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ABSTRACT

With the advent of multi-screen capability in multi-media communication centers, it is possible to control the visual learning environment in a number of interesting ways. The basic assumption implicit in the concept of the multiple-image presentation is that it increases learning. A study tested the effect on learning of single- and multiple-image presentations as they related to two levels of stimulus complexity of a series of similar problems and to practice of these problems. Three experimental variables (stimulus complexity, communicator strategy, practice), six stimulus conditions, and 24 treatment combinations were used. Subjects were asked to learn a visual concept and identify it on later slides. Results showed that reducing the number of irrelevant cues, while holding relevant ones constant, reduced the difficulty of learning. Also, practice over a series of similar concept attainment problems had a positive but differential effect over a series of four problems. (JK)

VISUAL CONCEPT ATTAINMENT AS AFFECTED BY STIMULUS COMPLEXITY AND SELECTED COMMUNICATOR STRATEGIES

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An important consideration for this study was the idea that much of the learning of the human organism involves categorizing events into useable form. Categorizing in the classroom requires that the student correctly name objects and ideas. To do this, he must learn to discriminate objects on the basis of cues that are relevant to a particular category.

Structuring of visual, non-verbal material could use design principles from the field of programed instruction, but little work has been done in the area of pictorial programming. The concept of programming makes it highly desirable that communicators know the effect of those presentation variables which they have within their control, for only if it is possible for the communicator to predict the results of the control he exercises will the visual stimulus become more useful.

With the advent of multi-screen capability in multi-media communication centers, it is possible to control the visual learning environment in a number of interesting ways. The basic assumption implicit in the concept of the multiple-image presentation is that it increases learning. There is no evidence to support or refute this assumption. The experimental work done with multiple images has been evaluated on the basis of student attitude without consideration of the variable of the number of images presented simultaneously. Further experimentation with this variable would appear to be valuable for the practicing communicator.

Problem

The writer considered worthy of investigation the effects of the variables of communicator strategy, stimulus complexity, and practice. Thus, this study was concerned with the effect on learning of single- and multiple-image presentations (communicator strategy) as they related to two levels of stimulus complexity of a series of similar problems and to practice over these problems. The specific statements of hypotheses selected for study are given below.

1. Learning, as measured by a visual recognition test in a concept attainment problem, will be an inverse function of the number of irrelevant cues available to the subject on any given problem with relevant cues held constant.

2. Learning, as measured by a visual recognition test in a concept attainment problem, will be a positive function of the number of stimuli presented simultaneously to the subject.

3. Learning, as measured by a visual recognition test in a concept attainment problem, will be a positive function of the number of problems previously solved.

Source of the Data

A total of 195 subjects was used for this experiment. They were students in beginning instructional materials courses with at least a junior standing at Southern Illinois University, Carbondale, Illinois. Participation in the experiment was required by the instructors. However, the students were told that the results of the experiment would have no bearing on their course grade.

Each student was requested to sign up for the experiment at a time which would be convenient for him. It was therefore assumed that the groups were randomized with regard to ability. Groups were then randomly assigned to the six different stimulus conditions.

Because the subjects were run in groups of unequal size, the stimulus conditions had an unequal number of subjects at the conclusion of the experiment. Subject data was cast out by random selection of data cards to equalize the number of subjects. After this had been accomplished, 30 subjects remained in each condition.

Method and Procedure

The design for this study was a Type III factorial design. As shown in Figure 1, it was a 2 x 3 x 4 design. It is diagrammed with L=2, S=3, and P=4. It can be seen then that this experiment consisted of three experimental variables, six stimulus conditions, and 24 treatment combinations.

Variable L represents stimulus complexity. Level one (L_1) indicates the level of complexity which had a ratio of two criterial to three non-criterial attributes (2:3), while level two (L_2) indicates a ratio of two criterial to six non-criterial attributes (2:6).

Variable S represents communicator strategy. Strategy one (S_1) indicates that the stimuli were presented one at a time. Strategies two and three (S_2 and S_3) indicate that the stimuli were presented two at a time and four at a time, respectively.

Variable P represents practice. Problem one (P_1) indicates that this was the first problem in the series of four similar problems. Similarly, problem two (P_2), problem three (P_3), and problem four (P_4) indicate the second, third, and fourth problems in the series. The presentation sequence of the problem series was not varied during the experiment.

