

VISUAL FEEDBACK, KNOWLEDGE OF THE PROBLEM, AND CHANGE IN
PERFORMANCE ON A DISCRETE PERCEPTUAL-MOTOR TASK

A Thesis

Presented to

The Faculty of Graduate Studies and Research
University of Manitoba

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by

William Charles Blair

April 1964



ACKNOWLEDGMENTS

The writer is indebted to Dr. A. H. Shephard who offered encouragement and advice throughout the investigation and preparation of this thesis.

This research was supported by Research Grant No. 9401-19 from the Defence Research Board of Canada.

ABSTRACT

Ten subjects were randomly assigned to each of thirty-two groups. No differences in percentage correct, percentage errors, or total number of responses could be demonstrated between the sixteen groups receiving information about subsequent measurement of recall (IMR), and the sixteen groups not receiving information about measurement of recall (NIMR). The sixteen groups were differentiated on the basis of four types of visual feedback.

No increase occurred in performance without knowledge of results, and no significant deterioration could be shown when knowledge of results was removed. Practicing first without KR did facilitate subsequent learning for one group when KR was provided.

A simple relationship between the amount of information to be processed and the number of responses could not be demonstrated. The results failed to demonstrate that the number of responses increases as the amount of information to be processed decreases.

TABLE OF CONTENTS

CHAPTER	PAGE
I INTRODUCTION.	1
II REVIEW OF THE LITERATURE.	3
Knowledge of Retention Measurement.	3
Knowledge of Results.	4
Amount of Information and the Length of the Interval Following Feedback	5
Hypotheses.	6
III EXPERIMENTAL METHOD, RESULTS, AND DISCUSSION	
OF RESULTS.	8
Subjects.	8
Apparatus	8
Procedure	11
Results	14
Discussion.	25
Suggestions for Further Research.	28
IV SUMMARY AND CONCLUSIONS	29
BIBLIOGRAPHY.	32
APPENDIX.	34

LIST OF TABLES

TABLE	PAGE
I Feedback Conditions for the Three Five- Minute Periods of Practice for Both Conditions of Knowledge of Retention Measurement,	13
II Analysis of the Average Percentage of Correct Responses for Three Five-Minute Periods of Practice Between Subsequent Measurement of Retention (IMR) and no Knowledge (NIMR) for all Groups.	14
III Analysis of Differences in Percentage of Correct Responses After Withdrawal of KR for Groups Differing in Prior KR Experience ,	15

LIST OF ILLUSTRATIONS

FIGURE	PAGE
1. Means of Percentage Correct for Groups Practicing on Condition A During Periods 1 and 3.	16
2. Means of Percentage Correct for Groups Practicing on Condition B During Periods 1 and 3.	17
3. Means of Percentage Correct for Groups Practicing on Condition C During Periods 1 and 3.	18
4. Means of Percentage Correct for Groups Practicing on Condition D During Periods 1 and 3.	19
5. Mean Number of Responses for Groups Practicing on Conditions A, B, and C, During Periods 1 and 3.	23
6. Mean Number of Responses for Groups Practicing on Conditions D During Periods 1 and 3.	24

CHAPTER I

INTRODUCTION

Both psychologists and educators have been interested in the changes in learning produced by (1) the knowledge that there will be subsequent measurement of retention, and (2) the provision of various amounts of knowledge about the consequences of making responses during learning. This thesis is concerned with some hypotheses derived from literature available on these topics. It differs from previous work in type of apparatus used, and in some aspects, in the measures of performance taken. The questions to be examined are:

- (1) Whether a task will be retained better when information that retention will subsequently be measured is given, or whether retention will be equally proficient without this information.
- (2) Whether learning occurs without knowledge of results.
- (3) Whether varying the amounts of visual feedback will change the level of performance.

A relatively recent way of conceptualizing part of the problem concerns the length of the time interval required to process information after feedback. The length of the time between two responses will be a function of the amount of information to be processed. As very little research has

been done on this problem in this conceptual framework, this thesis will attempt to answer some of the hypotheses that have been suggested with respect to the time interval after feedback. The task and the measures of performance differ from those previously used.

CHAPTER II

REVIEW OF THE LITERATURE

I. Knowledge of Retention Measurement

A number of investigators have shown that verbal material is retained better when learned with the knowledge that retention will later be measured (Mulhall, 1915; Achilles, 1920; Boswell and Foster, 1916; Peterson, 1916). For sake of brevity of expresseion, a condition in which such information is supplied prior to the beginning of the experiment, will be designated as the "information about measurement of retention" (IMR) condition. Sanderson (1929), using both number and stylus mazes, showed that knowledge of subsequent measurement of retention (IMR) resulted in retention superior to that found with no-knowledge (NIMR).

Lavery (1964) required Ss to learn a pressure response of 3.5 pounds, and found that IMR resulted in retention superior to both NIMR and similar knowledge given immediately following learning. On the basis of these results he concluded that instructions about the measurement of retention affected learning rather than retention following learning. However, he was unable to show any differences in level of performance for the different conditions during acquisition. While differences could not be shown in terms of his single measure of performance, if his conclusion on the effect of

IMR is correct, it would seem that it might be possible to show differences in terms of some other measure, such as number of errors.

II. Knowledge of Results

Feedback resulting from the occurrence of a response is frequently referred to as knowledge of results (KR). Numerous studies have attempted to demonstrate relations between some dimensions of KR and learning. Thorndike (1931) concluded that when no information was given on how well a line of standard length was duplicated, no learning occurred. Seashore and Bavelas (1941), in checking these results, found that although the responses were not correct, the lines became more consistent in length, but not necessarily consistent about the original standard length.

Greenspoon and Foreman (1956), demonstrated that intervals of delay of KR of 0, 10, 20, and 30 secs. all resulted in better learning than no KR for a line-drawing task. Increasing the length of the delay decreased the rate of learning. However, Bilodeau and Ryan (1960), and a number of earlier studies, found that increasing the delay did not decrease the rate of learning.

In a lever displacing task, Bilodeau, Bilodeau, and Shumsky (1959) found that prior practice without KR did not facilitate subsequent performance when KR was later supplied. When KR was withdrawn there was a drop in response proficiency. Baker and Young (1962) reported that with line drawing, the drop in performance resulting from the removal

of KR is independent of the amount of previous training with feedback. Although there was a drop in performance, there was not a complete loss of skill with removal of KR,

Arps (1917, 1920) reported that removal of KR did not produce a drop in level of performance with an ergograph task. With regard to this study Annett (1961, p. 20) observes, "In this case the response tolerance was not particularly stringent and the loss of visual information was not very great." This would suggest that the complexity of the response might be important in determining the significance of removal of knowledge of results. An interesting way to conceptualize complexity of task would be in terms of the amount of information in it, or the uncertainty of response associated with it. The more information in a task, the more there is to be learned. When a task has not been learned to criteria, it is said to contain further information. As learning progresses, the task will contain less information, or the responses will be more certain.

III. Amount of Information and the Length of the Interval Following Feedback

According to Miller (1956), the time required to process information is directly related to the amount of information to be processed. It would be expected that responses providing larger amounts of feedback (relevant information) would be less frequent due to the added time required

for processing. Bourne and Bunderson (1963, p. 4), on the basis of two different views suggest a longer post-information feedback (IF) interval is likely, "because the subject can process only a fraction of the available information in any short interval (Miller, 1956), or because stimulus cues fluctuate in and out of the sample effective at any instant (Estes, 1955)." This means that subjects on self-paced tasks will respond more slowly if each response yields a large amount of information.

Becker, et al (1963), in a simple line drawing experiment, found that the length of the post-IF interval was not a variable in terms of the ability to learn to draw the line correctly while blindfolded. Their measure of performance was percentage correct. It is possible that other measures of performance or more complex tasks might indicate the importance of the post-IF interval for learning.

IV. Hypotheses

This study will examine the following hypotheses suggested by the research noted above:

- (1) IMR will result in a smaller deterioration in level of performance, from original learning to retention measurement, than NIMR.
- (2) After learning with KR, removal of KR will produce a drop in level of performance.

- (3) An increase in KR will result in improved learning, indicated by an increase in level of performance.
- (4) Without KR there will be no learning.
- (5) Responses providing less information will have a shorter post-IF interval.
- (6) With more information transmitted, the post-IF interval gradually decreases as the amount of information to be processed decreases.

CHAPTER III

METHOD

Subjects

Thirty-two groups of ten Ss each were formed by a random assignment of students from an Introductory Psychology class. Male and female subjects were used as previous unpublished data showed no differences in learning between sexes on the apparatus used in this study. None had previous experience with the apparatus.

