STIMULUS SIMILARITY AND SEQUENCE, INTER-STIMULUS INTERVAL AND LEARNING METHOD IN AN AUDITORY PAIRED-ASSOCIATE TASK

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Major professor

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By

Joseph R. Levine

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ABSTRACT

STIMULUS SIMILARITY AND SEQUENCE, INTER-STIMULUS INTERVAL AND LEARNING METHOD IN AN AUDITORY PAIRED-ASSOCIATE TASK

by Joseph R. Levine

Results of previous studies on the affect of the sequence of similar stimuli in paired-associate learning are contradictory. Gagné (1950), using visual stimuli (nonsense shapes), found that grouping similar stimuli during practice trials (as opposed to maximally separating them) facilitated learning. Rothkopf (1958), using auditory stimuli (International Morse Code signals), found that maximally separating the similar stimuli facilitated learning.

Differences in stimulus materials, paired-associate learning method, timing, and the subjects' "knowledge" of the grouping were present in these studies.

The present study was designed to assess the effects of stimulus sequences while varying several of these factors. The subjects, 480 M.S.U. undergraduates, were given 16 alternating study and test trials on a list of 12 paired-associates. The stimuli were Morse Code signals; the responses were two-digit numbers. The design of the experiment is a 2 X 2 X 2 X 2 factorial

with two types of stimulus sequence (Grouped Similar vs. Maximally Separated), two methods of paired-associate learning (Anticipation and Recall), two different "effective" inter-stimulus intervals (Single vs. Dougle Signal) at two levels of subjects' "knowledge" of the sequence within the list (Informed vs. Non-Informed).

The hypotheses were the following: 1) Performance on the Maximally Separated List will be superior to performance on the Grouped Similar List when the anticipation learning method is employed in conjunction with a long "effective" inter-stimulus interval (Single Signal). 2) Performance on the Grouped Similar List will be superior to performance on the Maximally Separated List when the recall method is employed and the "effective" inter-stimulus interval is shorter (Double Signal). 3) Information concerning the stimulus sequences will facilitate learning, and the facilitation will be greater for the Grouped Similar List than for the Maximally Separated List.

The results indicate: 1) When the "effective" inter-stimulus interval was short (as in the Gagné experiment, 1950) grouping the similar stimuli facilitated learning. 2) When the "effective" inter-stimulus interval was long (as in the Rothkopf experiment, 1958) there was no difference in performance with the two sequences. 3) Informing the subjects of the nature of the sequences interfered with their learning in the Grouped Similar sequence. 4) Differences between performance in the

Recall and Anticipation conditions were not significant, and learning method did not interact with the other variables.

The main finding of this experiment was that, when the timing of the auditory task was made comparable to that of the Gagné visual task, the learning rates were affected by the same variable (List Sequence) in the same way.

References

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INTRODUCTION

The effects of sequence of stimuli on paired-associate learning have been studied by Gagné (1950), Rothkopf (1958), Rotberg and Wolman (1963), and Rotberg (1964).

Prior Studies

Gagné (1950) constructed a 12 item list of nonsense shapes paired with nonsense syllable responses. The stimulus items were four sets of three shapes each. The stimuli within each subset were highly similar, while the similarity among stimuli in different subsets was low.

Four lists varying in distribution of similar stimulus items were learned by 15 subjects each. In List 1, the *grouped similar list*, the items within each subset of similar stimuli were presented continuously. (On each trial the serial position of each *subset* within the list was randomly varied; also, the position of each *stimulus* within each subset was randomly varied.) In List 2, the *maximally separated list*, a given stimulus was always separated from the other two members of its subset by three dissimilar stimuli. In List 3, the *grouped dissimilar list*, four subsets of three dissimilar stimuli were delimited and presented in the same fashion as in

List 1. In List 4, the random list, the position of each pair was randomly varied from trial to trial.

Gagné found that during the later stages of learning performance on the similar list was superior to performance on the other three lists.

Rothkopf (1958) replicated the experimental conditions in the Gagné experiment. Instead of visual nonsense shapes he used International Morse Code Signals as stimuli with their letter or number equivalents as responses. He found that performance on the maximally separated list was superior to performance on the other three lists.

Rotberg and Wolman (1963) also studied the effects of clustering or grouping similar stimuli and similar response terms on paired-associate performance. The stimuli were three sets of three nonsense terms paired with common English words. Two lists (grouped similar and grouped dissimilar) were learned by their subjects. They found that performance on the grouped similar list was superior.

Rotberg (1964) found no difference in performance between the grouped similar and maximally separated sequences. Although the same materials and sequences were used as in her earlier experiment, a change in the paired-associate procedure produced a change in results.

Comparison of Prior Experimental Procedures

There are several procedural differences as well as differences in stimuli which may account for the differences in results among these four experiments.

Gagné used the recall method of paired-associate learning. The 12 S-R pairs were sequentially presented for study purposes at the rate of one every two seconds. A recall trial in which only the stimulus terms were presented followed each study trial. During the recall trial, subjects attempted to respond to each stimulus with the appropriate nonsense syllable.

Since Rothkopf used aural stimuli and aurally presented responses, it was not possible for him to present the stimulus and the response terms simultaneously. Furthermore, his study trial procedure was radically different from that of Gagné in another respect. In Rothkopf's practice trials each signal was followed by a three second silent period during which subjects were required to respond with the appropriate letter or number. After this three second interval the correct letter or number was announced. Rothkopf's subjects anticipated in practice trials while Gagné's subjects did not.

The test for learning was the same in both experiments; i.e., recall trials were given in which only the stimulus term occurred, and the subjects responded with the term they thought appropriate to each stimulus. In the Gagné experiment practice and recall trials were alternated, while in the Rothkopf experiment a recall trial occurred after every fourth study trial.

The timing relations in the Rothkopf experiment were radically different from those in the Gagné experiment.

In Rothkopf's experiment each signal on the study trials was followed by a three second delay. The correct response was then announced, and the next signal followed 1.6 seconds later. Estimating that the response took .5 - 1.0 seconds, the time between stimuli was 5.1 - 5.6 seconds. In the Gagné study the S-R pairs occurred at the rate of one every two seconds. It is important to note that each S-R pair was continuously exposed until the next pair occurred. The S_1-S_2 interval was the length of time it took the memory drum to advance one frame. A conservative estimate of this time is .5 seconds.

Rothkopf (1958) offered several suggestions to account for the difference between his and Gagné's results. First, shapes in the Gagné study elicited labeling or naming responses from the subjects. Thus, the stimuli may have been coded. Rothkopf's Morse Code signals transmitted at 20 words per minute could not be so coded. Subjects were unable to describe the signals in such terms as "three dots," "dot-dash-dot," etc. Second, Rothkopf used an anticipation method which resulted in many overt substitution errors during practice while Gagné's procedure minimized these errors.

Another possible source of the discrepancy in results not mentioned by Rothkopf is the radical difference in the timing of the two experimental tasks.

The "effective" inter-stimulus interval in the visual experiment was a half second, while in the auditory experiment it was approximately five seconds. Gagné argues that the facilitative effect of grouping similar stimuli is to bring the level of confusion among similar stimuli to its peak early in learning. Then, differential reinforcement begins to take place earlier in learning. Gagné (1950) said,

> . . . while the number of correct responses shows a steady increase from beginning to end, generalization, as measured by number of overt confusions of similar items, increases at first, passes through a maximum, and subsequently decreases. It is possible to draw the implication that this later process, because it does involve the expression of a large number of overt errors during the early stages of learning, thereby makes possible a most effective application of differential reinforcement. In other words, perhaps this initial "confusion" is itself a factor which tends to speed up acquisition of discriminative responses by fostering elimination of overt errors.

The underlying assumption of Gagné's argument is that the course and the distribution of overt errors reflects the course of stimulus differentiation. McGuire (1961) designed an experiment in which he was able to measure the level of stimulus generalization (the reciprocal of stimulus differentiation) independently of overt errors. He found, as Gagné did, that overt errors increased to a maximum, then decreased, but also that the curve for stimulus generalization showed a steady decrease. It is likely, therefore, that the facilitation of learning on the Grouped Similar List is not due solely to an increase of overt errors early in learning.

Furthermore, although Gagné's theoretical speculations revolve around increasing overt errors, his experimental procedure (recall method of paired-associate learning) minimized overt errors.

Another effect of grouping similar stimuli was that a more direct "comparison" between similar stimuli could be made or that the conditions for making a differential response would be more favorable. Since the similar stimuli were successively presented in the Grouped Similar condition, the subject is better able to note the differential features among the stimuli which were initially the main source of confusion. In the Maximally Separated List, the successive stimuli were initially well differentiated and no benefit from the more direct comparison was forthcoming.

In Rothkopf's experiment the time between signals may have been sufficiently long such that any benefit from successive presentation of similar signals was lost because of forgetting in the inter-signal intervals.

These differences between procedures in the two experiments may offer a clue to why the Grouped Similar List did not show facilitation in the Rothkopf experiment. However, they do not explain why the Maximally Separated condition was superior to the Random and Grouped Dissimilar conditions. Rothkopf offers no hypothesis to account for the differences in his experiment.

Rotberg and Wolman (1963), using verbal nonsense terms as stimuli and common English words as responses, found that grouping of similar stimuli facilitated learning. Their list was composed of three sets of three similar stimuli each. Two lists were used in the experiment: Grouped Similar and Grouped Dissimilar. The learning method was anticipation, but the whole list of nine pairs was not learned at the same time.

> During learning, each three-word group was presented for five trials. Words were randomized within groups each time they were repeated. The five trials for each three-word group were completed before the next group was presented.

After learning, five test trials with stimuli in random order were presented.

Rotberg (1964) used the same materials as the previous study. The anticipation method was again employed, but the three groups of stimuli were not "isolated" as in the previous study. Each trial contained: 1) a learning period in which the nine pairs were presented; 2) a test trial in which the stimuli were randomized; and 3) a second test trial in which the responses were presented in random order and the subject was required to respond with the matching stimulus. There was no significant difference between the Grouped Similar and Grouped Dissimilar conditions in this experiment. The presence of the second test trial may have interfered with the discriminations that occurred in the learning.

Table 1. Differences between the Gagné (1950) and the Rothkopf (1958) experiments.

Gagné	Rothkopf
1. Visual stimuli	1. Auditory stimuli
2. Recall method	2. Anticipation method
3. Short (.5 sec.) "effective" inter-stimulus interval	3. Long (5.0 - 5.5 sec.) "effective" inter-stimulus interval
4. 1:1 ratio of training to test trials	4. 4:1 ratio of training to test trials
5. CVC responses	5. Single letter or number response
6. College women	6. Airmen
7. Categories of similar stimuli relatively apparent to subjects	7. Categories of similar stimuli not apparent to subjects

Rotberg hypothesized that no difference was found in the later study because the similar categories were not "isolated" during learning, whereas they were "isolated" in the first experiment. She reported different distributions of errors in the 1963 and 1964 experiments. In the earlier experiment most of the errors on the Grouped Similar List were confusions between similar stimuli, while in the later study the errors on the Grouped Similar List were not so predominantly confined to substitutions within similar groupings.

This change may throw some light on the Gagné results. The four subsets of stimuli that he used were highly dissimilar. Perhaps, due to the great differences among them, his subsets were "effectively" or "functionally" isolated despite the fact that they were combined in one list.

Since there are so many differences among the materials, timing and procedures in these experiments, it is not possible to relate the differences in results to one factor. Table 1 presents the differences between the Rothkopf (1958) and Gagné (1950) experiments which might account for the discrepancy in results.

Purpose of the Experiment

Previous studies have reported discrepant results concerning the affects of sequence of similar stimuli on paired-associate learning. Differences in stimulus materials, paired-associate learning method, timing, and the subjects' "knowledge" of the grouping were present in these studies.

The present study was designed to assess the affects of stimulus sequence in an auditory task while varying several of these factors. Specifically, two methods (Anticipation and Recall) of paired-associate learning were employed, with two different "effective" inter-stimulus intervals (Single vs. Double Signal) at two levels of subjects' "knowledge" of the sequences within the list.

The hypotheses are the following:

1) Performance on the Maximally Separated List will be superior to performance on the Grouped Similar List when the anticipation learning method is employed in conjunction with a long "effective" inter-stimulus interval (Single Signal).

2) Performance on the Grouped Similar List will be superior to performance on the Maximally Separated List when the recall method is employed and the "effective" inter-stimulus interval is shorter (Double Signal).

3) Information concerning the stimulus sequences will facilitate learning, and the facilitation will be greater for the Grouped Similar List than for the Maximally Separated List.

METHOD AND PROCEDURE

Subjects

The subjects, 609 M.S.U. undergraduates, participated in the experiment to fulfill the requirements of the introductory psychology or education course.

Subjects were tested in groups of 5 - 50, with each group (or class) haphazardly assigned to one of the 16 experimental conditions. On several occasions the number of subjects tested in a single administration exceeded the number required. Since it was desirable to have an equal number of subjects in each experimental condition, subjects were non-systematically eliminated from the analysis until each of the 16 experimental conditions had 30 subjects each. Subjects who had participated in previous experimentation utilizing Morse Code signals were also excluded from the analysis.

Since the actual testing began late in the winter quarter of 1964, it was not possible to test subjects under all 16 experimental conditions before the termination of the quarter. Instead, half the subjects in eight of the conditions were tested in the winter quarter; the remaining half in these conditions plus all the subjects in the other eight conditions were tested during the spring quarter.

