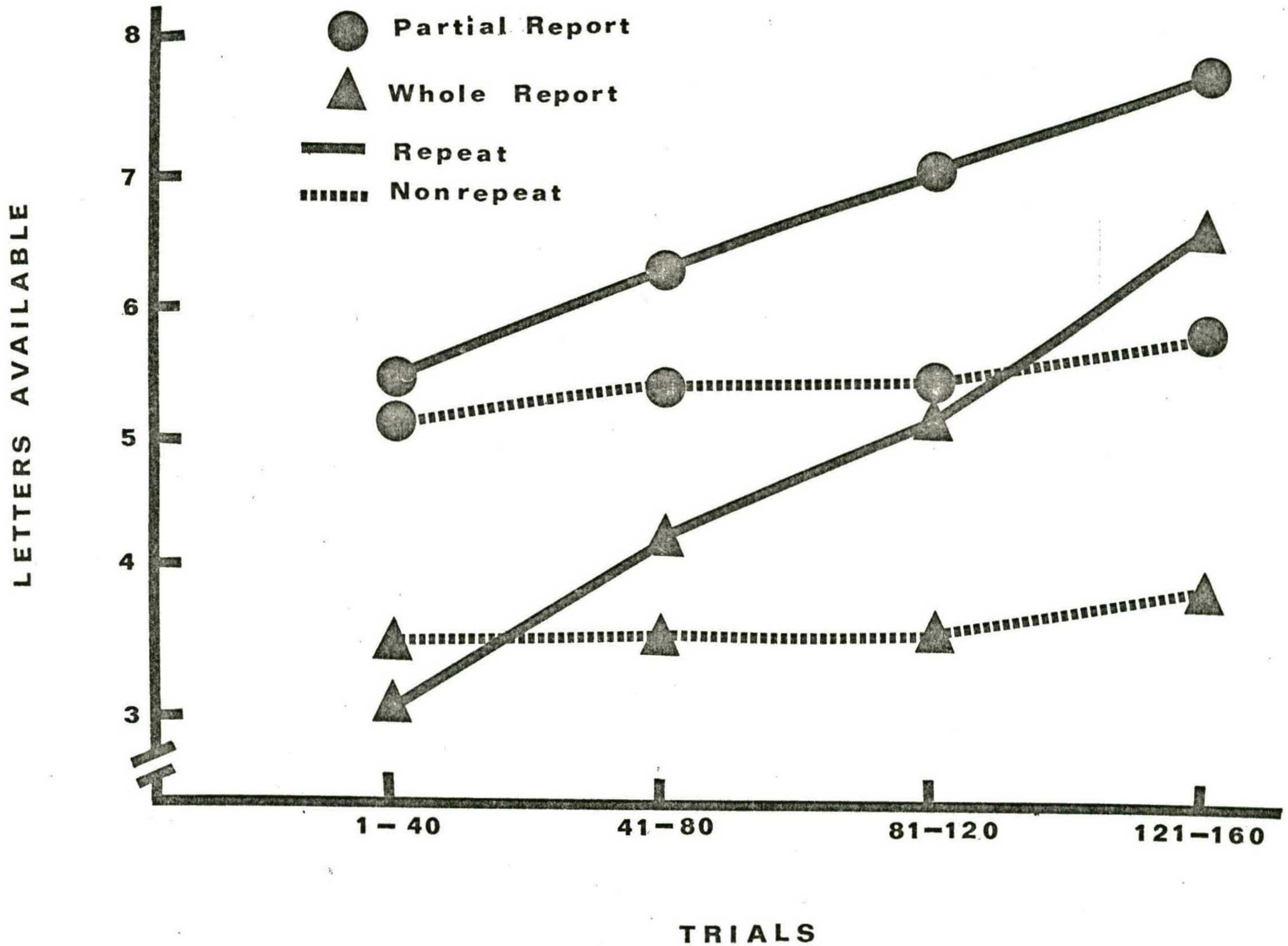

Fig. 3. Letters available across blocks of trials: Experiment II

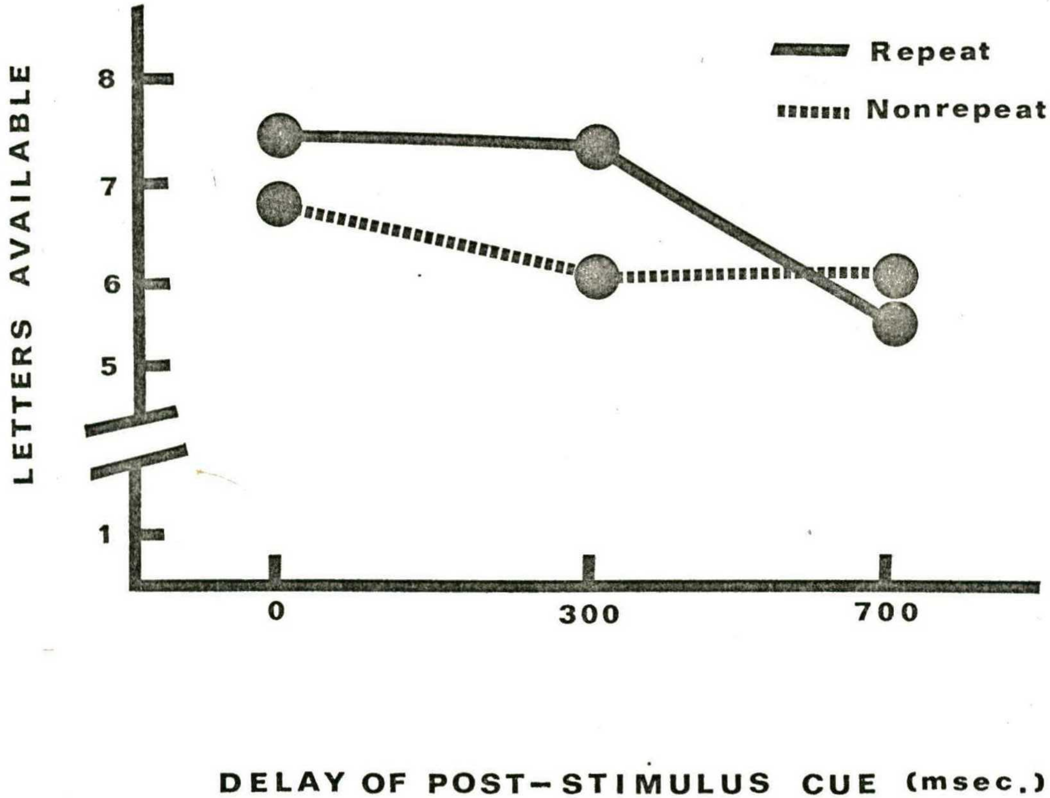

Fig. 4. Letters available across retention intervals: Experiment III

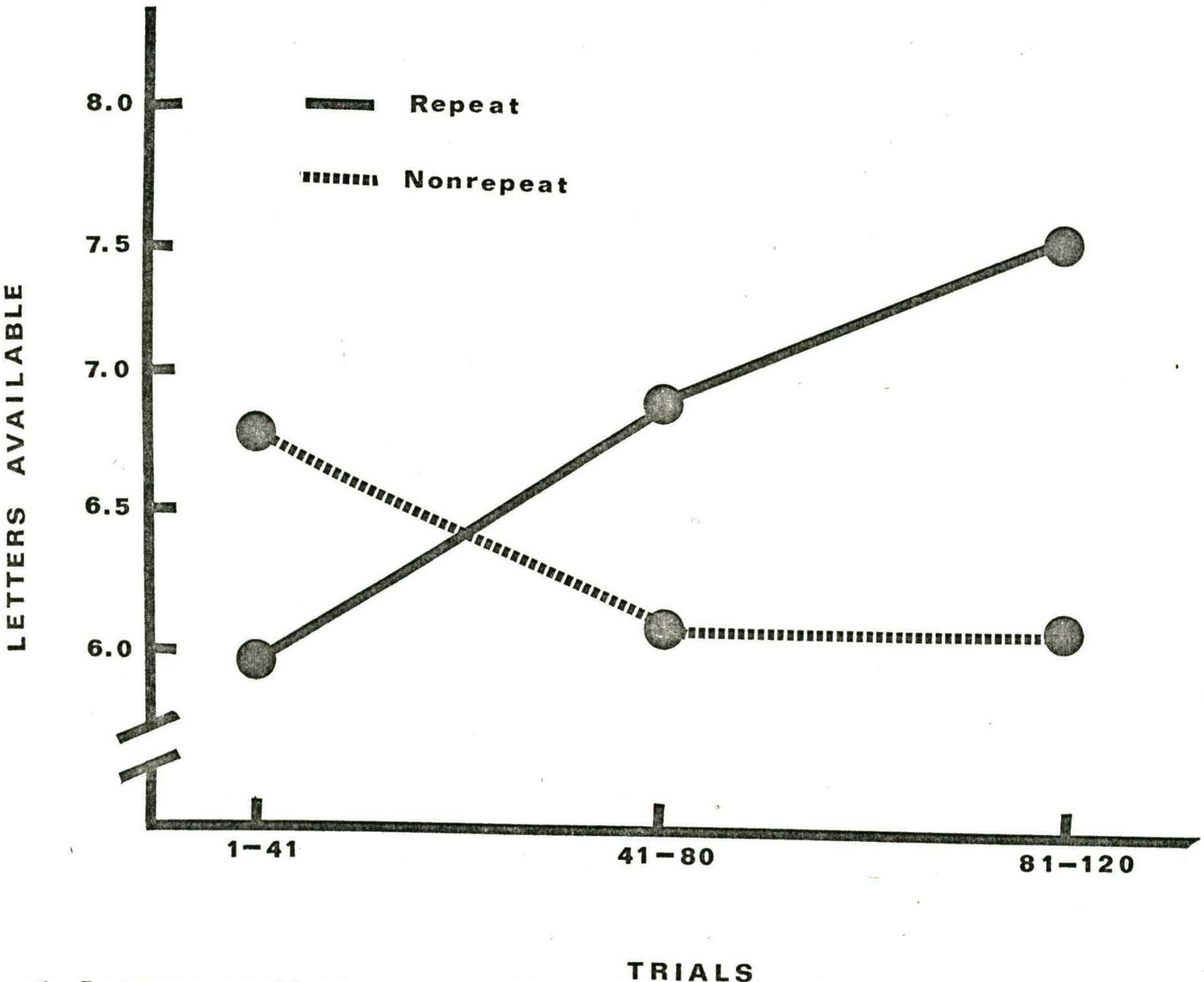

Fig. 5. Letters available across three blocks of trials: Partial data Experiment II

APPENDIX B

TABLES

TABLE 1

Analysis of Variance of Letters Available

Experiment I

Source	SS	df	MS	F
Repetition (A)	163.01	1	163.01	9.78 *
Report (B)	382.85	1	382.85	84.39 **
Delay (C)	103.22	4	25.81	34.09 **
Subjects (S)	150.24	7	21.46	
A X S	116.64	7	16.66	
B X S	31.76	7	4.54	
C X S	21.20	28	.76	
A X B	.03	1	.03	.02
B X C	122.54	4	30.63	29.92 **
A X C	14.28	4	3.57	7.05 **
A X B X S	9.27	7	1.32	
B X C X S	28.67	28	1.02	
A X C X S	14.19	28	.51	
A X B X C	2.53	4	.63	.02
A X B X C X S	902.51	28	32.23	