Apparatus

The Visual Discrimination Apparatus consists of a vertical panel containing six double-light assemblies arranged at eye-level in a horizontal row. Each light assembly consists of a red ring one inch in diameter with a green disc of $5/8$ inch diameter located inside it. Successive pairs of lights are $1/8$ inch apart.

The six red rings (stimulus lights) are lighted by feeding a punched five-hole telegraph tape into a tape reader. The programming of the random order of the red ring was arranged in such a way that each ring was presented twice in each sequence of twelve red rings, and that the same red ring did not occur twice in succession. The green discs (response lights) are lighted by pressing one of the six buttons arranged in a line in front of the seated S. The task was to learn the specific button associated with

each red ring. A given button-light pair was associated throughout the experiment.

The apparatus was such that the central green disc could be either lighted, or not lighted when S pressed a button, and a red ring extinguished and a new one lighted either when a correct response was made, or when any response was made. In this way, the type and amount of visual feedback was controlled by presenting various combinations of these four conditions.

The four different conditions of visual feedback used were:

Condition A. Each button lighted a central green disc, and S was to find the correct button to light the green disc inside the lighted red ring. This was referred to as a "correct match". In this condition a new red ring appeared only after a correct match. Information about a correct response was given by means of both the green disc coming on in the lighted red ring, and the red ring extinguishing and a new red ring lighting. When an incorrect button was pressed the green light associated with it came on, but a new red ring did not appear. Information regarding relationships between buttons and green lights could thus be obtained on incorrect responses as well as on correct ones.

Condition B. No green light was lighted for any button pressed in this condition. Information about a correct res-

ponse was given only in terms of the appearance of a new red ring. For an incorrect response no information was given about the red light for which this button would be correct. Knowledge that the response was incorrect was indicated by the failure of a new red ring to appear.

Condition C. As in Condition A, a green light lighted for each button pressed, and the green disc had to be placed in the red ring to be counted as a correct match. However, in this condition the red ring changed for each response, whether the response was correct or incorrect. Direct information regarding a correct response could only be obtained by pressing a correct button. Information was available for incorrect responses as in Condition A.

Condition D. As in Condition B, a green light was never lighted by a button press, and, as in Condition C, a new red ring appeared for each button press. This could be regarded as a no-KR condition.

While it is not readily possible to demonstrate operationally that the amount of information transmitted as the result of a response under each of these conditions forms a scale of the decreasing order A, B, C, and D, it was felt that this did represent such an order. This inference was based on two assumptions: (1) that direct feedback about correct responses would constitute the largest amount of information (Conditions A and B), and (2) that information

about non-correct responses (Condition A and C) would be greater than general information about non-correct responses (Condition B), but less than that about correct responses.

The relation between lights and buttons was such that green lights could be successively lighted across the panel from left to right by successively pressing buttons in the order 2, 1, 4, 6, 3, 5. Other button-light arrangements could have been used but this arrangement has been shown to be more difficult than others involving greater degrees of button-light spatial correspondence.

Two measures of performance were taken: (1) number of correct responses, and (2) number of incorrect responses, the latter being divided into corresponding responses, in which the button pressed corresponded to the lighted red ring in spatial position, and non-corresponding responses.

Measures were recorded in successive 20-second intervals over the three periods of five minutes of continuous practice. The measures from the 20-second intervals were later combined to form fifteen one-minute intervals.

Procedure

The groups differed in two respects: (1) prior knowledge regarding the conditions of practice (IMR and NIMR); (2) visual feedback conditions during the three practice periods.

Two general conditions of knowledge of retention

measurement were employed in this study, half the groups being assigned to each:

- (1) IMR - Instructions about the nature of the feedback for all three periods were read at the beginning of the experiment. Before each practice period instructions were given concerning the feedback which would immediately follow.
- (2) NIMR - Instructions were read only before each five-minute period. No information was given regarding the type of visual feedback for the practice periods which followed. Other instructions regarding the operation of the apparatus were identical between these conditions according to the feedback conditions assigned.

All Ss practiced continuously for three five-minute periods separated by two minutes of rest. In the first and third practice periods, practice was under the same condition. However, for the second period the conditions might be changed to one of the other feedback conditions. Conditions of feedback for the three periods for the 32 groups are shown in Table I. The Ss were told to make as many correct matches as possible before the apparatus was shut off. The specific conditions were carefully described. Groups with no-KR were told to press the button that they thought was correct for each red ring.

TABLE I

FEEDBACK CONDITIONS FOR THE THREE FIVE-MINUTE
PERIODS OF PRACTICE FOR BOTH CONDITIONS
OF KNOWLEDGE OF RETENTION MEASUREMENT

Retention Knowledge Group		Practice Period		
		1	2	3
NIMR	IMR			
1	17	A	A	A
2	18	A	B	A
3	19	A	C	A
4	20	A	D	A
5	21	B	A	B
6	22	B	B	B
7	23	B	C	B
8	24	B	D	B
9	25	C	A	C
10	26	C	B	C
11	27	C	C	C
12	28	C	D	C
13	29	D	A	D
14	30	D	B	D
15	31	D	C	D
16	32	D	D	D

Condition A: Red ring moves on a correct response, green disc lighted.

Condition B: Red ring moves on a correct response, no green light.

Condition C: Red ring moves on each response, green disc lighted.

Condition D: Red ring moves on each response, no green light.

RESULTS

I. No significant differences in the percentage of correct, total number, or percentage of error responses for any of the periods, could be demonstrated between the two general conditions IMR and NIMR. This would suggest that giving instructions regarding subsequent measurement of retention prior to learning did not affect performance in terms of any of the measures taken during the three practice periods.

TABLE II

ANALYSIS OF THE AVERAGE PERCENTAGE OF CORRECT RESPONSES FOR THREE FIVE-MINUTE PERIODS OF PRACTICE BETWEEN SUBSEQUENT MEASUREMENT OF RETENTION (IMR) AND NO KNOWLEDGE (NIMR) FOR ALL GROUPS

Source	df	ms	F	p
B (IMR and NIMR)	1	73.23	.09	> .05
C (Groups)	15	13017.19	17.21	< .001
B x C	15	622.91	.82	> .05
error (b)	288	756.35		
A (Periods)	2	70831.11	418.69	< .001
A x B	2	460.11	2.71	> .05
A x C	30	1552.74	9.17	< .001
A x B x C	30	112.65	.66	> .05
error (w)	576	169.17		
Total	959			

II. An analysis of the differences in percentage of correct responses after withdrawal of KR failed to show any significant deterioration in performance although the general performance level appeared to be slightly lower (groups 4, 8, 12, 16, 20, 24, 28, and 32). Since there were no differences in performance between comparable groups from the two general conditions IMR and NIMR, the groups were combined to provide four groups of 20 Ss each. For example, Groups 4 and 20 were combined to form a group of 20 Ss practicing under condition ADA. A comparison was made between the three groups having prior practice with KR in the first period and with no-KR in the second period, and the group having no KR throughout (Figures 1, 2, 3, and 4). The differences in the percentage correct for the last minute of Period 1 and the average percentage correct for Condition D for Period 2 were compared by means of the analysis shown in Table III.

TABLE III
ANALYSIS OF DIFFERENCES IN PERCENTAGE OF CORRECT RESPONSES AFTER
WITHDRAWAL OF KR FOR GROUPS DIFFERING IN PRIOR KR EXPERIENCE

Source	df	ms	F
Within	76	214.4	
Treatment	3	218.7	1.02*
Total	79		
*not significant	p > .05		