Materials

The experimental list was composed of 12 paired-associates. The stimuli were 12 aural International Morse Code signals and the responses were two-digit numbers.

As in the Rothkopf (1958) experiment, the 12 stimulus terms were subdivided into four subsets of three signals each. The stimuli and the responses, with the English equivalents in parentheses, were as follows: Subset A: (W) .-- 37, (G) --. 80, (R) .-. 26; Subset B: (1) .---- 32, (2) ..--- 48, (3) ...-- 96; Subset C: (P) .--. 14, (F) ..-. 63, (L) .-.. 85; Subset D: (S) ... 93, (H) .... 51, (5) ..... 72.

The average similarity of the stimuli within each subset was 42.5% and the average similarity of stimuli not in the same group was 16.6%. These percentages are based on a psychophysical study by Rothkopf (1957) in which subjects judged pairs of International Morse Code signals as being either "same" or "different." The similarity percentage refers to the percent of presentations in which the two signals were judged "same."

The similarity among the 12 response numbers was minimized. None of the responses paired with stimuli in the same subset employed the same digit. The mean association value (Battig and Spera, 1962) for all 12 responses is 1.50, and the mean association values for responses in Subsets A, B, C, and D are 1.41, 1.82, 1.58 and 1.20 respectively. Responses with low association value were chosen to minimize "extra-experimental" associations which might inadvertently facilitate the learning of one pair. The responses were assigned to stimuli such that there was no apparent correlation between the magnitude of the response number and the duration or number of elements in the signal.

The signals (pure tones of 1000 cps) were transmitted at the same rate as in the Rothkopf (1958) experiment. A dot had a duration of .05 seconds; a dash had the duration of .15 seconds; and the silent period between elements was .05 seconds.

The signals were produced by a Great Northern Telegraph Model 113 automatic keyer coupled with a Hewlett Packard audio oscillator. The keyer is essentially a device for "reading" two-channel punched paper tape. Each punched hole results in a tone of a given uniform duration. Use of the automatic keyer eliminated extraneous variations in tone speed and accent.

The stimuli and the spoken responses were recorded with an Ampex Model 602-2 tape recorder on Scotch low print magnetic tape.

Experimental Treatments

The experiment compared the following four treatments: 1) stimulus sequence during study or practice trials; 2) paired-associate learning method; 3) level of stimulus repetition; 4) instructional set.

In each of the conditions the subjects were given 16 alternating study and test trials. The timing and sequence of stimuli on the test trials were identical for all treatments. On the test trials, each signal was followed by a 4 second silent period, with a 10 second rest between study and test trials.

The signals in the test trials were randomized with the restriction that each signal appeared in each serial position at least once but no more than twice. Furthermore, no two signals were adjacent more than four times, and each signal was adjacent to every other signal at least twice.

A response sheet was devised which could be used for group administration of the task. Each response sheet contained 16 test trials (see Appendix C). In each test trial, the 12 response numbers were printed in 12 consecutive rows. The rows were labeled with the letters A - L. The subject responded to the first signal of the test trial by circling the two-digit response number in Row A which he thought was paired with that signal. He responded to the second signal of the test trial by circling a response number in Row B, and so on until the twelfth signal, Row L.

Stimulus Sequences. Two basic lists were constructed differing only in the sequence of items during the practice trials.

Grouped Similar List. In the Grouped Similar List, the study trials were arranged so that the signals of each subset were serially presented; i.e., no signal from a different subset was interposed between two signals from the same subset. Each study trial was in a different order and each subset occurred at each serial position an equal number of times. The order within each subset also varied from trial to trial, and each signal appeared at each serial position within the subset approximately an equal number of times.

If the letters A, B, C, D represent the subsets, and subscripts 1, 2, 3 represent the members of the subsets, then the sequences of two trials on the Grouped Similar List might be the following:

Trial 1 = $A_1A_2A_3B_1B_2B_3C_1C_2C_3D_1D_2D_3$ and

Trial 2 = $C_2C_3C_1A_3A_2A_1D_3D_1D_2B_2B_1B_3$.

Maximally Separated List. In the Maximally Separated List the signals of each subset were maximally temporally separated during study trials. After the presentation of a signal of any given subset, three signals (one from each of the other subsets) were presented before another member of that subset occurred. Sequences for two study trials on the Maximally Separated List might be the following:

Trial 1 = $A_1B_1C_1D_1A_2B_2C_2D_2A_3B_3C_3D_3$ and

Trial 2 = $B_2D_3C_3A_2B_3D_1C_3A_1B_1D_2C_2A_1$.

Learning Method and Stimulus Repetition. Two learning methods (Recall and Anticipation) at two levels of stimulus repetition (Single and Double) were compared for both the Grouped Similar and the Maximally Separated Lists.

Recall - Single Signal. During the study trials the 12 signal-number pairs were serially presented for study purposes. Subjects were not required to make any overt response during the study trials. On the study trials, one second after the termination of a signal, the two-digit response number was announced. The stimulus of the next pair occurred four seconds later.

Anticipation - Single Signal. The anticipation and the recall method differed only in the timing of the study trials. The timing on the study trials was the following: three and one-half seconds after the termination of the signal, the two-digit response number was announced. The stimulus of the next pair occurred 1.6 seconds after the termination of the response. Subjects were not required to respond on the first study trial. They were instructed merely to listen to each of the S-R pairs. On all subsequent study trials subjects responded to each signal during the interval between the response announcement. They responded by circling the number they thought was paired with each signal. (The response sheets for the anticipation conditions contained study trials as well as test trials.

All trials were clearly labeled with the type and number of each trial; e.g., "Study Trial 1," "Test Trial 1," etc.)

Recall - Double Signal. In this condition the response number was announced one second after termination of the signal. The same signal was then repeated. The interval between the termination of the signal and the beginning of its repetition was 2.2 seconds. The interval between the termination of the repetition and the first signal of the next pair was three seconds. Subjects were not required to make any overt response during these study trials.

Anticipation - Double Signal. On the study trials in this condition, a signal was presented, then repeated 2.2 seconds later. One second after the termination of the repetition the response was announced. The first signal of the next pair occurred three seconds after the termination of the repetition.

Table 2 graphically summarizes the sequences and intervals of the stimuli and responses for all experimental conditions. The S_1-S_2 interval in the single signal conditions was approximately 5.6 seconds and the interval between the first occurrence of S_1 and the first occurrence of S_2 in the double signal condition was approximately 6.5 seconds.

Table 2. Sequence and intervals of S and R for all conditions.

Recall - Single Signal	S_1 —— 1 —— R_1 —— 4 —— S_2
Anticipation - Single Signal	S_1 —— 3.4 —— R_1 —— 1.6 —— S_2
Recall - Double Signal	S_1 —— 2.2 —— R_1 —— S_1 —— 3 —— S_2
Anticipation - Double Signal	S_1 —— 2.2 —— S_1 —— 1 —— R_1 —— S_2
Test Trials	S_1 —— 4 —— S_2

Instructional Set

Informed. Half the subjects were instructed about the nature of the lists; i.e., there were four subsets of three signals and the signals in each subset were highly similar. They were also told about the rule by which the sequences were formed. Two charts (one for Grouped Similar List and one for Maximally Separated List) in which geometric figures represented the stimuli were used for demonstration purposes (see Appendix B for the complete instructions).

Non-informed. The remaining half of the subjects were given no information about the order of signals on the study trials.

Procedure

All testing took place in one of several classrooms at M.S.U. Although none of the classrooms was an ideal acoustic environment for sound field auditory discrimination testing, the experimenter was assured that subjects were able to hear all signals clearly. It is known that loudness level per se has little influence on Morse Code discrimination.[1] (The data from one of the testing session were eliminated from the analysis because of excessive echo in the testing room.)

The experimenter read a brief description of the experiment, followed by the paired-associate instructions. The subjects were allowed to ask questions concerning the paired-associate instructions. The experimenter attempted to answer such inquiries as briefly as possible; when possible, he repeated the relevant part of the instructions. The special instructions for the informed groups were read after the experimenter was reasonably sure that the subjects understood the paired-associate instructions.

The tape recorded lists were then presented to the subjects. There was a five minute rest between Test Trial 8 and Study Trial 9. The second half of the task was completed with no further rest periods.

Design of the Experiment

The design is a 2 X 2 X 2 X 2 factorial with two types of stimulus sequences (Grouped Similar vs. Maximally Separated); two methods of paired-associate learning (Recall vs. Anticipation); two levels of stimulus repetition (Single vs. Double Signal); and two levels of Instructions (Informed vs. Non-informed).

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[1] Personal communication from Dr. E. Rothkopf.

RESULTS

Analysis of Total Scores

The number of correct responses, with omissions scored as errors, was tabulated for each subject.

Performance of subjects tested in the winter quarter was compared to performance of subjects in the same experimental groups tested spring quarter. A *t* ratio was calculated for each of these eight groups. None of the eight *t* tests was significant at the .05 level of confidence. The combined mean number correct of the winter subjects (N = 108) was compared to the combined mean number correct of the spring subjects tested in the same experimental conditions (N = 132). The difference was not significant (t = .93, 238 df). Since these differences were not significant, the data from the two quarters were combined for all subsequent analyses.

The means and standard deviations of the correct responses for all experimental groups are presented in Table 3. Examination of Table 3 indicates that the task was extremely difficult; i.e., the "best" group achieved only 34% correct. Bartlett's Test of Homogeneity of Variance (Edwards, 1960) was performed, and the X^2 was significant at the .01 level of confidence (X^2 = 34.01, 15 df). Despite the fact that the variances were not

Table 3. Means and standard deviations of total number of correct responses.

	Informed				Non-Informed			
	Anticipation		Recall		Anticipation		Recall	
Grouped Similar	M	SD	M	SD	M	SD	M	SD
Single Signal	38.9	19.4	38.9	29.6	41.4	22.6	47.2	25.7
Double Signal	44.2	15.0	35.7	14.0	49.6	26.8	64.0	27.6
Maximally Separated								
Single Signal	41.2	24.1	44.1	20.7	40.0	20.7	45.6	23.1
Double Signal	47.7	28.0	52.0	25.3	43.4	23.8	41.3	26.8

homogeneous, an analysis of variance was performed to assess the effects of the treatments. [Edwards (1960), p. 132) states, ". . . since the _F_ test is very insensitive to nonnormality and since with equal _n_'s it is also insensitive to variance inequalities, it would be best to accept the fact that it could be used safely under most conditions."]

A 2 X 2 X 2 X 2 factorial analysis of variance was performed to assess the overall effects of the treatments and their interactions. Table 4 is a summary of this analysis. The _F_ ratio for Signal Repetition, and the interactions of List Sequence X Instructions, and List Sequence X Signal Repetition X Instructions were statistically significant. The learning curves for the Single and Double Signal treatments are presented in Figure 1. As can be seen in Figure 1, the overall performance of the Double Signal group was superior to performance of the Single Signal group.

Inspection of Figure 2 indicates that the significant interaction of List Sequence X Instructions is due to superior performance by the Non-Informed subjects on the _Grouped Similar List_, while the difference in performance of the Informed and Non-Informed groups on the _Maximally Separated List_ is not significant. Comparison of individual treatment means reveals: 1) Performance of the Similar Non-Informed groups was superior to all other groups; 2) Performance of the Separated Informed groups was

Table 4. Summary of analysis of variance of total correct responses.