In addition to presenting the three independent variables of stimulus complexity (L), communicator strategy (S), and practice (P), Figure 1 illustrates the six stimulus conditions which were the result of the combination

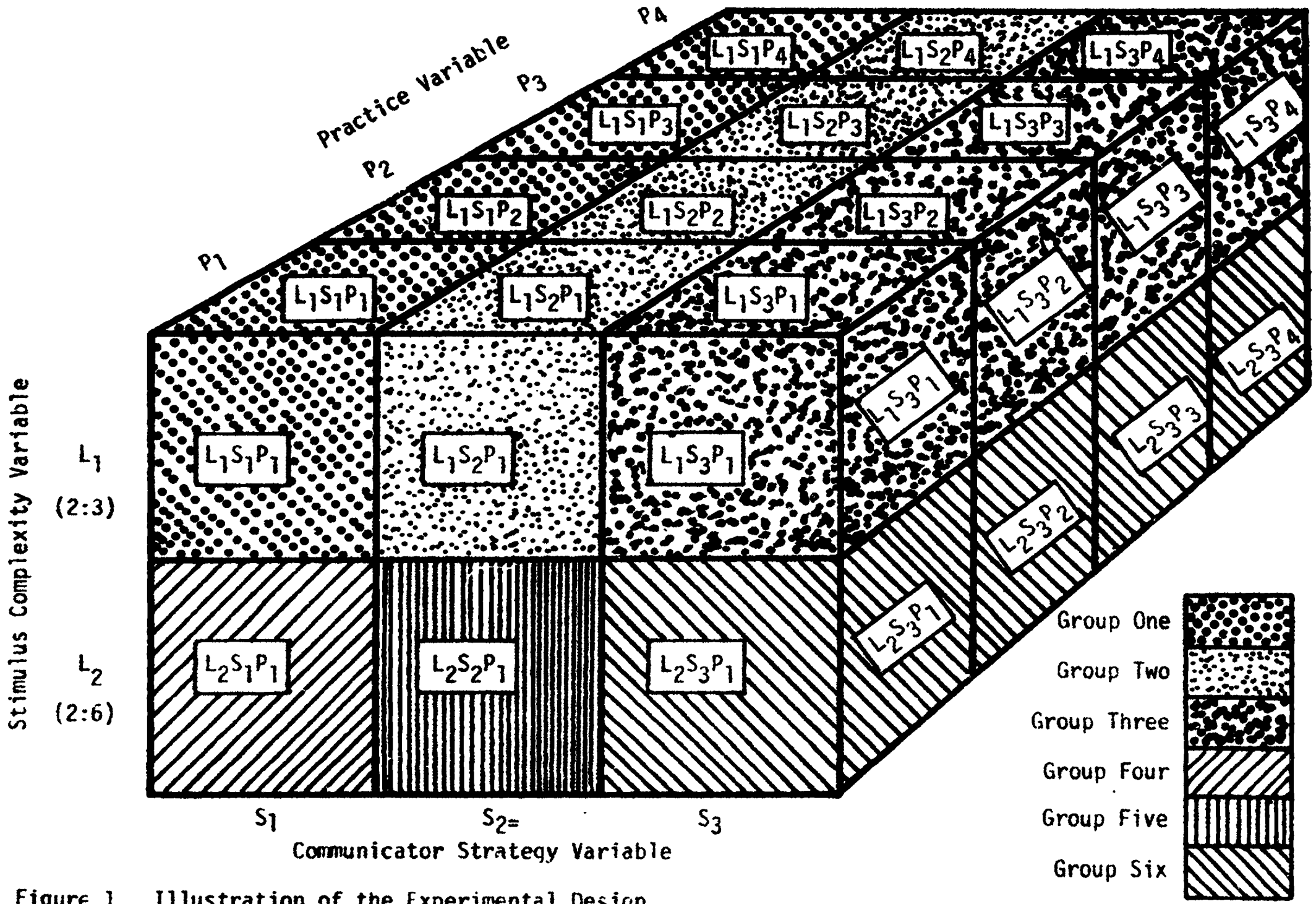

Figure 1. Illustration of the Experimental Design

of the level and strategy variables. Each of the six conditions was given to a separate experimental group. Therefore, the stimulus conditions on the face of the diagram L_1S_1, L_1S_2, L_1S_3, L_2S_1, L_2S_2, and L_2S_3 were encountered by groups one, two, three, four, five, and six respectively on the first problem (P_1) of the series of four problems.

For stimulus condition number one, the subjects were told first that all the figures they would see would look at least like the basic figure on the screen. After this basic slide had been on the screen for 10 seconds, the tape recorder automatically advanced the slide to the first exemplar to be presented. The experimenter's recorded voice then said, "This is a MOT." After 10 seconds, this cycle was repeated, and at the end of another 10 seconds, repeated again, and finally repeated after another 10 seconds.

After these 4 exemplars had been shown for 10 seconds each, the tape advanced the projector to the first test slide or slide five. The experimenter's recorded voice asked, "Is this a MOT?" The experimenter caused the tape recorder to pause. Subjects were told that they could take all the time they needed to answer the question, but that when they were finished they should in some way indicate that they had answered. After all subjects had answered the question, the tape recorder was started, and the projector advanced to the second test slide (slide 6). The same question was again asked, "Is this a MOT?", and finally the last slide (8) in the test block was presented with the question, "Is this a MOT?"