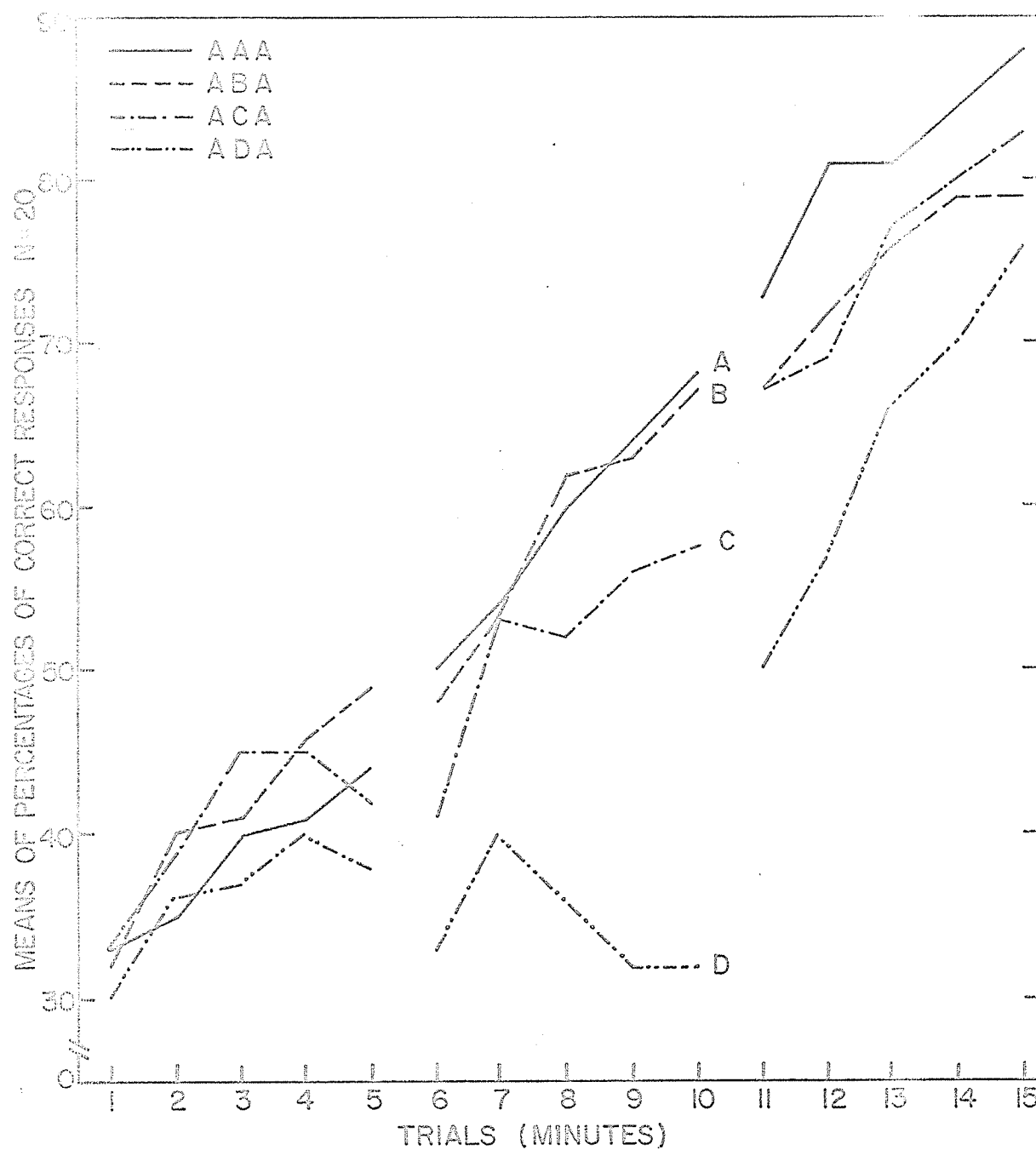


FIGURE 1
 MEANS OF PERCENTAGE CORRECT FOR GROUPS PRACTICING ON
 CONDITION A DURING PERIODS 1 AND 3

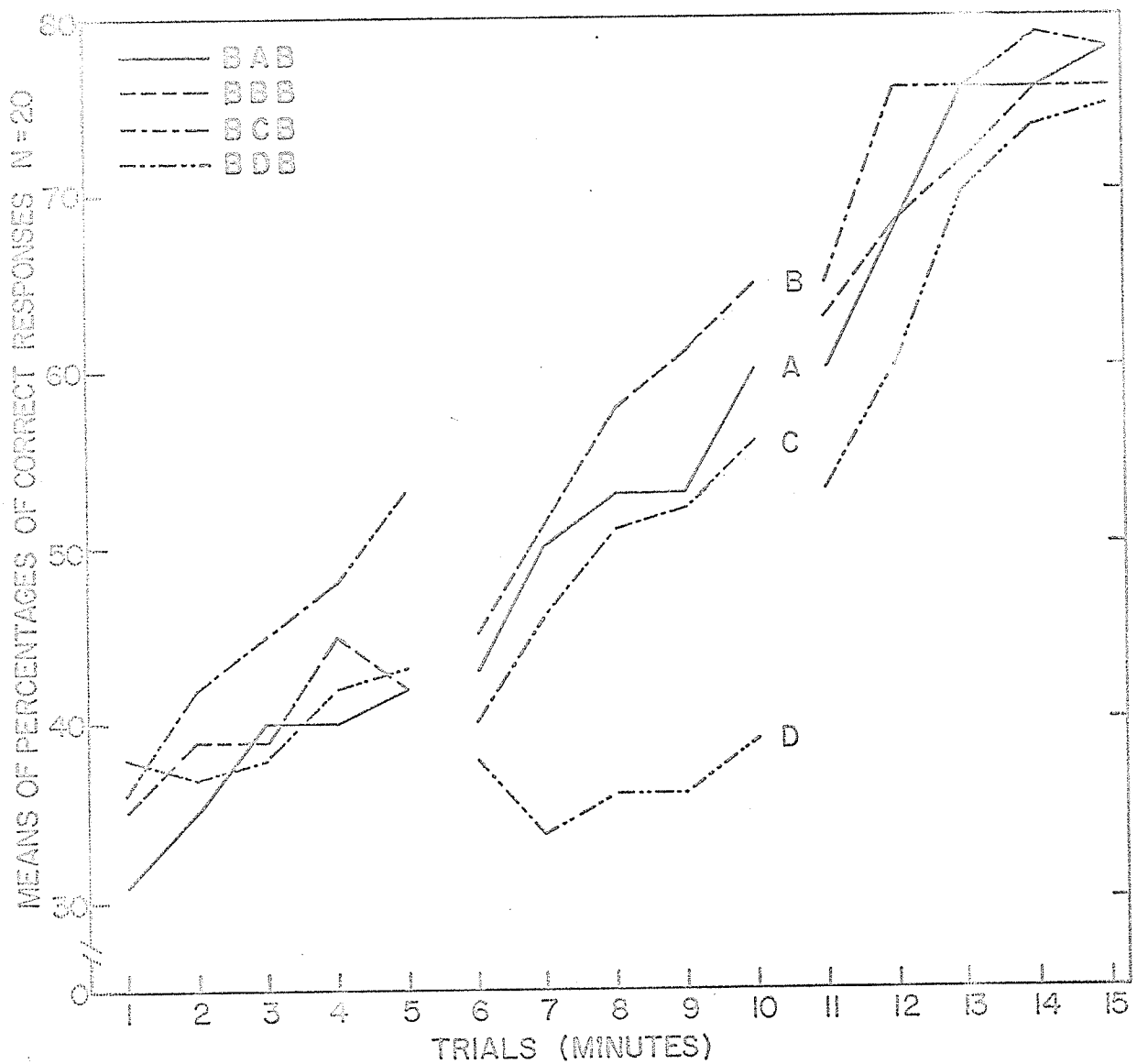


FIGURE 2
MEANS OF PERCENTAGE OF CORRECT RESPONSES FOR GROUPS
PRACTICING ON CONDITION B DURING PERIODS 1 AND 3

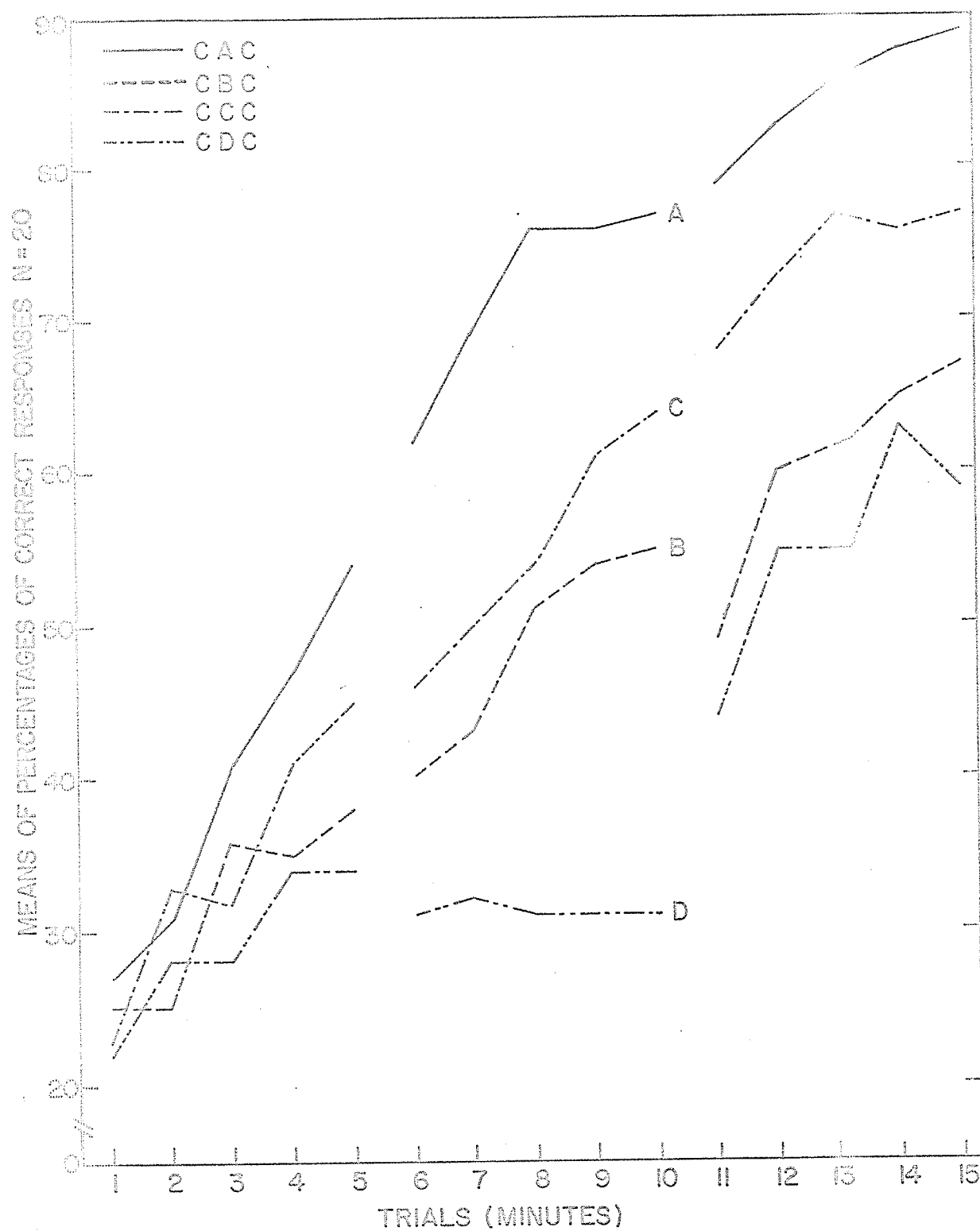


FIGURE 3
MEANS OF PERCENTAGE OF CORRECT RESPONSES FOR GROUPS
PRACTICING ON CONDITION C DURING PERIODS 1 AND 3

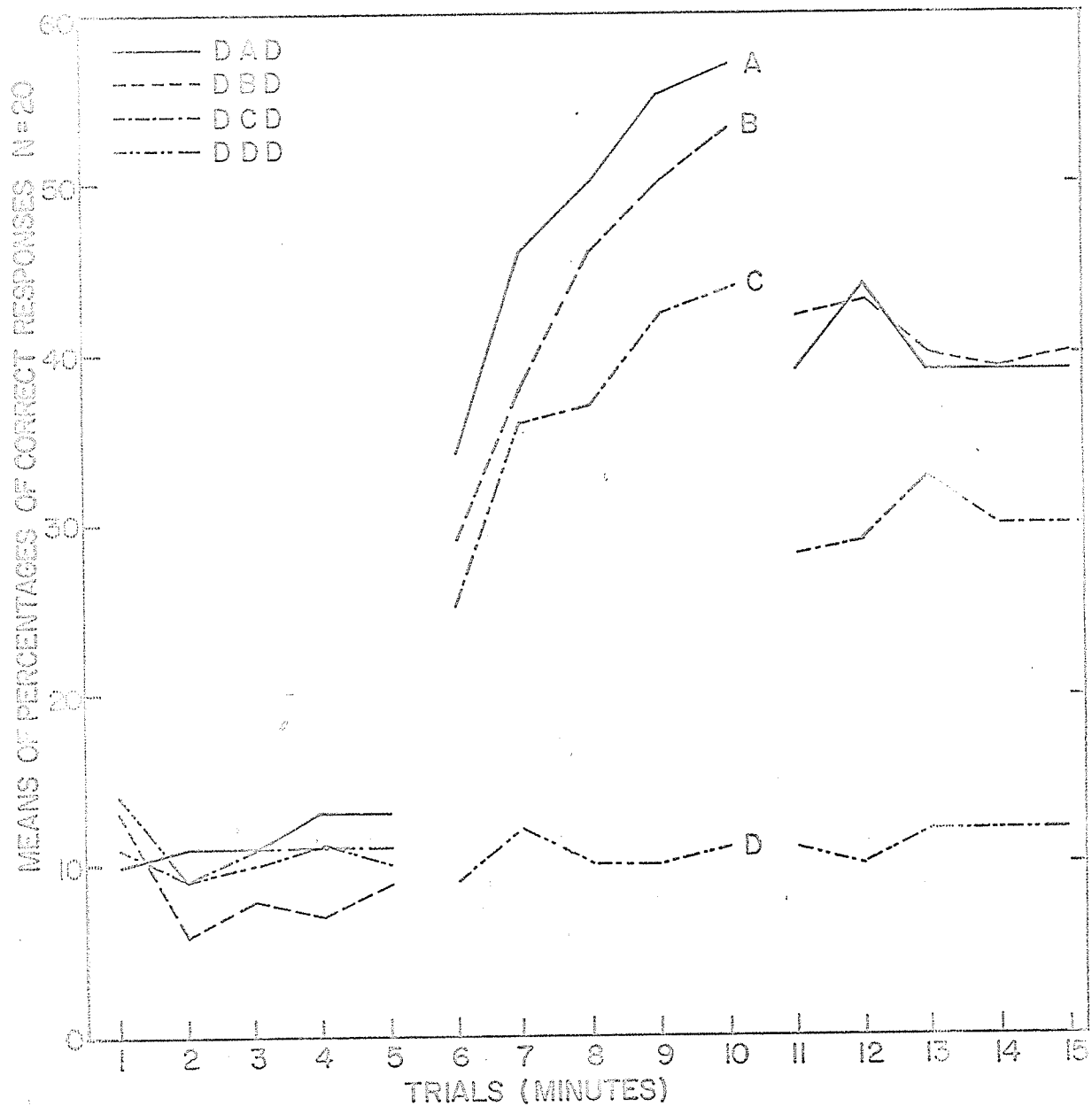


FIGURE 4
 MEANS OF PERCENTAGE OF CORRECT RESPONSES FOR GROUPS
 PRACTICING ON CONDITION D DURING PERIODS 1 AND 3

As was previously noted, since no difference could be demonstrated between the general conditions IMR and NIMR, the groups with the same feedback in each of these conditions were combined, thus making 16 groups. From Figures 1, 2, and 3, it can be seen that the level of performance improved rapidly during the first five minutes with the KR provided in Conditions A, B, and C. For the first five minutes the level of performance for Conditions A and B were comparable, with C somewhat lower, and D, the condition of No-KR, the lowest of the four. Analyses were done between:

- (1) Conditions A and B, ($F = .26$, $df = 1/304$, $p > .05$);
- (2) Conditions A, B; and C, ($F = 15.03$, $df = 1/304$, $p < .001$);
- (3) Conditions A, B, C; and D, ($F = 344.2$, $df = 1/304$, $p < .001$).

The results of these analyses are interpreted to mean that differences in the nature of the feedback influence levels of percentage of correct responses, with the two conditions characterized by the largest amount of feedback being superior.

As can be seen from Figure 4, no learning occurred without KR. However, it was found that practice on Condition D during the first period facilitated subsequent performance during the second period under condition A, but not when switched to Conditions B or C. After practicing under Condition D, when KR was introduced, performance under Conditions A, B, and C began at approximately the same level as that for the groups which did not practice on Condition D. After five minutes of

practice on Condition A, during Period 2, percentage correct was at a higher level for this group than for the group not previously practicing on Condition D. This was not the case for Conditions B and C as shown in Figures 1, 2, 3, and 4. Using the average percentage correct for the composite groups, the t -values were as follows:

- (1) Condition A in period 1, and Condition A following Condition D ($t = 3.5$, $df = 98$, $p < .01$).
- (2) Condition B, and Condition B following Condition D ($t = 1.59$, $df = 98$, $p > .05$).
- (3) Condition C, and Condition C following Condition D ($t = .70$, $df = 98$, $p > .05$).