Source	df	Mean Square	F-Ratio
Method (M)	1	957.68	
List Sequence (L)	1	38.53	
Signal Repetition (SR)	1	3090.68	5.22*
Instructions (I)	1	1680.01	
M X L	1	1.40	
M X SR	1	70.52	
M X I	1	1178.13	
L X SR	1	343.41	
L X I	1	6586.01	11.13**
SR X I	1	104.53	
M X L X SR	1	76.81	
M X L X I	1	1968.31	
M X SR X I	1	118.02	
L X SR X I	1	2745.63	4.64*
M X L X SR X I	1	1274.00	
Error (w)	464	591.50	
Total	479		

*Significant at alpha = .05

**Significant at alpha = .01

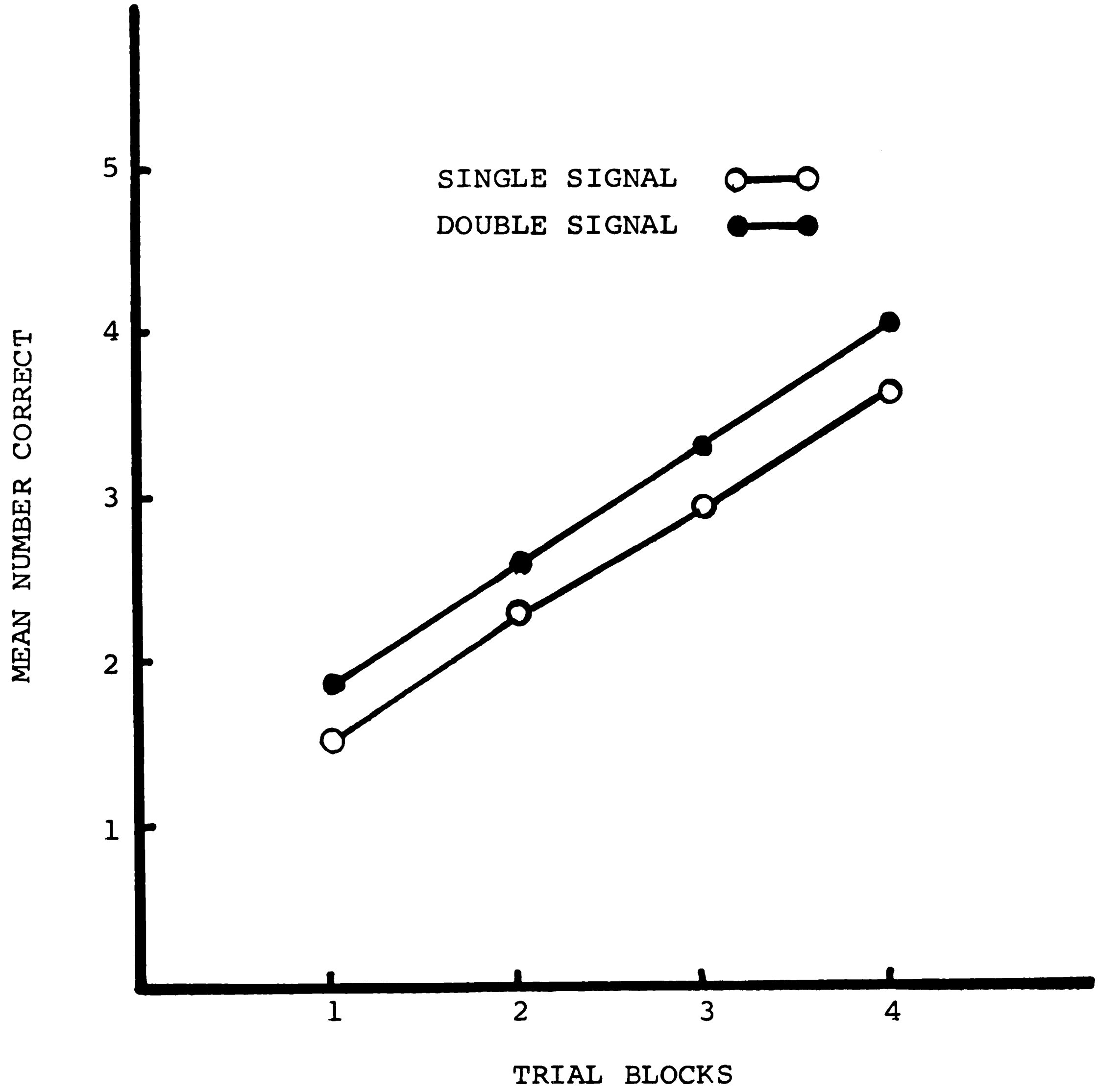

Figure 1. Mean number correct for single and double signals per trial block of 4 trials.

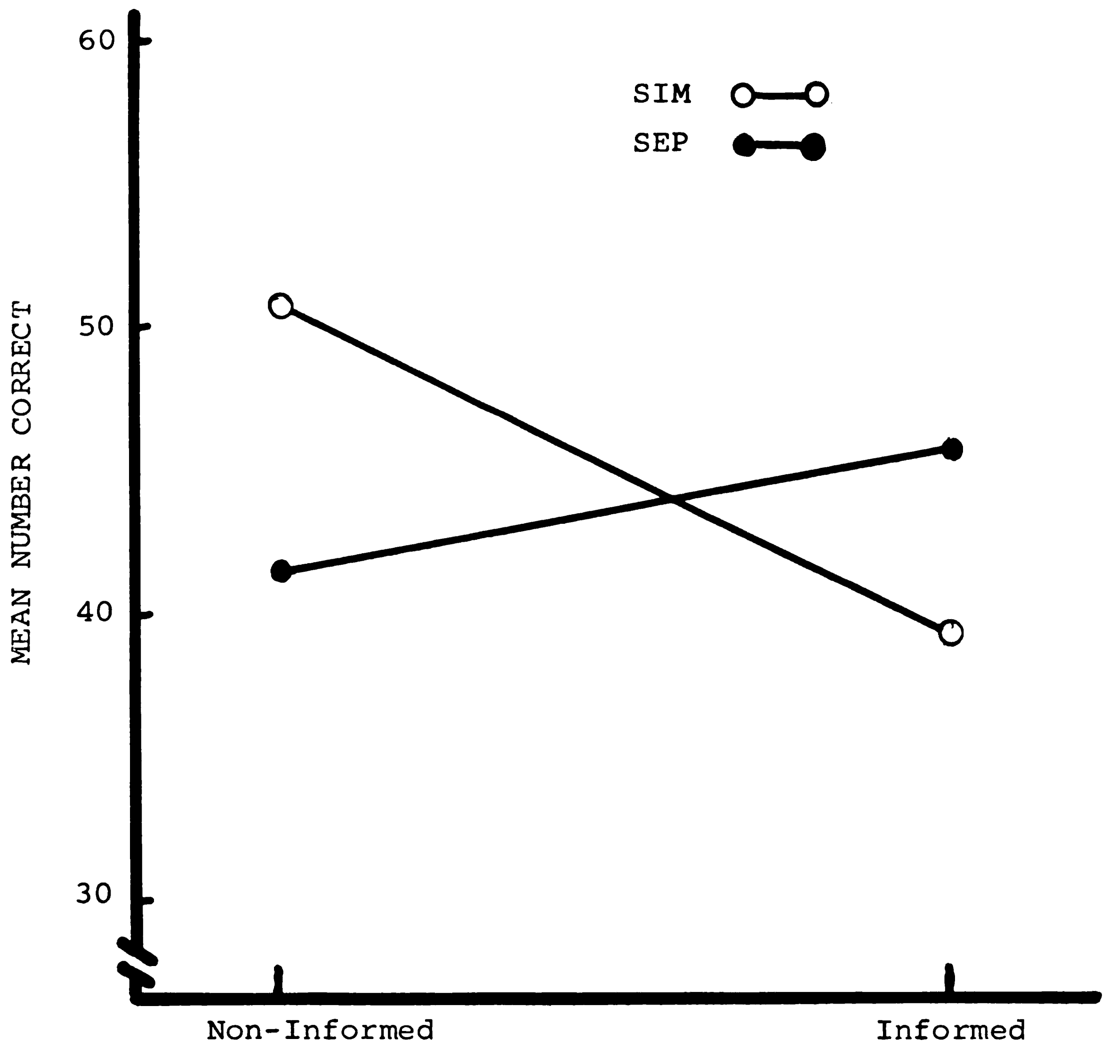

Figure 2. Mean number correct on similar and separated list for informed and non-informed groups.

superior to the Similar Informed groups; 3) The difference between the Separated groups was not significant. It appears that the instructions interfered with learning in the Similar Informed group.

As can be seen in Figure 3, on the Similar List, the difference between the Single Signal Non-Informed and the Double Signal Non-Informed groups is markedly greater than the difference between the Single and Double Signal Informed groups. On the Separated List this relationship is reversed; i.e., the difference between the Single and Double Signal Informed groups is greater than the difference between the Single and Double Signal Non-Informed groups.

Comparisons of the individual treatment means ($Q_{.05}$ 8k, 60 df) reveal: 1) The Double Signal Non-Informed group on the Similar List was superior to all other groups; 2) The Double Signal Informed group on the Separated List was superior to all groups except the Double and Single Signal Non-Informed groups on the Similar List; and 3) Performance of the Double Signal Informed group on the Separated List was superior to performance of the Informed groups on the Similar List.

The interpretation of this interaction is that the instructions interfered with the facilitative effects of the additional signal on the Similar List, while the instructions enhanced the facilitative effects of the signals on the Separated List. Rothkopf (1958, experiment

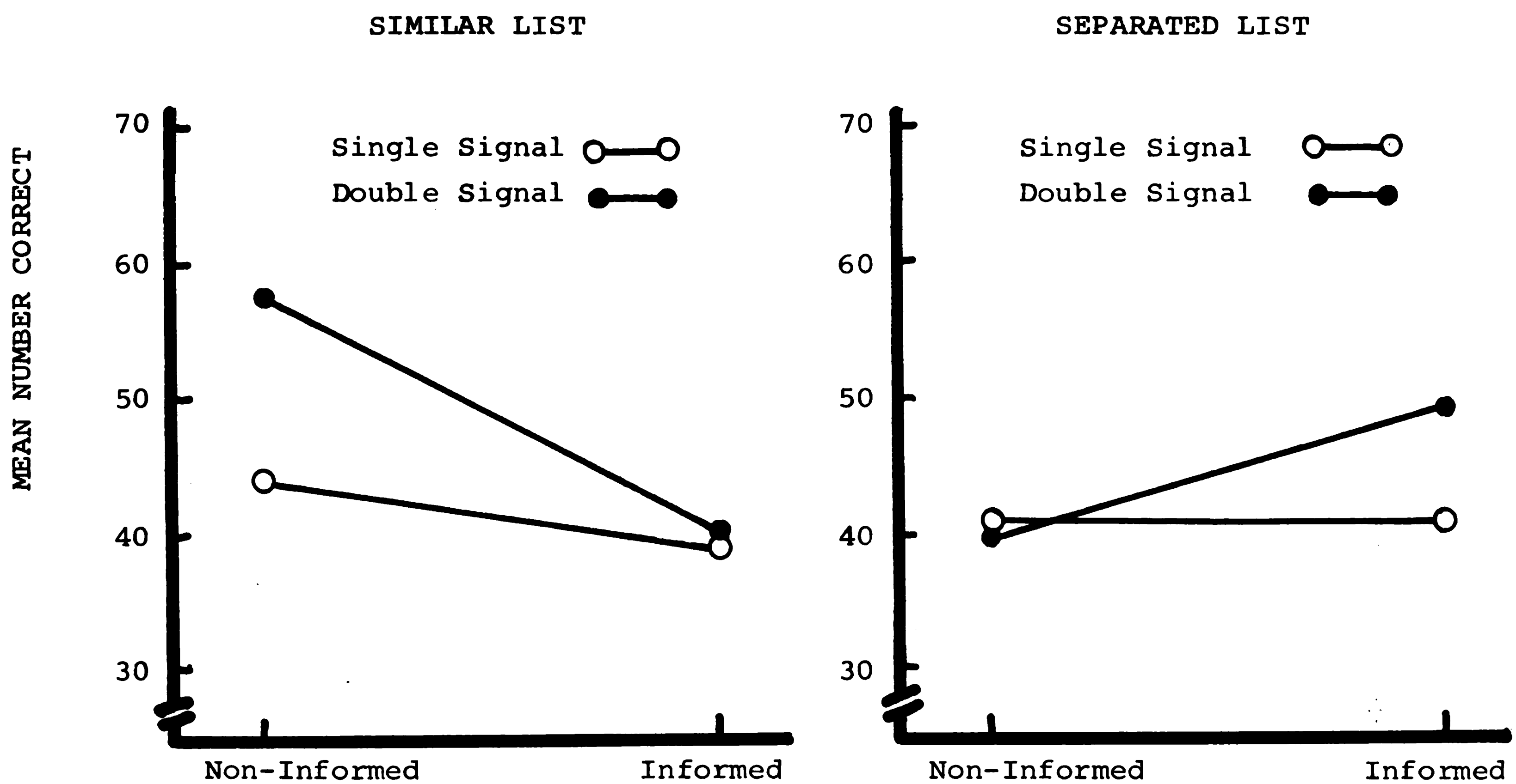

Figure 3. Mean number correct of similar and separated lists as a function of instructions and signal repetition.

III) found that subjects with superior scores on the army code test gave better performance on the Maximally Separated List than on the Grouped Similar List. In the present experiment there were no independent measures of "code receiving ability" available. Instead, the scores of the subjects above the median in each experimental group were analyzed separately. The results of an analysis of variance of the total scores for these subjects are in essential agreement with the results of the analysis of the scores of the entire group.

Analysis of Stages of Practice

Trial Block 1

In order to assess the effects of treatments at different stages of learning, the task was divided into four trial blocks of four trials each. Bartlett's Test of Homogeneity of Variance was performed, and the assumption of homogeneity of variance was found tenable ($X^2 = 23.87$, 15 df). Analyses of variance were performed on Trial Block 1 (Test Trials 1 - 4) and Trial Block 4 (Test Trials 13 - 16).

The means and standard deviations for Trial Block 1 appear in Table 5. The summary of the analysis of variance for Trial Block 1 appears in Table 6. The F ratio for Signal Repetition is significant, and the Signal Repetition X Instructions interaction is statistically significant.

Table 5. Means and standard deviations of the number of correct responses on Trial Block 1.

	Informed				Non-Informed			
	Anticipation		Recall		Anticipation		Recall	
Grouped Similar	M	SD	M	SD	M	SD	M	SD
Single Signal	6.4	3.7	6.4	3.8	5.2	2.4	6.6	3.0
Double Signal	6.1	3.5	5.9	3.2	6.7	4.3	8.1	4.0
Maximally Separated								
Single Signal	6.6	3.8	7.0	3.8	4.6	2.6	6.4	2.7
Double Signal	6.8	3.9	7.1	4.0	6.8	3.6	6.7	4.3

Table 6. Summary of analysis of variance of correct responses on Trial Block 1.