Total	2026.29	159		

* $p < .05$

** $p < .01$.

TABLE 2

Analysis of Variance of Letters Available

Experiment II

Source	SS	df	MS	F
Repetition (A)	53.48	1	53.48	6.94 *
Report (B)	133.22	1	133.22	16.03 **
Delay (C)	46.72	4	11.68	7.82 **
Subjects (S)	520.33	7	74.33	
A X S	54.06	7	7.72	
B X S	58.17	7	8.31	
C X S	41.84	28	1.50	
A X B	.00	1	.00	.00
B X C	52.76	4	13.19	20.34 **
A X C	9.16	4	2.29	4.15 *
A X B X S	9.99	7	1.43	
B X C X S	18.16	28	.65	
A X C X S	15.44	28	.55	
A X B X C	1.64	4	.41	.55
A X B X C X S	20.73	28		
Total	1035.69	159		

* $p < .05$

** $p < .01$

TABLE 3

Analysis of Variance of Blocked Data

Experiment II

Source	SS	df	MS	F
Repetition (A)	44.90	1	44.90	7.58 *
Report (B)	99.77	1	99.77	16.30 **
Blocks (C)	44.06	3	14.69	6.12 **
Subjects (S)	425.98	7	60.85	
A X S	41.45	7	5.93	
B X S	42.86	7	6.12	
C X S	50.46	21	2.40	
A X B	.01	1	.01	.00