These seem to indicate that in some cases learning will be facilitated by initial practice without KR.

As can be seen from Figure 4, during the five minutes of practice with KR in Period 2, following initial practice with no-KR, performance increases rapidly, and when KR is again removed, the level of performance drops. For Period 3, the level of performance for the three groups that had KR during Period 2 was higher than for the no-KR condition ($F = 11.34$, $df = 1/76$, $p < .005$). This would seem to indicate that Ss in Period 3 were supplying themselves with some feedback, thus preventing, due to some kind of extinction process, the level of performance from dropping to the level of the group which had no-KR during Period 2.

III. The results only partially support the hypothesis that with less information to be processed, the post-IF interval will be shorter, and as a result more responses will be made. Condition D, which supplied the least information had the largest number of responses in Period 1, as shown in Figure 6. Next were Conditions A and B, and then Condition C, with the least number of responses in Period 1, as shown in Figure 5. Analyses of the average number of responses for the different KR conditions for Period 1 were:

- (1) Condition A and B ($F = .15$, $df = 1/304$, $p > .05$);
- (2) Conditions A, B; and D, ($F = 3.75$, $df = 1/304$, $p > .05$);
- (3) Conditions A, B, D; and C, ($F = 226.32$, $df = 1/304$, $p < .001$).

This is interpreted to mean that the relation between the magnitude of the post-IF interval and amount of information to be processed is not a simple linear one.

As can be seen from Figure 5, the results did not support the hypothesis that as the amount of information transmitted decreases, as a consequence of learning, the number of responses increases. During the first five minutes with KR, learning occurred, but the mean number of responses remained the same. The only group that shows a consistent rise in number of responses is the no-KR group.