Source	df	Mean Square	F-Ratio
Method (M)	1	38.53	
List Sequence (L)	1	1.87	
Signal Repetition (SR)	1	56.03	4.39*
Information (I)	1	4.03	
M X L	1	.14	
M X SR	1	9.07	
M X I	1	21.68	
L X SR	1	.04	
L X I	1	34.14	
SR X I	1	75.21	5.89**
M X L X SR	1	10.20	
M X L X I	1	5.20	
M X I X SR	1	1.64	
L X SR X I	1	9.07	
M X L X SR X I	1	10.81	
Error (w)	464	12.77	
Total	479		

*Significant at alpha = .05

**Significant at alpha = .01

The means of the Single and Double Signal groups as a function of Instructions are plotted in Figure 4. It appears that instructions interfered with the facilitative effects of the repetition of the signal in the Double Signal group.

Comparisons of the individual treatment means show that the difference between the Single and Double Signal groups in the Non-Informed conditions was statistically significant. No other difference reached significance at the .05 level.

Thus, at an early stage of practice in the Non-Informed condition the Double Signal groups are superior to the Single Signal groups irrespective of stimulus sequence. In the Informed condition, none of the differences are significant.

Trial Block 4

The means and standard deviations for Trial Block 4 (Test Trials 13 - 16) appear in Table 7. Bartlett's Test of Homogeneity of Variance was performed, and the assumption of homogeneity of variance was found tenable ($X^2 = 13.60$, 15 df). An analysis of variance of the scores of Trial Block 4 was performed. The summary of the analysis of variance for the scores on Trial Block 4 appears in Table 8.

The $\underline{F}$ ratios for Signal Repetition, Instructions, and the interactions of List Sequence X Instructions, Method X List Sequence X Instructions, and List Sequence X

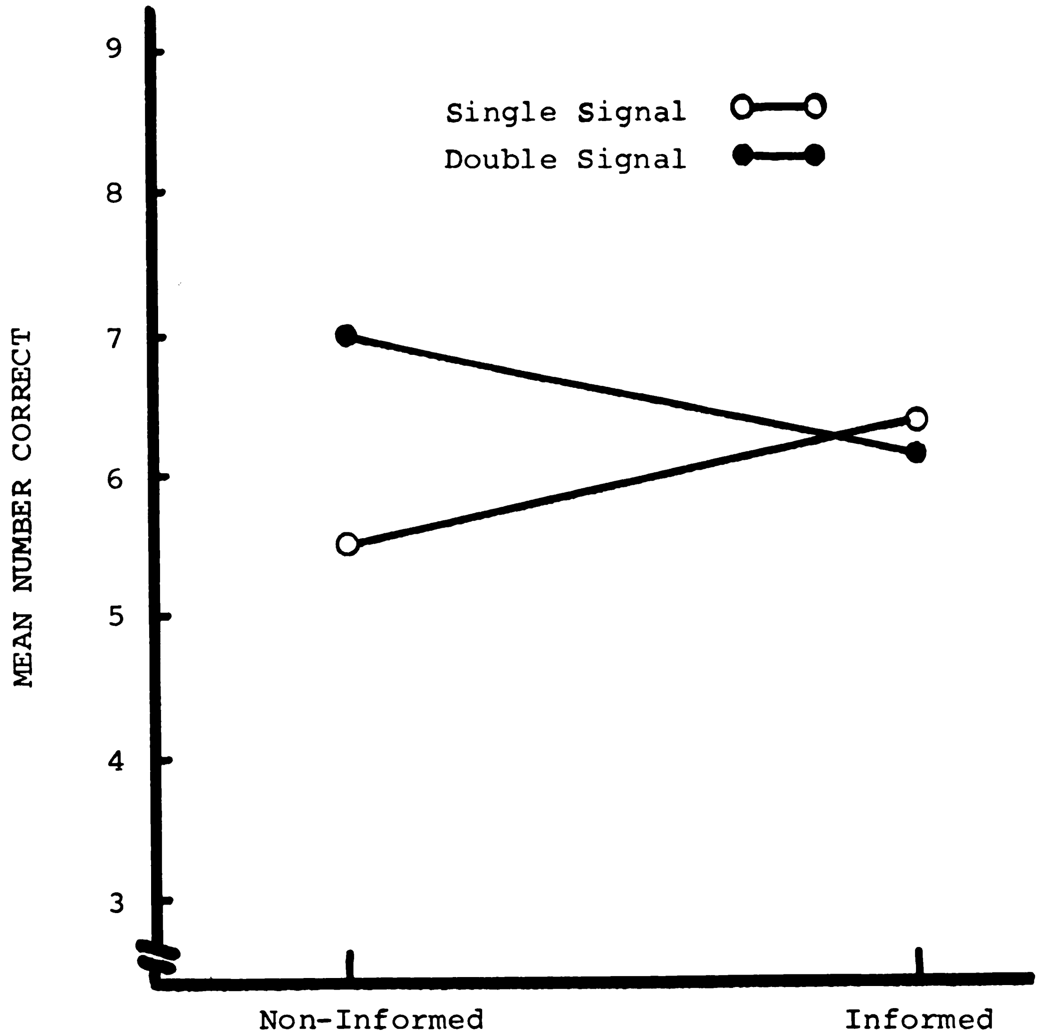

Figure 4. Mean number correct on Trial Block 1 of single and double signal groups as a function of instructions.

Table 7. Means and standard deviations of correct responses on Trial Block 4.

	Informed				Non-Informed			
	Anticipation		Recall		Anticipation		Recall	
Grouped Similar	M	SD	M	SD	M	SD	M	SD
Single Signal	14.2	6.9	12.1	11.1	15.7	9.9	16.5	10.21
Double Signal	16.2	7.1	11.9	9.8	19.4	10.6	23.2	10.27
Maximally Separated								
Single Signal	14.1	9.5	14.5	9.4	14.9	8.7	15.7	9.2
Double Signal	15.4	10.7	17.4	9.6	14.5	8.3	13.4	9.1

Table 8. Summary of analysis of variance of correct responses on Trial Block 4.

Source	df	Mean Square	F-Ratio
Method (M)	1	.46	
List Sequence (L)	1	166.85	
Signal Repetition (SR)	1	355.35	3.96*
Instructions (I)	1	574.21	6.40*
M X L	1	28.06	
M X SR	1	.26	
M X I	1	131.27	
L X SR	1	212.01	
L X I	1	1006.31	11.22**
SR X I	1	5.86	
M X L X SR	1	1.76	
M X L X I	1	347.99	3.88*
M X I X SR	1	5.40	
L X SR X I	1	462.16	5.16*
M X L X SR X I	1	146.81	
Error (w)	464	89.65	
Total	479		

*Significant at alpha = .05

**Significant at alpha = .01

Signal Repetition X Instructions are statistically significant.

The List Sequence X Instructions interaction is shown in Figure 5. Comparisons of individual treatment means reveal that the Similar Non-Informed group was superior to both the Similar Informed group and Separated Non-Informed group (alpha = .05). These differences are the same differences reflected in the List Sequence X Instructions interaction for the total scores.

The List Sequence X Signal Repetition X Instructions interaction is shown in Figure 6. The Double Signal Similar Non-Informed group was significantly superior to all groups except the Single Signal Similar Non-Informed group and the Double Signal Separated Informed group. No other differences between individual treatment means were significant.

In general the above interaction on Trial Block 4 reflects the same differences as does the same interaction on the total scores.

On the total scores, however, the Single and Double Signal groups in the Similar Informed condition were significantly different. This difference was not significant on Trial Block 4.

The Method X List Sequence X Instructions interaction was not significant in the analysis of total scores, but it was significant in the analysis of the scores on Trial Block 4.

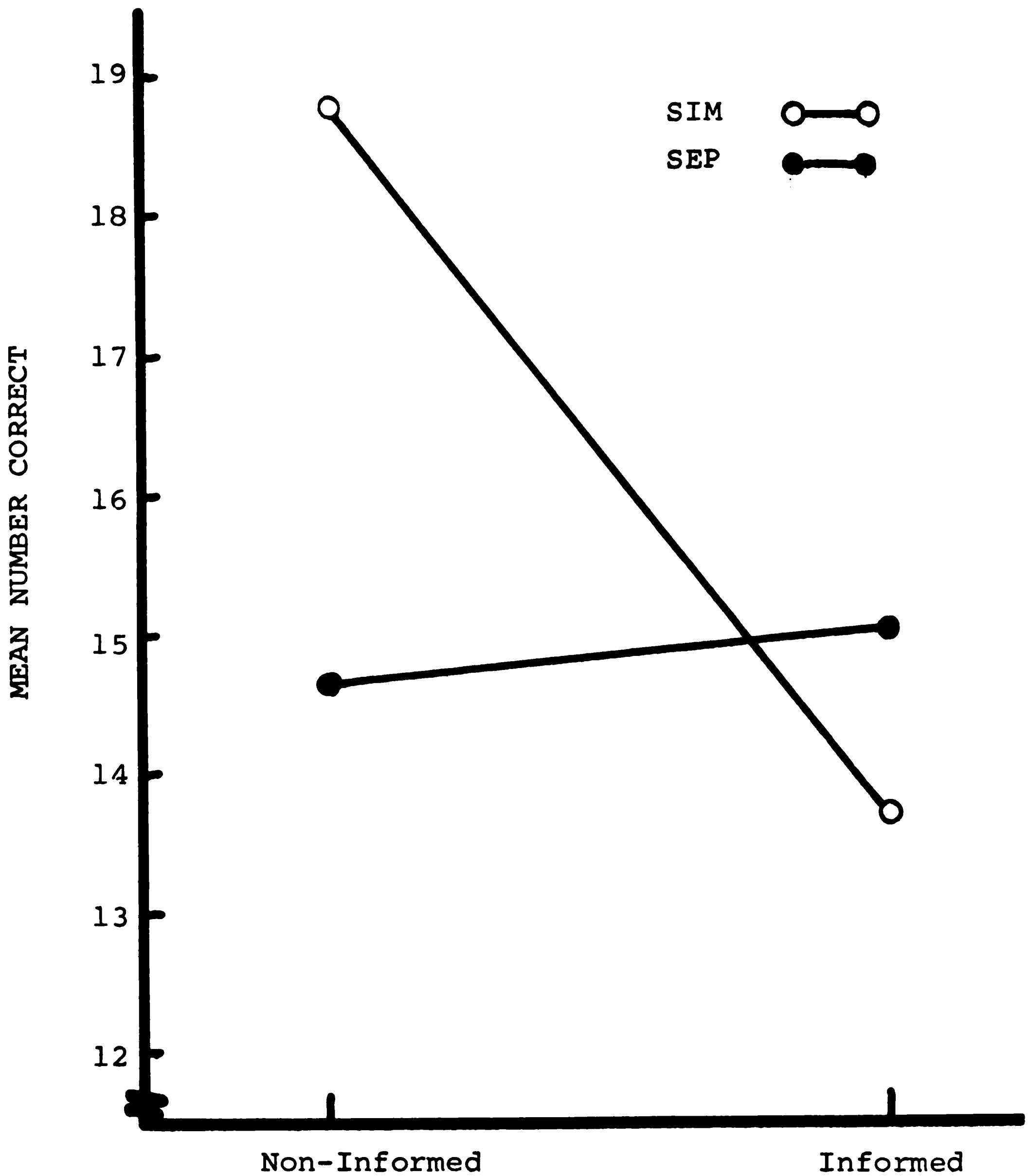

Figure 5. Mean number correct on Trial Block 4 of grouped similar and maximally separated lists as a function of instructions.