A X C	27.73	3	9.24	5.57 **
B X C	1.88	3	.63	1.37
A X B X S	16.60	7	2.37	
A X C X S	34.78	21	1.66	
B X C X S	9.61	21	.46	
A X B X C	1.49	3	.50	1.14
A X B X C X S	9.30	21	.44	
Total	850.88	126		

* $p < .05$

** $p < .01$

TABLE 4

Analysis of Variance of Letters Available

Experiment III

Source	SS	df	MS	F
Repetition (A)	3.18	1	3.18	.86
Delay (B)	15.16	2	7.58	14.69 **
Subjects (S)	103.16	7	14.75	
A X S	25.88	7	3.70	
B X S	7.22	14	.52	
A X B	4.21	2	2.11	5.55 *
A X B X S	5.30	14	.38	
Total	164.21	47		

* $p < .05$

** $p < .01$

TABLE 5

Analysis of Variance of Partial Data

Experiment II

Source	SS	df	MS	F
Repetition (A)	3.36	1	3.36	2.35
Blocks (B)	1.27	2	.64	.55
Subjects (S)	335.43	7	47.92	
A X S	10.01	7	1.43	
B X S	16.31	14	1.16	
A X B	11.57	2	5.79	4.23 *
A X B X S	19.24	14	1.37	
Total	397.19	47		

* $p < .05$

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