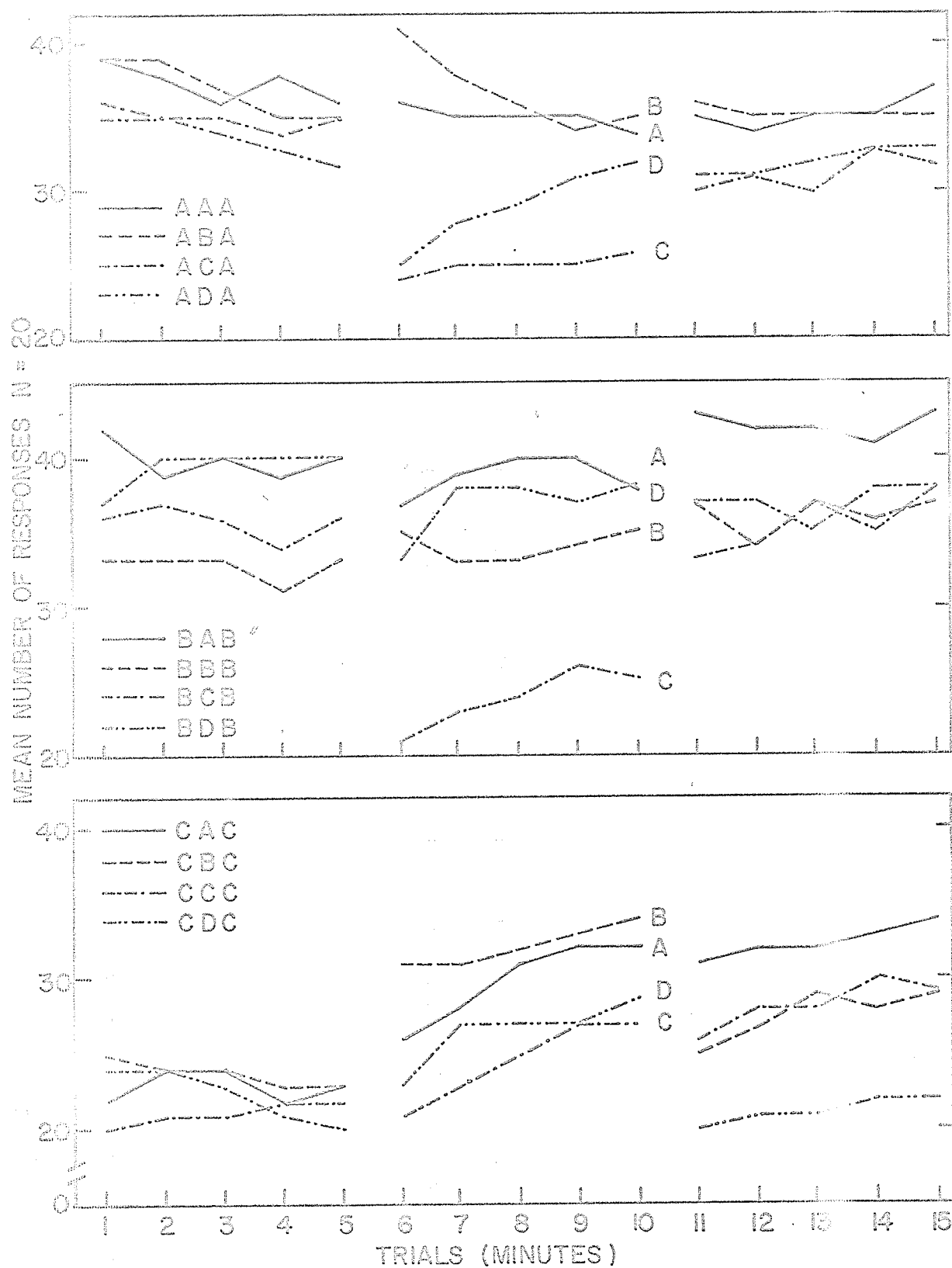


FIGURE 5

MEAN NUMBER OF RESPONSES FOR GROUPS PRACTICING ON
CONDITIONS A, B, AND C, DURING PERIODS 1 AND 3

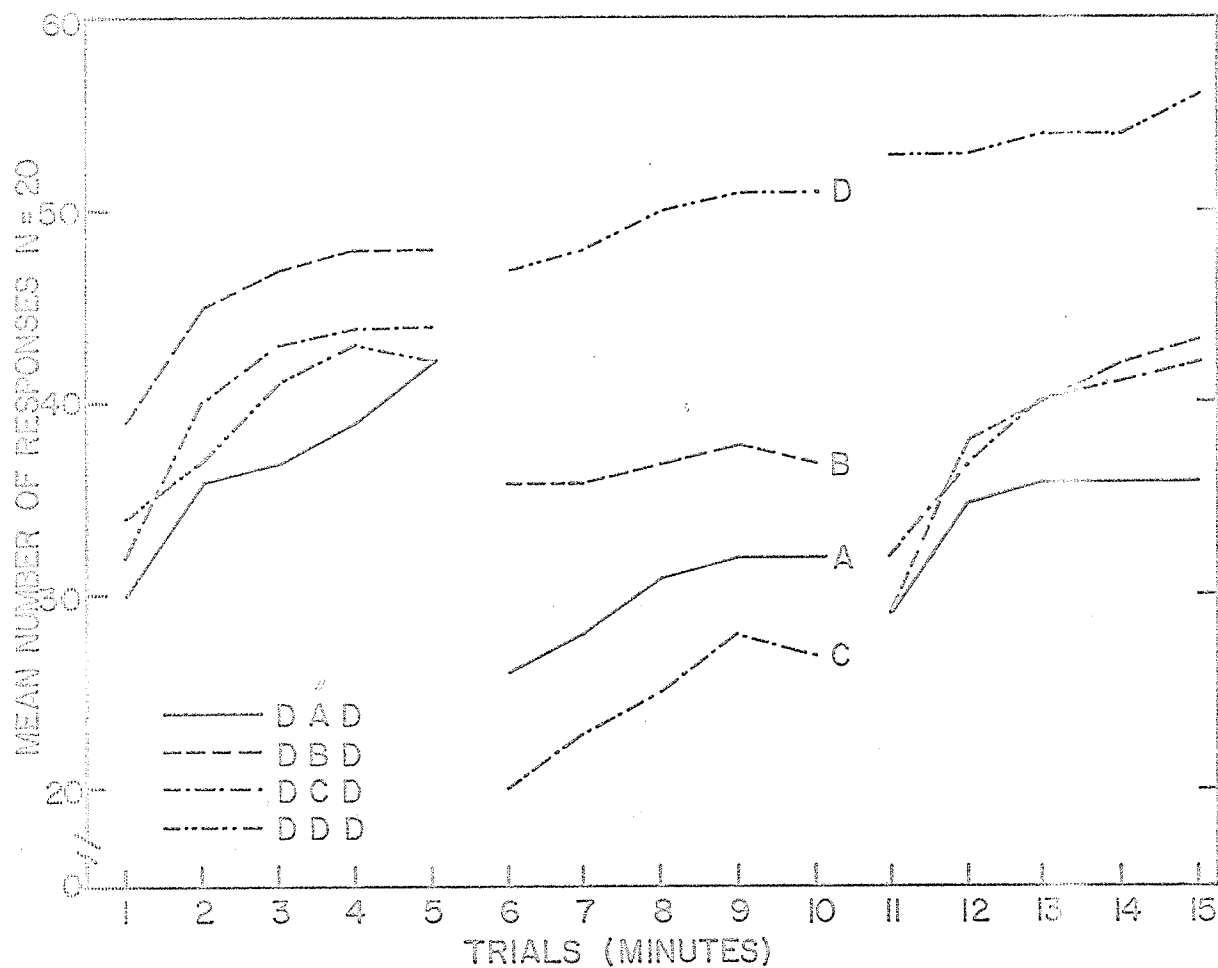


FIGURE 6
MEAN NUMBER OF RESPONSES FOR GROUPS PRACTICING ON
CONDITION D DURING PERIODS 1 AND 3

DISCUSSION

The results of this experiment were not able to support previous research in demonstrating differences in the level of retention between groups that had knowledge about subsequent measurement of retention and those that had no knowledge. The percentage correct, percentage errors, and mean number of responses, appeared to be similar for the IMR and NIMR conditions in aquisition and retention.

The groups (16 and 32) that received no-KR showed no increase in percentage correct during the 15 minutes of practice under this condition. This was consistent with the findings of Thorndike (1931), Greenspoon and Forman (1956), and Bilodeau, et al (1959).

Some of the other findings of Bilodeau, et al (1959) did not seem to be supported by this study. The first was that prior practice without KR did not improve subsequent performance with KR. The results of this experiment show that five minutes of practice without KR facilitated learning when conditions of practice were changed from D to A, but not when changed to B or C. This facilitation would not appear to be due to the effects of a warm-up as only Condition A showed an increase in performance. If this was merely the effect of a warm-up, Conditions B and C should also have shown a similar increase in level of performance.

Perhaps some aspect of the task interacted with the amount of visual feedback supplied in Period 2 and Ss became more familiar with this as the result of the prior non-KR practice.

Although Bilodeau, et al (1959) were able to demonstrate that removing KR produced a deterioration in performance, the general performance level in this study appeared to be slightly lower, but the statistical analysis failed to demonstrate any significant deterioration. This was consistent with the findings of Arps (1917, 1920), but not with Baker and Young (1962). It is doubtful that this finding can be criticized on the basis that the responses to be learned were not complex enough as was suggested of Arps' study by Annett. After 15 minutes practice none of the groups had achieved over 90% proficiency. It appears that the knowledge gained in the first period was used to maintain performance when KR was removed. Responding without KR is non-reinforcing, and if Ss had not been supplying themselves with some feedback, extinction might have been expected.

Although Condition A would appear to supply more visual feedback than Condition B, it did not change the general level of performance. Condition A and B, differing only in that a green light did not come on for B, performed at the same level of proficiency during the first period. As the additional feedback supplied by the green light did not appear to increase the level of

performance, it would seem that the only information used in learning the correct button was the change in the location of the illuminated red ring. If the important information in learning this task is the making of a correct response, it can be hypothesized that Condition A and B would learn faster than Condition C. Due to the nature of Conditions A and B, a failure to make a correct match with the first button pushed, permits S to have additional attempts, as needed until a correct response is made. For Condition C, the red ring moves with every response, making the theoretical probability of making a correct match one in six if there is no learning carried over from the previous non-reinforced response. As the overall rate of responding was higher for A and B, to get a higher percentage correct, they had to make more correct responses, and since correct responses seem more important for learning, one would expect learning to be faster for Conditions A and B.

The finding of this study only partially supported the hypotheses of Bourne and Bunderson (1963). Consistent with their prediction, the largest number of responses was produced under Condition D, resulting in the shortest post-IF interval. However, numbers of responses for each of the other conditions were not in the order predicted. Under Conditions A and B an equal number of responses were made and while slower than

D, were faster than Condition C. Perhaps the relationship between the amount of feedback and the post-IF interval is not a linear one, or, as noted by Becker, et al (1963), the post-IF interval is not an important variable in learning. In this study the length of the post-IF interval was not related to the level of learning in any simple fashion.

The hypothesis that the post-IF interval would decrease as learning occurred was not supported. After five minutes of practice with KR, some learning had occurred, but the mean number of responses had not changed. It appears that correct responses are substituted for incorrect, with the post-IF interval remaining constant.

Suggestions for Further Research

Further experimentation is needed to learn why the additional information, given by the green light in Condition A, was not used to facilitate performance. If Ss had used the additional information supplied by the green light, their level of performance should have been higher than Condition B. It is also suggested that a group similar to Condition C be run, except that the green light be omitted and some other method used to give information regarding a correct match.

If making a correct match is the important factor in learning the task, and the green light is not used to provide additional information about wrong responses, then the latter group should have the same level of performance as the group in Condition C.

CHAPTER IV

SUMMARY AND CONCLUSIONS

This investigation is concerned with the effects on learning of:

- (1) information about subsequent measurement of retention (IMR);
- (2) removal of knowledge of results (KR);
- (3) the introduction of KR;
- (4) practice with no-KR;
- (5) the amount of visual feedback in relation to the post-information feedback (IF) interval.

Ten subjects were randomly assigned to each of thirty-two groups. There were sixteen groups in each of two general experimental conditions, the first receiving information about subsequent measurement of recall (IMR), and the second no information about measurement of recall (NIMR). The sixteen groups provided various combinations of four types of visual feedback. Practice during the first and last of three five-minute periods was on the same feedback condition. However, during the middle period, practice was systematically varied over the four possible feedback conditions. Performance was measured in terms of correct responses and errors for a one-minute interval.

No differences in performance could be demonstrated between the IMR and NIMR groups. No increase occurred in

performance without KR, and no significant deterioration could be shown when KR was removed. Practicing first without KR did facilitate learning in one group when switched to a KR condition.

A simple relationship between the amount of information to be processed and the length of the post-IF interval could not be demonstrated. The results failed to demonstrate that the post-IF interval gradually decreases as the amount of information to be processed decreases. The post-IF interval remained fairly constant during learning.

Further experimentation is suggested for the investigation of the failure to utilize additional feedback which was supplied to some groups but which failed to increase rate of learning or level of performance.

BIBLIOGRAPHY

- Achilles, E.F.N. Studies in recall and recognition. Archiv. Psychol., 1920, 27, 1-77.
- Annett, J. The role of knowledge of results in learning: A survey technical report: NAVTRADEVCE, 342-3, May, 1961.
- Arps, G.F. A preliminary report of work with knowledge versus work without knowledge of results. Psychol. Rev., 1917, 24, 449-455.
- _____. Work with knowledge of results versus work without knowledge of results. Psychol. Monog., 1920, 28, No. 125.
- Baker, C., and Young, P. Feedback during training and retention of motor skill. Canad. J. Psych., 1960, 14, 257-264.
- Becker, P., Mussina, C., and Persons, R. Intertrial interval, delay of knowledge of results, and motor performance. Percept. Mot. Skills, 1963, 17, 559-563.
- Bilodeau, E., Bilodeau, I., and Shumsky, D. Some effects of introducing and withdrawing knowledge of results early and late in practice. J. exp. Psychol., 1959, 58, 142-144.
- Bilodeau, E., and Ryan, F., Prediction of complex task proficiency by means of component responses. Percept. Mot. Skills, 1961, 12, 299-306.
- Bowsell, F., and Foster, W. On memorizing with the intention of permanently to retain. Amer. J. Psychol., 1916, 27, 420-426.
- Bourne, L., and Bunderson, C. Effect of delay of informative feedback and length of post-feedback interval on concept identification. J. exp. Psychol., 1963, 65, 1-6.
- Greenspoon, J., and Foreman, S. Effect of delay of knowledge of results on learning a motor task. J. exp. Psych., 1956, 51, 226-228.