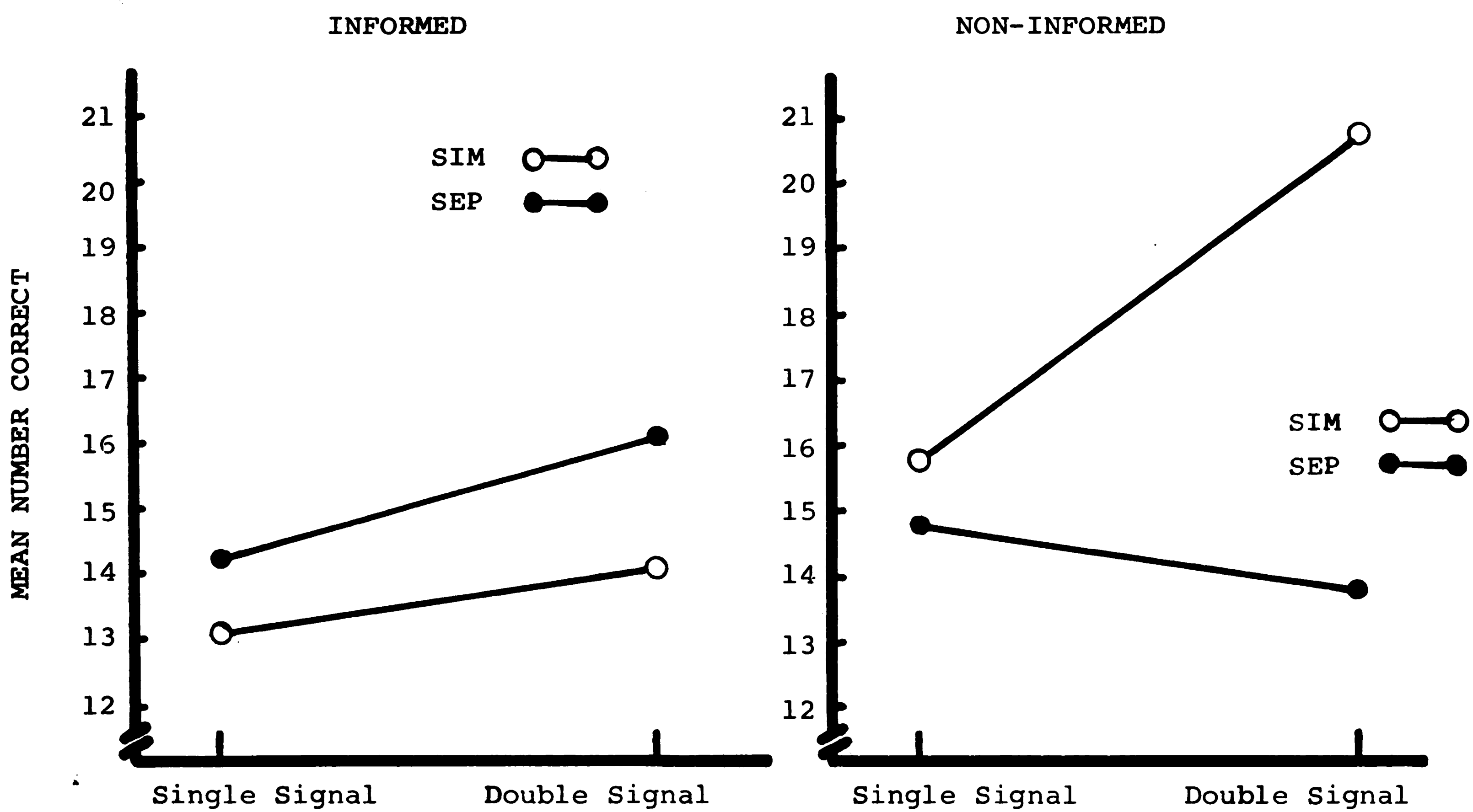

Figure 6. Mean number correct on Trial Block 4 of single and double signal groups on the similar and separated lists.

The means for the two lists as a function of learning method and instructions are presented in Figure 7. The only significant difference among these means occurred between the Recall Similar Non-Informed group and the Recall Similar Informed group. It appears that the instructions interfered with performance of the Recall Similar group to a greater extent than in the Anticipation Similar group.

Analysis of total scores indicates that the interactions involving instructions, stimulus sequences, and repetitions of signals were significant sources of variance. At early stages of practice (Trial Block 1) the repetition of signals and instructions interacted. In general, the results of the analysis of later stages of practice (Trial Block 4) conform to the results of the analysis of the total scores.

Analysis of Rate of Learning

In order to assess the effects of experimental treatments on the rate of learning, a set of gain scores between performance on Trial Block 1 and Trial Block 4 was calculated. Each subject's score on Trial Block 1 was subtracted from his score on Trial Block 4. The means and standard deviations of the gain scores are presented in Table 9.

The variances were assumed homogeneous (Bartlett's test, X^2 = 17.63, 15 df) and a 2 X 2 X 2 X 2 factorial

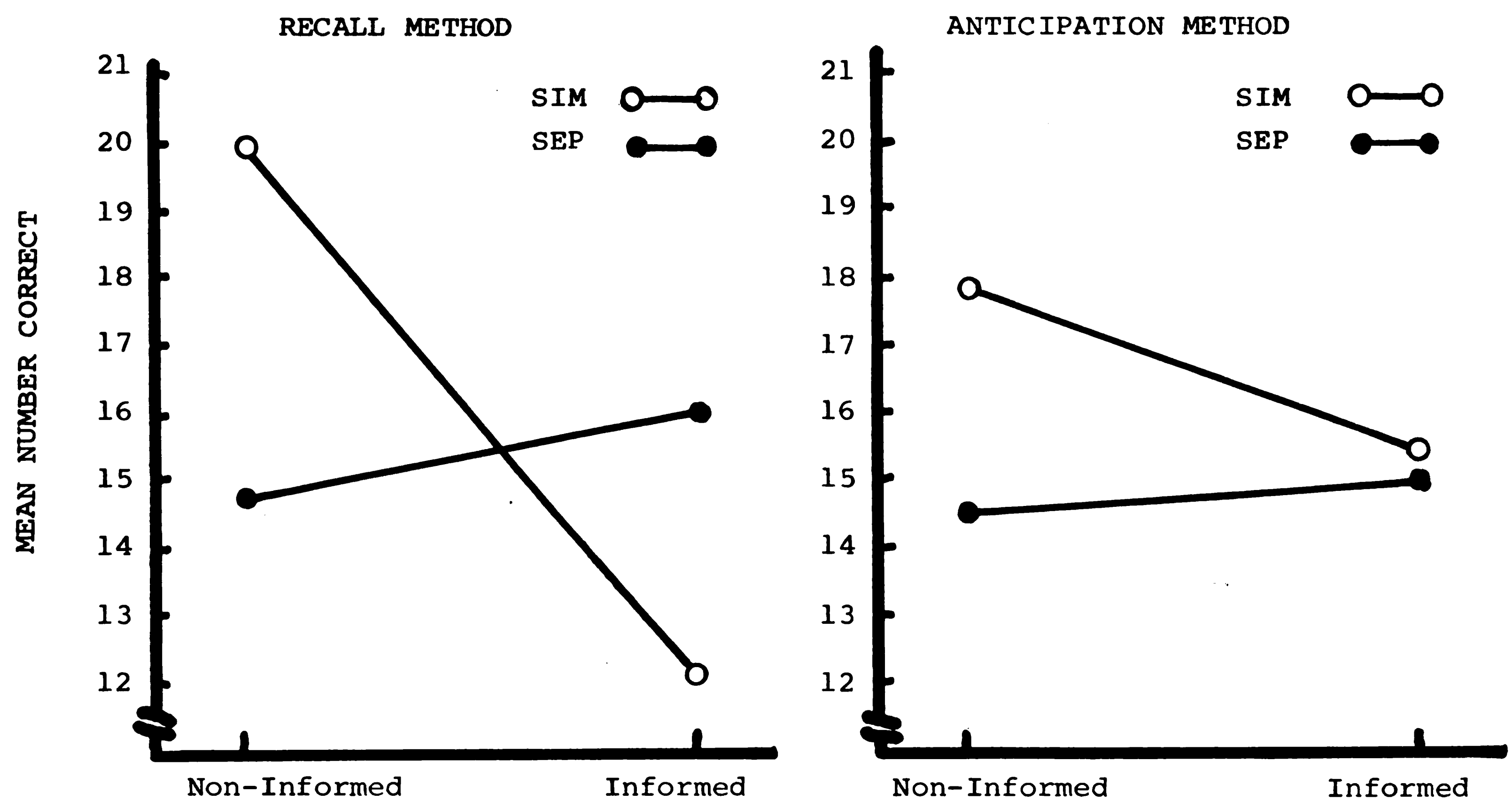

Figure 7. Mean number correct on Trial Block 4 of the recall and anticipation groups on the grouped similar and maximally separated lists as a function of instructions.

Table 9. Means and standard deviations of gain scores.

	Informed				Non-Informed			
	Anticipation		Recall		Anticipation		Recall	
Grouped Similar	M	SD	M	SD	M	SD	M	SD
Single Signal	7.8	6.1	5.7	9.9	10.5	9.9	10.3	9.0
Double Signal	10.1	6.5	6.0	7.9	12.7	7.9	15.1	8.2
Maximally Separated								
Single Signal	7.6	8.3	7.2	7.6	16.2	8.4	9.3	7.9
Double Signal	8.6	9.2	10.3	8.3	7.7	6.5	6.7	6.4

analysis of variance was performed on the gain scores. A summary of this analysis appears in Table 10. The $\underline{F}$ ratios for Instructions and the interactions of List Sequence X Instructions, Method X List Sequence X Instructions, and List X Signal Repetition of X Instructions were statistically significant.

The means of the gain scores of both lists as a function of instructions are plotted in Figure 8. Performance of the Non-Informed subjects on the Grouped Similar List was superior to performance of the Informed subjects on the Grouped Similar List. No other differences were significant.

The means of the gain scores of both lists as a function of learning method and instructions are plotted in Figure 9. Comparison of individual treatment means reveals: 1) None of the differences among the Informed group are significant; 2) In the Non-Informed condition, the Recall Similar group is superior to the Recall Separated group, while the difference between lists with the anticipation method is not significant.

The means of the gain scores for both lists as a function of Signal Repetition and Instructions are plotted in Figure 10. Comparison of individual treatment means reveals: 1) The differences between treatment means among the Informed groups are not significant; 2) In the Non-Informed condition only the difference between the Double Signal Similar group and the Double Signal Separated group

Table 10. Summary of analysis of variance of gain scores.

Source	df	Mean Square	F-Ratio
Method (M)	1	34.67	
List Sequence (L)	1	214.67	
Signal Repetition (SR)	1	137.60	
Instructions (I)	1	693.60	10.61**
M X L	1	20.42	
M X SR	1	15.05	
L X SR	1	206.72	
L X I	1	651.01	9.97**
SR X I	1	43.80	
M X L X SR	1	4.22	
M X L X I	1	256.66	3.92*
M X I X SR	1	10.51	
L X SR X I	1	355.35	5.44*
M X L X SR X I	1	84.17	
Error (w)	464	65.31	
Total	479		

*Significant at alpha = .05

**Significant at alpha = .01

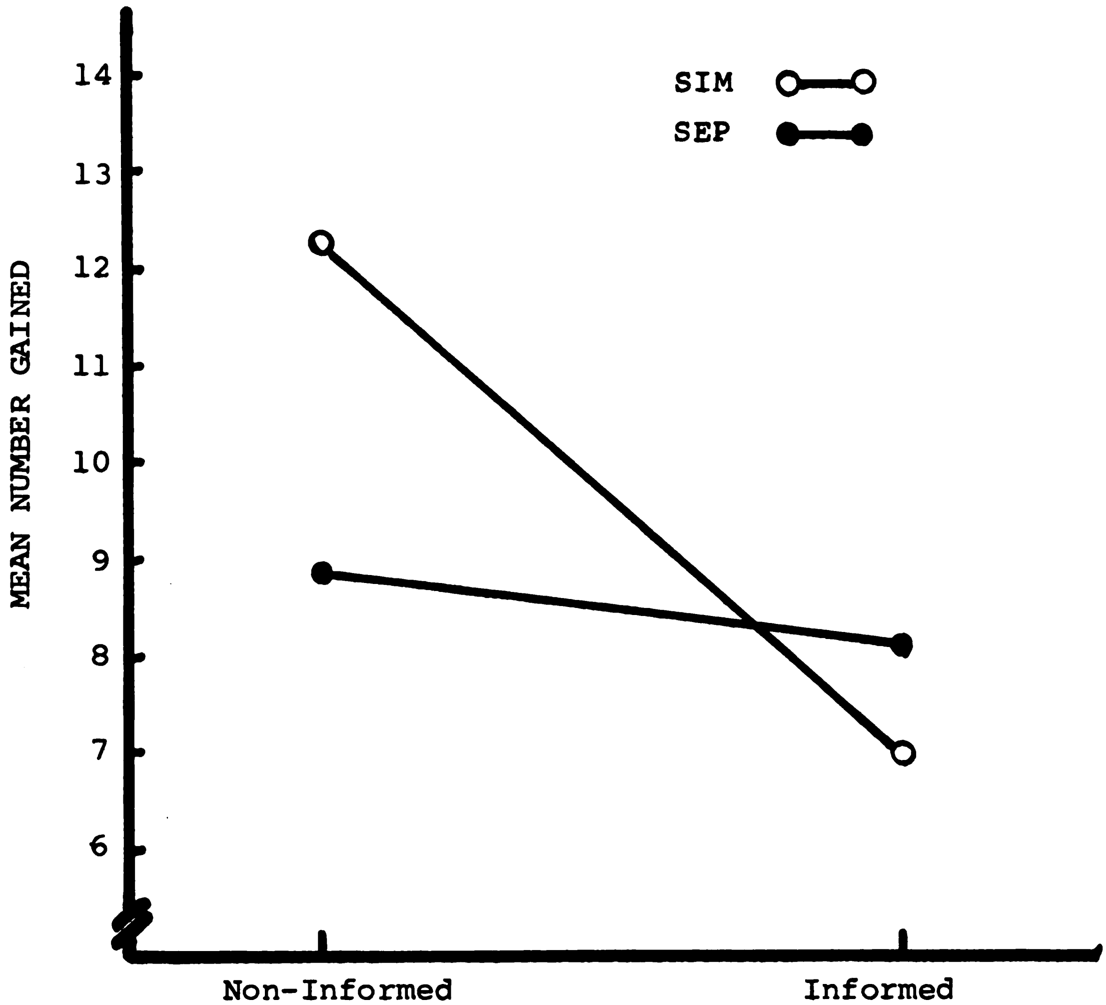

Figure 8. Mean number gained (T.B.4 - T.B.1) of informed and non-informed Ss on similar and separated lists.

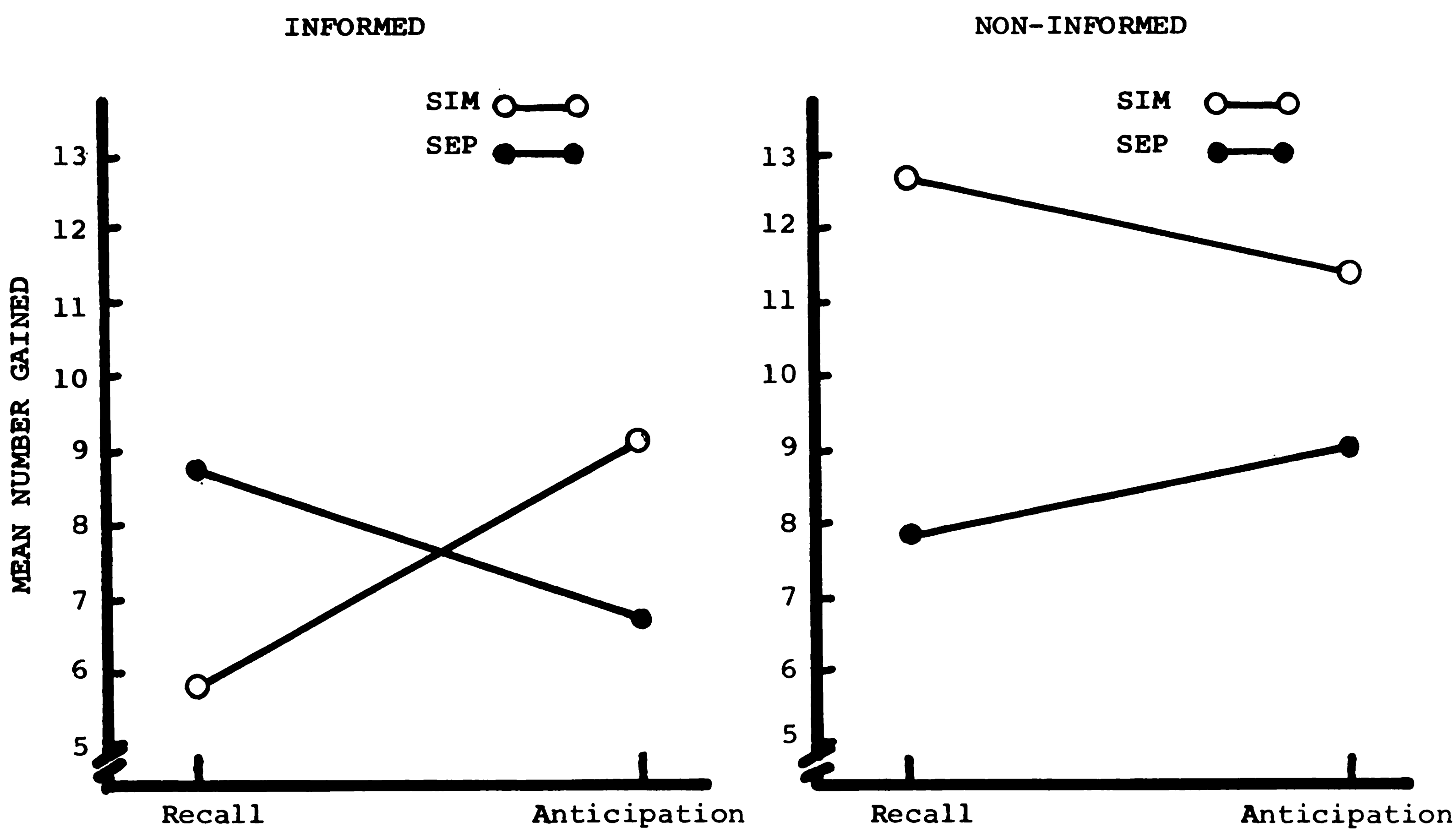

Figure 9. Mean number gained (T.B.4 - T.B.1) of grouped similar and maximally separated lists as a function of learning method and instructions.

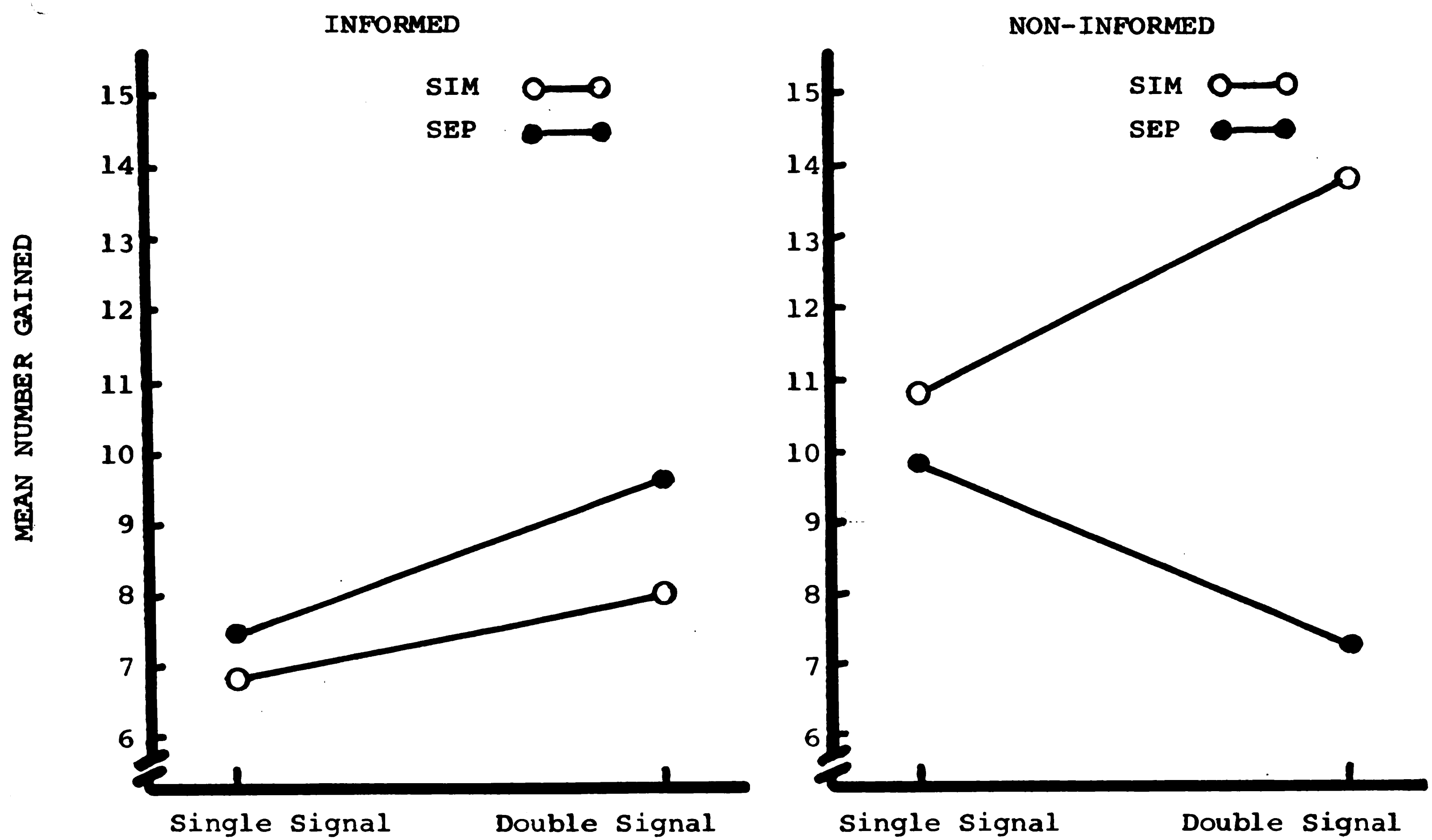

Figure 10. Mean number gained (T.B.4 - T.B.1) of grouped similar and maximally separated lists as a function of signal repetition and instructions.

is significant. It appears that when timing arrangements allow for comparisons among stimuli, the rate of learning on the Grouped Similar List is facilitated.

Substitution Data

Rothkopf (1957) has reported that the level of similarity among Morse Code Signals is positively related to substitution errors. Rothkopf (1958) found that the distribution of errors was not related to sequence of stimuli in the list (Grouped Similar vs. Maximally Separated). He states, ". . . errors generally were found to be in keeping with the relative standing of the four treatments as far as correct responses were concerned."

In order to assess the affects of the present experimental treatments on the distribution of substitution errors, the substitution errors of four experimental groups were examined. The groups examined were the following: (A) Informed Anticipation Single Signal Separated, (B) Informed Anticipation Double Signal Separated, (C) Non-Informed Recall Single Signal Similar, and (D) Non-Informed Recall Double Signal Similar.

The responses to each signal on Trials 13 - 16 were recorded for each subject. For each signal the frequency that each response was given to that signal was tabulated. Substitution error frequencies of each of the four groups were correlated with the other groups. The correlations appear in Table 11. All the correlations in

Table 11. Correlations of distribution of substitution errors.

	Recall Non-Informed Single Signal	Recall Non-Informed Double Signal	Anticipation Informed Single Signal
Recall Non-Informed Double Signal	.85		
Anticipation Non-Informed Single Signal	.81	.75	
Anticipation Informed Double Signal	.78	.76	.82

Table 11 are significantly different from zero, and none of the differences between the correlations reaches significance at the .05 level of confidence.

These results confirm Rothkopf's results.

The correlation between the substitution errors in the four groups of the present experiment and the percentage of confusions in a psychophysical situation (Rothkopf, 1957) are .69, .78, .74 and .72 respectively. It appears that irrespective of experimental conditions, the main source of errors was perceptual confusions among the signals.

DISCUSSION

Results of the Present Experiment

Previous experiments on the effects of stimulus sequence on paired associate learning report contradictory results. Differences in stimulus materials and procedures among these experiments may account for the differences in results. The present experiment manipulated several presumably salient features of these previous experiments to determine their effects on an auditory paired-associate learning task.

The results indicate the following:

1) Performance on the Grouped Similar List was superior to performance on the Maximally Separated List when the effective inter-stimulus interval was short.

2) There was no significant difference in performance on the two lists when the effective inter-stimulus interval was long and the subjects were not informed of the nature of the sequence of the list.

3) Instructions concerning the nature of the sequence of stimuli "depressed" performance on the Grouped Similar List but facilitated performance on the Maximally Separated List.

4) At the later stages of practice, the interfering effect of the instructions on the Grouped Similar List

was greater with the recall method than with the anticipation method.

Comparison of Results to Prior Experiments

The present results agree with the Gagné (1950) results, but are in apparent disagreement with the Rothkopf (1958) and the Rotberg (1964) results.

Decreasing the time between the stimuli to more closely approximate the timing in the Gagné experiment resulted in superior performance on the Grouped Similar List. Rothkopf has argued that the discrepancy between his and Gagné's results may be due to the difference in stimulus materials. However, the results of the present experiment indicate that, even with transitory auditory stimuli, grouping the similar stimuli facilitates learning if the effective inter-stimulus interval is short.

The present experiment contained several experimental conditions which were similar to Rothkopf's (1958) experiment with respect to timing and learning method. He found facilitation on the Maximally Separated List. In the present experiment performance on the Grouped Similar and Maximally Separated Lists was not significantly different when the effective inter-stimulus interval was long. However, the differences Rothkopf (1958, experiment II) reported were based on 160 study trials and 40 test trials. He did not report an analysis at different stages of learning. Careful examination of his Figure 2 (Rothkopf,

1958) reveals that at the stage of practice equivalent to the practice given in the present experiment, the differences between lists were not significant.

Rotberg (1964) argued that the successive presentation of similar stimuli is facilitative only when the subsets of similar stimuli are <u>temporally or perceptually isolated</u>. In the present experiment half the subjects were instructed about the similarities and sequences in the lists. It was expected that these instructions would facilitate learning by facilitating perceptual isolations. It was further expected that the instructions would interact with stimulus sequence such that the <u>Grouped Similar List</u> would show greater facilitation from instruction than the <u>Maximally Separated List</u>. This did not occur. On the contrary, when the effective inter-stimulus interval was long (Single Signal condition), the difference between the Informed groups and the Non-Informed groups was not significant. On the other hand, when the effective inter-stimulus interval was short, the performance on the <u>Grouped Similar List</u> was "depressed" by the instructions while performance on the <u>Maximally Separated List</u> was facilitated by the instructions.

The special instructions for the <u>Grouped Similar List</u> stressed similarities among the stimuli, while the special instructions for the <u>Maximally Separated List</u> did not have this emphasis (see Appendix B). Perhaps the emphasis on similarities set the subjects to attend to similarities rather than to differences among the stimuli, thereby interfering with learning.

The present results indicate that learning method per se was not a significant source of variance. The significant M X L X I interaction on the scores of Trial Block 4 and on the gain scores indicates that performance on the Grouped Similar List was superior to performance on the Maximally Separated List in the Non-Informed Recall condition. This difference is probably due to the facilitative effect of the short effective inter-stimulus interval in the Grouped Similar List, rather than being due to learning method.

Recent studies (Battig and Brackett, 1961, and Lockhead, 1962) utilizing visual and verbal stimuli reported contradictory results on the effects of the recall and anticipation methods in paired-associate learning. The recall method either yielded superior performance or there was no significant difference in performance with both methods. Using International Morse Code Signals as stimuli, Levine and Barch (1963) found that performance with the anticipation method was superior to performance with the recall method. Although there were several S-R pairs common to both the 1963 and the present study, learning method (recall vs. anticipation) was not a significant source of variance. In the prior study the list consisted of eight pairs, while the present study had 12 pairs. Perhaps increasing the list length also increased the opportunity for subjects in the anticipation condition to "practice errors." This change may have depressed performance in the anticipation condition while not affecting performance in the recall condition. There was also a procedural difference in the present study and the Levine and Barch (1963) study which may account for the difference in results. In the prior study all trials of the anticipation condition used the study trial anticipation procedure and there were no separate test trials.