- Lavery, J. Retention of a skill following training with and without instructions to retain. Percept. Mot. Skills, 1964, 18, 275-281.
- Lindquist, D. Design and Analysis of Experiments in Psychology and Education. Houghton Mifflin Co., Boston, 1953.
- Miller, G. The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychol. Rev., 1956, 63, 81-87.
- Mulhall, E.F. Experimental studies in recall and recognition. Amer. J. Psychol., 1915, 26, 217-228.
- Peterson, J. The effect of attitude on immediate and delayed reproduction: A class experiment. J. exp. Psychol., 1916, 7, 523-532.
- Sanderson, S. Intention in motor learning. J. exp. Psychol., 1929, 12, 463-489.
- Seashore, R., and Bavelas, A. The functioning of knowledge of results in Thorndike's line-drawing experiment. Psychol. Rev., 1941, 48, 155-164.
- Thorndike, E.L. Human Learning. New York: Century Co., 1931.

APPENDIX

IMR INSTRUCTIONS PERIOD I

Group 17 A A A

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

You are to light the green light inside the red ring like this (push green light switch), and this is called making a match. The green light can be lighted by pushing one of the buttons here in front of you. A given button always lights the same green light.

When you push the button lighting the correct green light, (dem.) a different red ring will appear, and you are to push the button which lights the green light for this new red ring. Your score will be the number of correct matches that you make.

You will have three five-minute testing periods with a two-minute rest between each. The apparatus will operate the same way for all three periods.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Remember, in the first condition each green light is lighted by one and only one button. Each green light is lighted by the same button. Continue pressing the buttons until the correct button to light the green disc inside the red ring is found.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 18 A B A

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these conditions. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of lighting the green light inside the red ring, like this (demonstrate). This is called making a match. The green light can be lighted by pushing one of the buttons here in front of you. A given button always

lights the same green light.

When you push the button lighting the correct green light (dem.) a different red ring will appear, and you are to push the button which lights the green light for this new red ring. Your score will be the number of correct matches that you make.

In the middle or second period you will operate under a different condition in which you are to extinguish the red ring by pushing one of the buttons. This is a correct match. Only when you push the button that extinguishes the red ring will a new red ring appear.

Remember in the third period the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons. (Point).

Remember, in the first condition each green light is lighted by one and only one button. Each green light is lighted by the same button. Continue pressing the buttons until the correct button to light the green disc inside the red ring is found.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 19 A C A

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these conditions. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of lighting the green light inside the red ring like this (dem.). This is called making a match. The green light can be lighted by pushing one of the buttons in front of you. A given button always lights the same green light.

When you push the button lighting the correct green light (dem.) a different red ring will appear, and you are to push the button which lights the green light for this new red ring. Your score will be the number of correct matches that you make.

In the middle or second period you will operate under a different condition in which you are to light the green light inside the red ring as before, but this time whenever you push a button to light a green disc, a new red ring will

appear. Only when the green light was placed in the red ring is the response correct.

Remember in the third period the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off. Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons. (Point).

Remember, in the first condition each green light is lighted by one and only one button. Each green light is lighted by the same button. Continue pressing buttons until the correct button to light the green disc inside the red ring is found.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 20 A D A

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will

light up in this fashion. (Push red light switch),

There are two possible ways that the apparatus can operate. You are going to practice under both of these conditions. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of lighting the green light inside the red ring like this (dem.). This is called making a match. The green light can be lighted by pushing one of the buttons here in front of you. A given button always lights the same green light.

When you push the button lighting the correct green light (dem.) a different red ring will appear, and you are to push the button which lights the green light for this new red ring. Your score will be the number of correct matches that you make.

In the middle or second period you will operate under a different condition in which you will have to press the button which you think is correct. However, no green light will come on when you press a button and the red ring will move every time.

Remember, in the third period the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it

easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Remember, in the first condition each green light is lighted by one and only one button. Each green light is lighted by the same button. Continue pressing the buttons until the correct button to light the green disc inside the red ring is found.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 21 B A B

This is a learning experiment. You will observe that there are six double-lights in a row. (point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of pushing one of the buttons in front of you in order to extinguish the red ring and to light another red ring.



This is called making a match. You are then to press the correct button for this red ring. Your score will be the number of correct matches you make.

In the middle or second period you will operate under a different condition in which you are to light a green light inside the lighted red ring by pushing one of the buttons in front of you.

Only when you push the button lighting the correct green light (dem.) will a new red ring appear.

Remember, in the third period, the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

The same button always extinguishes the same red ring.

Remember, in the first condition continue pressing the button until a match is made.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 22 B B B

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

You are to push one of the buttons here in front of you (point) in order to extinguish the red ring and to light another red ring. This is called making a match. You are then to press the correct button for this red ring. Your score will be the number of correct matches you make.

Try to make as many correct matches as possible before the apparatus shuts off.

You will have three five-minute testing periods with a two-minute rest between each. The apparatus will operate the same way for all three periods.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

The same button always extinguishes the same red ring.

Continue pressing the buttons until a match is made.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 23 B C B

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of pushing one of the buttons in front of you in order to extinguish the red ring and to light another red ring. This is called making a match. You are then to press the correct button for this red ring. Your score will be the number of correct matches you make.

In the middle or second period you will operate under a different condition in which you are to light the green light inside the red ring by pushing one of the buttons in front of you. Your score will be the number of correct matches that you make (dem.).

Whenever you push a button to light a green disc, a new red ring will appear, but only when the green light was

placed in the red ring is the response correct.

Remember, in the third period the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

The same button always extinguishes the same red ring.

Remember, in the first condition continue pressing the buttons until a match is made.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 24 B D B

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus

can operate. You are going to practice under both of these. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of pushing one of the buttons in front of you in order to extinguish the red ring and to light another red ring. This is called making a match. You are then to press the correct button for this red ring. Your score will be the number of correct matches you make.

In the middle or second period you will operate under a different condition in which the red ring will move whenever you push a button. You are to push the button which you think is correct for the red ring.

Remember, in the third period the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons. (Point).

The same button always extinguishes the same red ring.

Remember, in the first condition continue pressing the buttons until a match is made.

Do not press the buttons until the first red ring

appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 25 C A C

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of lighting the green light inside the red ring like this (dem.). This is called making a match. The green light can be lighted by pushing one of the buttons in front of you. A given button always lights the same green light. Your score will be the number of correct matches you make (dem.).

Whenever you push a button to light a green disc, a new red ring will appear, but only when the green light was placed in the red ring is the response correct.

In the middle or second period you will operate under a different condition in which you are to light the

green light in the red ring as before. This time, however, only when you push the button lighting the correct green light will a new red ring appear.

Remember in the third period the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Remember, in the first condition each green light is lighted by one and only one button. Each green light is always lighted by the same button. Everytime a button is pressed, the red ring will move.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 26 C B C

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of lighting the green light inside the red ring like this (dem.). This is called making a match. The green light can be lighted by pushing one of the buttons in front of you. A given button always lights the same green light. Your score will be the number of correct matches you make (dem.).

Whenever you push a button to light a green disc, a new red ring will appear, but only when the green light was placed in the red ring is the response correct.

In the middle or second period you will operate under a different condition in which you are to extinguish the red ring by pushing one of the buttons. This is a correct match. Only when you push the button that extinguishes the red ring will a new red ring appear.

Remember in the third period the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of

the left hand on these buttons (point).

Remember, in the first condition each green light is lighted by one and only one button. Each green light is always lighted by the same button. Every time a button is pressed the red ring will move.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 27 C C C

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

You are to light the green light inside the red ring like this (dem.). This is called making a match. The green light can be lighted by pushing one of these buttons here (point) in front of you. A given button always lights the same green light. Your score will be the number of correct matches (dem.) you make.

Whenever you push a button to light a green disc, a new red ring will appear, but only when the green light was placed in the red ring is the response correct.

You will have three five-minute testing periods with

a two-minute rest between each. The apparatus will operate the same way for all three periods.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Remember, in the first condition each green light is lighted by one and only one button. Each green light is always lighted by the same button. Every time a button is pressed the red ring will move.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 28 C D C

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these. You

will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of lighting the green light inside the red ring like this (dem.). This is called making a match. The green light can be lighted by pushing one of the buttons in front of you. A given button always lights the same green light. Your score will be the number of correct matches you make (dem.).

Whenever you push a button to light a green disc, a new red ring will appear, but only when the green light was placed in the red ring is the response correct.

In the middle or second period you will operate under a different condition in which you will have to press the button which you think is correct. However, no green light will come on when you press a button and the red ring will move every time.

Remember in the third period the apparatus will be the same as in the first period.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Remember, in the first condition each green light is

lighted by one and only one button. Each green light is always lighted by the same button. Every time a button is pressed the red ring will move.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 29 D A D

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of pushing one of the buttons in front of you. The one which you think is correct for the red ring lit up. Whenever you push a button, a new red ring will appear. You are to push the button which you think is correct for each red ring.