The present study, although confined to auditory stimuli, throws light on the comparison of learning with auditory vs. learning with visual stimuli. The main finding of the present study is that, if the timing of the auditory task is made comparable to that of the visual task, the learning rates will be affected by the same variable (List Sequence) in the same way. A timing characteristic of central importance may be the effective inter-stimulus interval as well as the rate of presentation. In studies utilizing visual materials the stimuli are usually left in view of the subject until the next stimulus occurs. This is not possible in studies utilizing patterned auditory stimuli.

SUMMARY AND CONCLUSION

The effects of stimulus sequence on a paired-associate auditory learning task were studied while varying learning method (Anticipation vs. Recall), Instructions on list sequence (Informed vs. Non-Informed) and effective inter-stimulus intervals (Single vs. Double Signal). The stimuli were International Morse Code Signals transmitted at the rate of 15 words per minute and the responses were two-digit numbers. Subjects were given 16 alternating study and test trials.

The hypotheses were the following:

1) Performance on the Maximally Separated List will be superior to performance on the Grouped Similar List when the anticipation learning method is employed in conjunction with a long effective inter-stimulus interval.

2) Performance on the Grouped Similar List will be superior to performance on the Maximally Separated List when the recall learning method is employed in conjunction with a short effective inter-stimulus interval.

3) Information concerning the stimulus sequences will facilitate learning and the facilitation will be greater for the Grouped Similar List than for the Maximally Separated List.

The results supply confirmatory evidence for hypothesis 2, but not for hypotheses 1 and 3.

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APPENDICES

APPENDIX A

PAIRED ASSOCIATE INSTRUCTIONS

Recall - Single Signal

This is an auditory identification experiment. We are interested in investigating the circumstances and situations under which sound patterns are best learned. This is not a test of personality or intelligence. We are interested only in the average scores of various groups; so please do not look at your neighbor's paper. Cheating will invalidate the information we gather. Please listen to the following instructions very carefully.

You will hear 12 different sound patterns or signals. Each of these signals is paired with a two-digit number. Your job is to learn which number belongs with or is associated with each signal. Look at your answer sheet. The numbers that will be used are printed there.

We will present two kinds of trials: study trials and test trials. Study trials present the 12 signals with their numbers so that you can learn the pairs. Test trials present only the 12 signals and test whether you can give the number part of the pair. You will have 16 study trials and 16 test trials. Remember: Study trials are only for the purpose of learning the pairs; so do not write anything during the study trials. Listen carefully and try to associate each signal with its number.

Look at your answer sheet. Look for Test Trial 1. Notice the numbers are arranged in 12 rows labeled A through L. When you hear the first signal of the test trial, circle its paired number in Row A. For example, if you think its paired number is 14, circle the number 14 in Row A. When you hear the second signal of a test trial, circle its number in Row B, and so on until the twelfth signal.

Recall - Double Signal

This is an auditory identification experiment. We are interested in investigating the circumstances and situations under which sound patterns are best learned. This is not a test of personality or intelligence. We are interested only in the average scores of the various groups; so please do not look at your neighbor's paper. Cheating will invalidate the information we gather. Please listen to the following instructions very carefully.

You will hear 12 different sound patterns or signals. Each of these signals is paired with a two-digit number. Your job is to learn which number belongs with or is associated with each signal. Look at your answer sheet. The numbers that will be used are printed there.

We will present two kinds of trials: study trials and test trials. Study trials present the 12 signals with their numbers so that you can learn the pairs. Test trials present only the 12 signals and test whether you can give the number part of the pair. You will have 16 study trials and 16 test trials. During the study trials a signal will be presented. Immediately after the signal its paired number will be announced. Then the same signal will be sounded again. A new signal will follow after a brief pause. Study trials are only for the purpose of learning the pairs; so do not write anything during the study trials. Listen carefully to the signal, its paired number and the repetition of the signal. In this way you will be able to learn what number is paired with each signal. During the test trials we will test your learning of the pairs by presenting only the signals. On test trials each signal will be presented only once.

Look at your answer sheet. Look for Test Trial 1. Notice the numbers are arranged in 12 rows labeled A through L. When you hear the first signal of a test trial, circle its paired number in Row A. For example, if you think its paired number is 14, circle the number 14 in Row A. When you hear the second signal, circle its paired number in Row B, and so on until the twelfth signal.

Non-Informed - Recall

The pairs will occur in a different order from trial to trial; so do not learn the pairs in order. Learn each signal with its number. Do not write anything during the study trials. During the test trials, circle the number that you think is paired with each signal. Leave no blanks. If you are not sure, make the best guess you can.

Anticipation - Single Signal

This is an auditory identification experiment. We are interested in investigating the circumstances and situations under which sound patterns are best learned. This is not a test of personality or intelligence. We are interested only in the average scores of various groups; so please do not look at your neighbor's paper. Cheating will invalidate the information we gather. Please listen to the following instructions very carefully.

You will hear 12 different sound patterns or signals. Each of these signals is paired with a two-digit number. Your job is to learn which number belongs with or is associated with each signal. Look at your answer sheet. The numbers that will be used are printed there.

We will present two kinds of trials: study trials and test trials. Study trials present the 12 signals and after each signal the correct two-digit number will be announced. Test trials present only the 12 signals and test whether you can give the number part of the pair. Each study trial will be followed by a test trial. You will have 16 study trials and 16 test trials.

Respond to each signal by circling the number that you think is paired with that signal. When you hear the first signal of a trial, circle its paired number in Row A. For example, if you think its paired number is 14, then you would circle the number 14 in Row A. When you hear the second signal of a trial, circle its paired number in Row B, and so forth through the twelfth signal.

During the study trials a signal will be followed by a brief pause. After this pause the correct two-digit number will be announced. Circle the number that you think is paired with the signal during the pause between the signal and the announcement of the correct number. Then listen to the announcement of the correct response. In this way you will be able to learn which number is paired with each signal.

During the test trials only the signals will be presented. Respond to each signal by circling the number you think is paired with each signal.

Anticipation - Double Signal

This is an auditory identification experiment. We are interested in investigating the circumstances and situations under which sound patterns are best learned. This is not a test of personality or intelligence. We are interested only in the average scores of various groups; so please do not look at your neighbor's paper. Cheating will invalidate the information we gather. Please listen to the following instructions very carefully.

You will hear 12 different sound patterns or signals. Each of these signals is paired with a two-digit number.

Your job is to learn which number belongs with or is associated with each signal. Look at your answer sheet. The numbers that will be used are printed there.

We will present two kinds of trials: study trials and test trials. Study trials present the 12 signals. After each signal the correct two-digit number will be announced. Test trials present only the 12 signals and test whether you can give the number part of the pair. Each study trial will be followed by a test trial. You will have 16 study trials and 16 test trials. Respond to each signal by circling the number that you think is paired with that signal. When you hear the first signal of the first trial, circle its paired number in Row A. For example, if you think its paired number is 14, then you would circle the number 14 in Row A. When you hear the second signal of a trial, circle its number in Row B, and so forth through the twelfth signal.

During the study trials a signal will be followed by a brief pause and then the same signal will be sounded again. After the repetition of the signal, the number that is paired with that signal will be announced. Circle the number that you think is paired with the signal during the pause between the first and second sounding of the signal. Listen to the announcement of the correct number. In this way you will be able to learn which number is paired with each signal.

During the test trials each signal will be presented only once. The correct number will not be announced. Respond to each signal by circling the number you think is paired with each signal.

Non-Informed - Anticipation

The pairs will occur in a different order from trial to trial; so do not learn the pairs in order. Learn each signal with its number.

Respond to each signal by circling the number that you think is paired with that signal. Leave no blanks. If you are not sure, make the best guess you can.

APPENDIX B

SPECIAL INSTRUCTIONS FOR INFORMED GROUPS

Informed - Grouped Similar List

The pairs will occur in a different order from trial to trial. However, the pairs are arranged in a special way. You will notice that certain signals are very similar. As a matter of fact, the entire set of 12 signals is made up of four groups of signals. Within each of the four groups there are three similar sounding signals.

Now, during the study trials the three signals within a group will always be presented together.

Suppose for demonstration purposes, each of these forms represents a signal. Notice there are 12 forms. This list contains four subgroups: circles, triangles, crosses and squares. On any trial the circles would be presented together as would the other forms.

From trial to trial, the location of any subset will vary. Notice that on Trial 1, the group of crosses is presented first. Similarly, the triangles are in the second position on Trial 1 and in the last position on Trial 2.

Furthermore, within each subgroup the order of signals changes from trial to trial. Notice that on

Trial 1, the closed circle is first, while on Trial 2, the closed circle is second.

In summary, the location of the four groups will vary from trial to trial, and the order within each group will also change from trial to trial. The similar signals will always be presented together on the study trials. There is no specific arrangement of signals on the test trials.

Remember to listen carefully to the signals and their paired numbers on the study trials. On the test trials only the signals will be presented. You will respond to each signal by circling its paired number in the appropriate row.

Leave no blanks. If you are not sure, make the best guess you can.

Informed - Maximally Separated List

The pairs will occur in a different order from trial to trial. However, the pairs are arranged in a special way. You will notice that certain signals are very similar. As a matter of fact, the entire set of 12 signals is made up of four groups. Within each of the four groups there are three similar sounding signals.

Now, during the study trials, the three signals within a group will never be presented together.

Suppose, for demonstration purposes each one of these forms represents a signal. Notice there are 12 forms. This list contains four subgroups: circles, triangles, crosses and squares.

Notice that each member of a subgroup is always separated from any other member of that subgroup by three dissimilar signals.

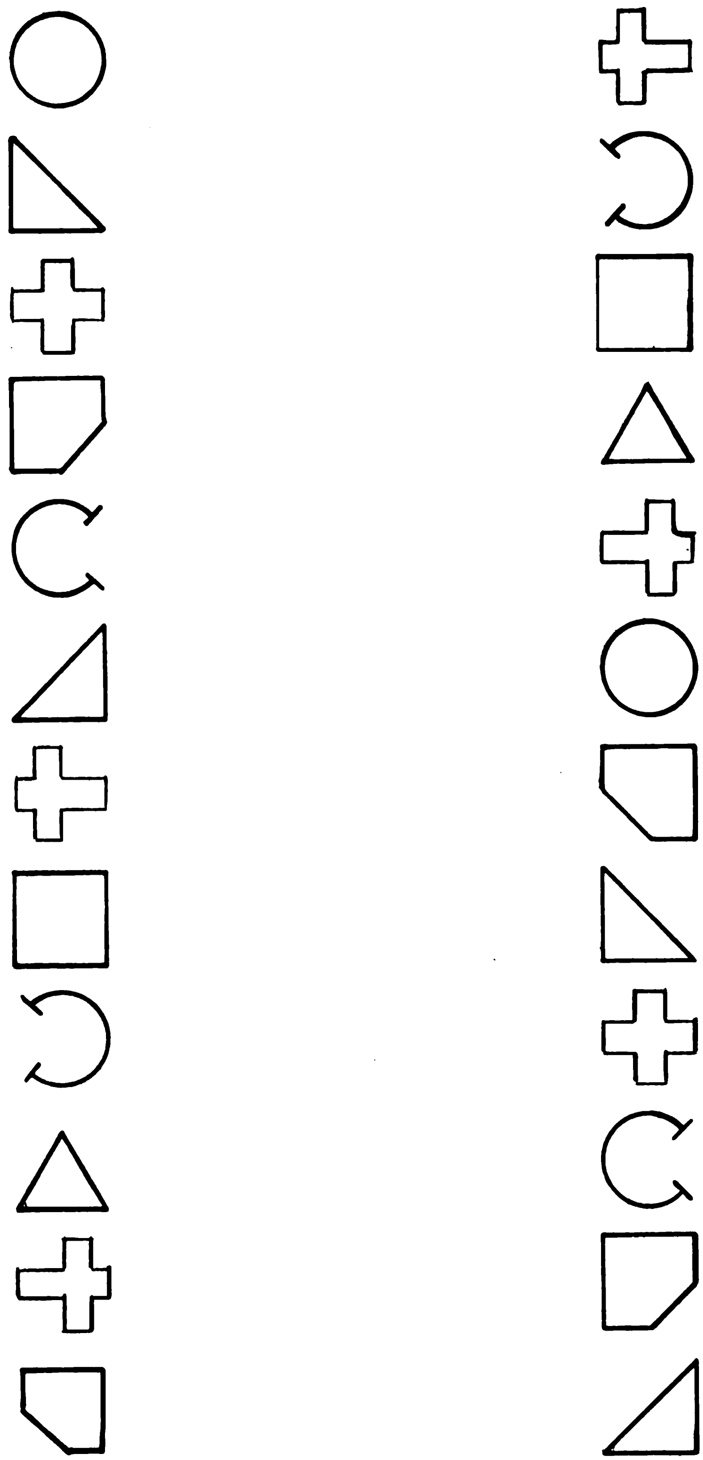
From trial to trial the order of the signals will change. Furthermore, the same member of the subgroup will not always appear first. Notice that the right triangle appears as the first member of its group on Trial 1, while the equilateral triangle appears as the first member on Trial 2.