In the middle or second period you will operate under a different condition in which you are to light a green light

inside the lighted red ring by pushing one of the buttons in front of you.

Only when you push the button lighting the correct green light (dem.) will a new red ring appear.

Remember in the third period the apparatus will be the same as in the first period.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Do not press the buttons until the first red ring appears. Remember, in the first condition continue pressing the buttons which you think are correct until the apparatus shuts off.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 30 D B D

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these. You

will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of pushing one of the buttons in front of you. The one which you think is correct for the red ring lit up. Whenever you push a button a new red ring will appear. You are to push the button which you think is correct for each red ring.

In the middle or second period you will operate under a different condition in which you are to extinguish the red ring by pushing one of the buttons. This is a correct match and only when you push the button that extinguished the red ring will a new red ring appear.

Remember in the third period the apparatus will be the same as in the first.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Do not press the buttons until the first red ring appears. Remember, in the first condition continue pressing the buttons which you think are correct until the apparatus shuts off.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 31 D C D

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

There are two possible ways that the apparatus can operate. You are going to practice under both of these. You will practice for three five-minute periods with a two-minute rest between each period. For the first and last period you will operate under one condition which consists of pushing one of the buttons in front of you. The one which you think is correct for the red ring lit up. Whenever you push a button, a new red ring will appear. You are to push the button which you think is correct for each red ring.

In the middle or second period you will operate under a different condition in which you are to light the green light inside the red ring by pushing one of the buttons in front of you. Your score will be the number of correct matches that you make (dem.).

Whenever you push a button to light a green disc, a new red ring will appear, but only when the green light was placed in the red ring is the response correct.

Remember in the third period the apparatus will be the same as in the first period.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Do not press the buttons until the first red ring appears. Remember, in the first condition continue pressing the buttons which you think are correct until the apparatus shuts off.

Are there any questions?

IMR INSTRUCTIONS PERIOD I

Group 32 D D D

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

You are then to push one of the buttons here in front of you (point). The one which you think is correct for the red ring lit up. Whenever you push a button a new red ring will appear. There is one correct button for each red ring. You are to push the button which you think is correct for each red ring.

You will have three five-minute testing periods with a two-minute rest between each. The apparatus will operate

the same way for all three periods.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Do not press the buttons until the first red ring appears. Continue pressing the buttons which you think are correct until the apparatus shuts off.

Are there any questions?

NIMR INSTRUCTIONS FOR CONDITION A PERIOD I

Group 1 - 4

(Red ring moves on correct response, green light on).

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

You are to light the green light inside the red ring like this (push green light switch), and this is called making a match. The green light can be lighted by pushing one of the buttons here (point) in front of you. A given button always lights the same green light.

When you push the button lighting the correct green light, (demonstrate a correct match) a different red ring will

appear, and you are to push the button which lights the green light for this new red ring. Your score will be the number of correct matches that you make.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Remember, each green light is lighted by one and only one button. Each green light is lighted by the same button. Continue pressing the buttons until the correct button to light the green disc inside the red ring is found.

Do not press the buttons until the first red ring appears.

Are there any questions?

NIMR INSTRUCTIONS FOR CONDITION B PERIOD I

Group 5 - 8

(Red ring moves on a correct response, no green light).

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

You are to push one of the buttons here in front of

you (point) in order to extinguish the red ring and to light another red ring. This is called making a match. You are then to press the correct button for this red ring. Your score will be the number of correct matches you make.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

The same button always extinguishes the same red ring.

Continue pressing the buttons until a match is made.

Do not press the buttons until the first red ring appears.

Are there any questions?

NIMR INSTRUCTIONS FOR CONDITION C PERIOD I

Group 9 - 12

(Red ring moves on any response, green light on)

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

You are to light the green light inside the red

ring like this (push the green light switch). This is called making a match. The green light can be lighted by pushing one of these buttons here (point) in front of you. A given button always lights the same green light. Your score will be the number of correct matches (demonstrate a correct match) you make.

Whenever you push a button to light a green disc, a new red ring will appear, but only when the green light was placed in the red ring is the response correct.

Try to make as many correct matches as possible before the apparatus shuts off.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Remember, each green light is lighted by one and only one button. Each green light is always lighted by the same button. Every time a button is pressed the red ring will move.

Do not press the button until the first red ring appears.

Are there any questions?

NIMR INSTRUCTIONS FOR CONDITION D PERIOD I

Group 13 - 16

(Red ring moves on any response - no green light)

This is a learning experiment. You will observe that there are six double-lights in a row. (Point). When you begin to practice on this apparatus a red ring will light up in this fashion. (Push red light switch).

You are then to push one of the buttons here in front of you (point). The one which you think is correct for the red ring lit up. Whenever you push a button a new red ring will appear. There is one correct button for each red ring. You are to push the button which you think is correct for each red ring.

Press only one button at a time. You may find it easier to operate the apparatus if you place three fingers of the right hand on these buttons (point) and three fingers of the left hand on these buttons (point).

Do not press the buttons until the first red ring appears. Continue pressing the buttons which you think are correct until the apparatus shuts off.

Are there any questions?

IMR AND NIMR INSTRUCTIONS FOR CONDITION A PERIOD II
(Red ring moves on a correct response, green disc lighted)

We want you to continue pushing buttons as before.
When the red ring comes on, you are to light the green light inside the red ring by pushing one of the buttons in front of you

Only when you push the button lighting the correct green light, (explain a correct match) will a new red ring appear.

Each green light is lighted by one and only one button. Each green light is lighted by the same button.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR AND NIMR INSTRUCTIONS FOR CONDITION B PERIOD II
(Red ring moves on a correct response, no green light)

We want you to continue pressing buttons as before.
You are to extinguish the red ring by pushing one of the buttons. This is a correct match.

Only when you push the button that extinguishes the red light will a new red ring appear.

The same button always extinguishes the same red ring.

Continue pressing the buttons until the correct button extinguishes the red ring and lights another red ring.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR AND NIMR INSTRUCTIONS FOR CONDITION C PERIOD II

(Red ring moves on any response, green light on)

We want you to continue pressing buttons as before. When the red ring comes on you are to light the green light inside that red ring by pushing one of the buttons in front of you. Your score will be the number of correct matches (explain a correct match) you make.

Whenever you push a button to light a green disc, a new red ring will appear but only when the green light was placed in the red ring is the response correct.

Each green light is lighted by one and only one button. Each green light is lighted by the same button. Every time a button is pressed the red ring will move.

Do not press the buttons until the first red ring appears.

Are there any questions?

IMR AND NIMR INSTRUCTIONS FOR CONDITION D PERIOD II

(Red ring moves on any response - no green light)

We want you to continue pushing buttons as before. This time, whenever you push a button a new red ring will appear. There is one correct button for each red ring. You are to push the button which you think is correct for each red ring.

Do not press the buttons until the first red ring appears. Continue pressing the buttons which you think are correct until the apparatus shuts off.

Are there any questions?

IMR AND NIMR INSTRUCTIONS FOR CONDITION A PERIOD III

(Red ring moves on correct response, green light on)

We want you to continue pressing buttons as before. The green light must be lighted inside the red ring. This is a correct match and then a new red ring will appear.

Remember each green light is lighted by one and only one button. Each green light is lighted by the same button. Continue pressing the buttons until the correct button to light the green disc inside the red ring is found.

Are there any questions?

IMR AND NIMR INSTRUCTIONS FOR CONDITION B PERIOD III
(Red ring moves on a correct response, no green light)

We want you to continue pressing buttons as before. You are to extinguish the red ring by pressing the correct button. The same button always extinguishes the same red ring.

Continue pressing the buttons until the correct button extinguishes the red ring and lights another red ring.

Are there any questions?

IMR AND NIMR INSTRUCTIONS FOR CONDITION C PERIOD III
(Red ring moves on any response, green light on)

We want you to continue pressing buttons as before. You are to light the green light inside the red ring by pushing one of the buttons. Whenever you push a button to light the green disc a new red ring will appear, but only when the green light was placed in the red ring is the response correct.

Each green light is lighted by one and only one button. Each green light is lighted by the same button.

Are there any questions?

IMR AND NIMR INSTRUCTIONS FOR CONDITION D PERIOD III

(Red ring moves on any response, no green light)

We want you to continue pressing buttons as before. Whenever you push a button a new red ring will appear. There is still one correct button for each red ring. You are to push the button which you think is correct for each red ring.

Continue pressing the buttons which you think are correct until the apparatus shuts off.

Are there any questions?