There is no specific arrangement of signals on the test trial.

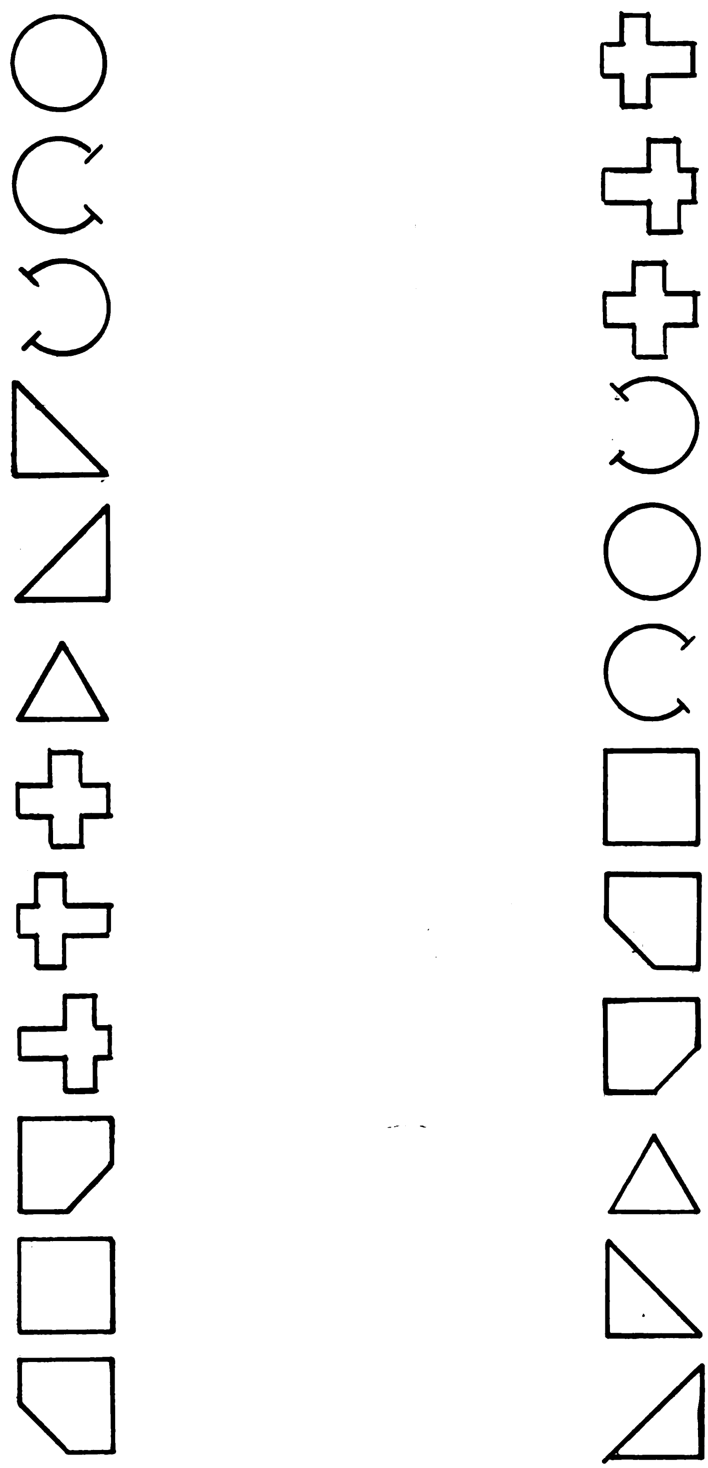
Remember to listen carefully to the signals and their paired numbers on the study trials. On the test trials only the signals will be presented. You will respond to each signal by circling the paired number you think is correct in the appropriate row.

Leave no blanks. If you are not sure, make the best guess you can.

Demonstration Card for Maximally Separated Condition



Demonstration Card for Grouped Similar Condition



APPENDIX C

RESPONSE SHEETS

NAME____ DATE______________

STUDENT NUMBER____________ SEX______________

AGE__________ #_________________

PSYCHOLOGY 151 INSTRUCTOR______________________________

STUDY TRIAL 1

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32337 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 1

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G -14 26 32 37 48 51 63 72 80 85 93 96
H -15 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 24 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 2

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 2

A- 14 26 32 37 48 51 63 73 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 2[illegible] 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 3

A- 14 26 32 37 46 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 3

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 4

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 4

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 43 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 5

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 5

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 6

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 6

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 7

A-	14	26	32	37	48	51	63	72	80	85	93	96
B-	14	26	32	37	48	51	63	72	80	85	93	96
C-	14	26	32	37	48	51	63	72	80	85	93	96
D-	14	26	32	37	48	51	63	72	80	85	93	96
E-	14	26	32	37	48	51	63	72	80	85	93	96
F-	14	26	32	37	48	51	63	72	80	85	93	96
G-	14	26	32	37	48	51	63	72	80	85	93	96
H-	14	26	32	37	48	51	63	72	80	85	93	96
I-	14	26	32	37	48	51	63	72	80	85	93	96
J-	14	26	32	37	48	51	63	72	80	85	93	96
K-	14	26	32	37	48	51	63	72	80	85	93	96
L-	14	26	32	37	48	51	63	72	80	85	93	96

TEST TRIAL 7

A-	14	26	32	37	48	51	63	72	80	85	93	96
B-	14	26	32	37	48	51	63	72	80	85	93	96
C-	14	26	32	37	48	51	63	72	80	85	93	96
D-	14	26	32	37	48	51	63	72	80	85	93	96
E-	14	26	32	37	48	51	63	72	80	85	93	96
F-	14	26	32	37	48	51	63	72	80	85	93	96
G-	14	26	32	37	48	51	63	72	80	85	93	96
H-	14	26	32	37	48	51	63	72	80	85	93	96
I-	14	26	32	37	48	51	63	72	80	85	93	96
J-	14	26	32	37	48	51	63	72	80	85	93	96
K-	14	26	32	37	48	51	63	72	80	85	93	96
L-	14	26	32	37	48	51	63	72	80	85	93	96

STUDY TRIAL 8

A-	14	26	32	37	48	51	63	72	80	85	93	96
B-	14	26	32	37	48	51	63	72	80	85	93	96
C-	14	26	32	37	48	51	63	72	80	85	93	96
D-	14	26	32	37	48	51	63	72	80	85	93	96
E-	14	26	32	37	48	51	63	72	80	85	93	96
F-	14	26	32	37	48	51	63	72	80	85	93	96
G-	14	26	32	37	48	51	63	72	80	85	93	96
H-	14	26	32	37	48	51	63	72	80	85	93	96
I-	14	26	32	37	48	51	63	72	80	85	93	96
J-	14	26	32	37	48	51	63	72	80	85	93	96
K-	14	26	32	37	48	51	63	72	80	85	93	96
L-	14	26	32	37	48	51	63	72	80	85	93	96

TEST TRIAL 8

A-	14	26	32	37	48	51	63	72	80	85	93	96
B-	14	26	32	37	48	51	63	72	80	85	93	96
C-	14	26	32	37	48	51	63	72	80	85	93	96
D-	14	26	32	37	48	51	63	72	80	85	93	96
E-	14	26	32	37	48	51	63	72	80	85	93	96
F-	14	26	32	37	48	51	63	72	80	85	93	96
G-	14	26	32	37	48	51	63	72	80	85	93	96
H-	14	26	32	37	48	51	63	72	80	85	93	96
I-	14	26	32	37	48	51	63	72	80	85	93	96
J-	14	26	32	37	48	51	63	72	80	85	93	96
K-	14	26	32	37	48	51	63	72	80	85	93	96
L-	14	26	32	37	48	51	63	72	80	85	93	96

STUDY TRIAL 9

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 9

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 84 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 10

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 10

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 11

A-	14	26	32	37	48	51	63	72	80	85	93	96
B-	14	26	32	37	48	51	63	72	80	85	93	96
C-	14	26	32	37	48	51	63	72	80	85	93	96
D-	14	26	32	37	48	51	63	72	80	85	93	96
E-	14	26	32	37	48	51	63	72	80	85	93	96
F-	14	26	32	37	48	51	63	72	80	85	93	96
G-	14	26	32	37	48	51	63	72	80	85	93	96
H-	14	26	32	37	48	51	63	72	80	85	93	96
I-	14	26	32	37	48	51	63	72	80	85	93	96
J-	14	26	32	37	48	51	63	72	80	85	93	96
K-	14	26	32	37	48	51	63	72	80	85	93	96
L-	14	26	32	37	48	51	63	72	80	85	93	96

TEST TRIAL 11

A-	14	26	32	37	48	51	63	72	80	85	93	96
B-	14	26	32	37	48	51	63	72	80	85	93	96
C-	14	26	32	37	48	51	63	72	80	85	93	96
D-	14	26	32	37	48	51	63	72	80	85	93	96
E-	14	26	32	37	48	51	63	72	80	85	93	96
F-	14	26	32	37	48	51	63	72	80	85	93	96
G-	14	26	32	37	48	51	63	72	80	85	93	96
H-	14	26	32	37	48	51	63	72	80	85	93	96
I-	14	26	32	37	48	51	63	72	80	85	93	96
J-	14	26	32	37	48	51	63	72	80	85	93	96
K-	14	26	32	37	48	51	63	72	80	85	93	96
L-	14	26	32	37	48	51	63	72	80	85	93	96

STUDY TRIAL 12

A-	14	26	32	37	48	51	63	72	80	85	93	96
B-	14	26	32	37	48	51	63	72	80	85	93	96
C-	14	26	32	37	48	51	63	72	80	85	93	96
D-	14	26	32	37	48	51	63	72	80	85	93	96
E-	14	26	32	37	48	51	63	72	80	85	93	96
F-	14	26	32	37	48	51	63	72	80	85	93	96
G-	14	26	32	37	48	51	63	72	80	85	93	96
H-	14	26	32	37	48	51	63	72	80	85	93	96
I-	14	26	32	37	48	51	63	72	80	85	93	96
J-	14	26	32	37	48	51	63	72	80	85	93	96
K-	14	26	32	37	48	51	63	72	80	85	93	96
L-	14	26	32	37	48	51	63	72	80	85	93	96

TEST TRIAL 12

A-	14	26	32	37	48	51	63	72	80	85	93	96
B-	14	26	32	37	48	51	63	72	80	85	93	96
C-	14	26	32	37	48	51	63	72	80	85	93	96
D-	14	26	32	37	48	51	63	72	80	85	93	96
E-	14	26	32	37	48	51	63	72	80	85	93	96
F-	14	26	32	37	48	51	63	72	80	85	93	96
G-	14	26	32	37	48	51	63	72	80	85	93	96
H-	14	26	32	37	48	51	63	72	80	85	93	96
I-	14	26	32	37	48	51	63	72	80	85	93	96
J-	14	26	32	37	48	51	63	72	80	85	93	96
K-	14	26	32	37	48	51	63	72	80	85	93	96
L-	14	26	32	37	48	51	63	72	80	85	93	96

STUDY TRIAL 13

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 8C 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G -14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 13

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 14

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 5k 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G -14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 14

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 15

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 15

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

STUDY TRIAL 16

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 16

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

NAME *Kathryn M. Nash* DATE *April 29*

STUDENT NUMBER *345333* SEX *Female*

AGE *20* # *16*

PSYCHOLOGY 151 INSTRUCTOR *Meyyana* *ED 200*

G - yes -
3 shirts was 43
4 " 51
5 " 72
also there was ||.
|||. etc.
||||.

TEST TRIAL 1

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 2

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 3

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 4

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 5

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 95

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 6

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 7

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 8

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 9

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 11

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 10

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 12

A- 14 26 32 37 48 51 63 72 80 85 93 96
B- 14 26 32 37 48 51 63 72 80 85 93 96
C- 14 26 32 37 48 51 63 72 80 85 93 96
D- 14 26 32 37 48 51 63 72 80 85 93 96
E- 14 26 32 37 48 51 63 72 80 85 93 96
F- 14 26 32 37 48 51 63 72 80 85 93 96
G- 14 26 32 37 48 51 63 72 80 85 93 96
H- 14 26 32 37 48 51 63 72 80 85 93 96
I- 14 26 32 37 48 51 63 72 80 85 93 96
J- 14 26 32 37 48 51 63 72 80 85 93 96
K- 14 26 32 37 48 51 63 72 80 85 93 96
L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 13

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 14

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 15

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96

TEST TRIAL 16

A- 14 26 32 37 48 51 63 72 80 85 93 96

B- 14 26 32 37 48 51 63 72 80 85 93 96

C- 14 26 32 37 48 51 63 72 80 85 93 96

D- 14 26 32 37 48 51 63 72 80 85 93 96

E- 14 26 32 37 48 51 63 72 80 85 93 96

F- 14 26 32 37 48 51 63 72 80 85 93 96

G- 14 26 32 37 48 51 63 72 80 85 93 96

H- 14 26 32 37 48 51 63 72 80 85 93 96

I- 14 26 32 37 48 51 63 72 80 85 93 96

J- 14 26 32 37 48 51 63 72 80 85 93 96

K- 14 26 32 37 48 51 63 72 80 85 93 96

L- 14 26 32 37 48 51 63 72 80 85 93 96