Block two presented four more positive exemplars, one at a time for 10 seconds each. The subjects were tested for a second time with a different set of test items. After block two was completed, the third training/testing block was presented in exactly the same way, and following that, the fourth training/testing block was presented.

Problem two of S_1L_1 (see Figure 1) was handled in exactly the same way as problem one. The task remained the same, but the creature the subjects were to learn to identify had changed. The same was also true of problems three and four in condition one. Each subject was exposed to only a single stimulus condition (strategy and level). Upon completing the fourth problem the group was excused and asked not to discuss the experiment with anyone who might be participating in the experiment in the future.

For condition two (S_2L_1) the experimental method was virtually the same as for condition one except that the training stimuli were presented two at a time. Subjects were shown the same basic figure as for condition one. The first slide of training/testing block one, with two figures visible, was presented to the subjects on the screen for a total of twenty seconds while the second slide with two stimulus figures was also shown for twenty seconds. The test items for any given block of any individual problem were exactly the same for all strategies of level one. They were presented in exactly the same manner and order as were the test questions for S_1L_1.

Stimulus condition three was essentially the same as the previous conditions except that four stimulus figures were shown together on one slide, continuously for a period of forty seconds. The test items were again shown in exactly the

same manner as those in conditions one and two, and the problems progressed at the same speed as did the problems in those conditions.

Condition four was identical to condition one except that level two (L_2) (more complex) stimulus figures were used for this presentation. L_2 training slides were shown one at a time and the L_2 testing slides were shown in the same way as for conditions one, two, and three. Condition five was again presented in a manner identical to condition two except that L_2 images were used. Two slides were shown for 20 seconds each, or a total of 40 seconds, for each of the four training blocks. Condition six was presented exactly as condition three except for the more complex figures involved.

Screen time for each presented exemplar was controlled precisely by metallic sensing tape placed on the back of the recording tape at measured intervals. Screen time for the test items was not controlled by the experimenter. Subjects had as much time as they needed to answer the questions with the minimum time dependent upon the slowest individual in the group.

The data were subjected to an analysis of variance. The results of this analysis are shown in Table 1. All three experimental variables yielded

TABLE 1. ANALYSIS OF VARIANCE FOR LEVEL (L), STRATEGY (S), AND PRACTICE (P) VARIABLES

Source	df	Mean Square	F
Between Subjects	179	21.96	1.14
Levels (L)	1	318.67	16.56***
Strategies (S)	2	75.47	3.92**
L x S	2	56.22	2.92
Error (b)	174	19.24	
Within Subjects	540	2.76	1.01
Practice (P)	3	7.66	2.82*
P x L	3	3.39	1.25
P x S	6	4.00	1.47
P x L x S	6	2.48	0.91
Error (w)	522	2.72	
Total	719		

*** $P < .001$, ** $P < .025$, * $P < .05$

differences which were significant at the .05 level or beyond. All grand means (with the exception of Problem 4) were in the predicted direction. There were no significant interactions.

The hypothesis that learning would be an inverse function of the number of irrelevant cues available to a subject with relevant cues held constant was confirmed. The data had statistical significance beyond the .001 level of confidence. The hypothesis that learning would be a positive function of the number of stimuli presented simultaneously to a subject was confirmed at the .025 level. The hypothesis that learning would be a positive function of practice was confirmed at the .05 level.

Conclusions

As a result of this study the following conclusions seem warranted.

First, the difficulty of attaining a concept through the presentation of pictorial stimuli can be controlled by varying the ratio of relevant to irrelevant cues. Reducing the number of irrelevant cues (relevant cues held constant) reduces the difficulty of learning.

Second, the strategy for presenting stimulus materials to a college-age subject can, under the conditions described in this experiment, have a positive effect on learning.

Third, practice over a series of specifically different but generally similar concept attainment problems has a positive but differential effect over a series of four problems.

Recommendations

On the basis of this study the following considerations are recommended for possible future research:

1. In studies which involve communicator strategies for multiple-image stimulus presentation, the stimuli should be made more complex for subjects on the college level. This greater complexity is necessary to insure that a greater range of performance scores may be obtained.

2. Various ordered procedures for presenting exemplars should be tested versus random procedures for presenting exemplars. Perhaps a procedure of changing irrelevant cues one at a time over a series of single-image presentations would facilitate learning in a concept attainment problem more than presenting a random array of irrelevant cues simultaneously to a subject.

3. Different combinations of criterial to non-criterial cues should be tested with different numbers of items presented simultaneously. A ratio of three criterial to six non-criterial attributes might be tested with strategies of single-image presentations and six and twelve images presented simultaneously to check the relationships found in this study.

4. Studies of communicator strategies should test group presentations versus individual presentations. Some subjects may learn more efficiently in groups while others may learn more efficiently alone.

5. Studies of communicator strategies should test the presentation-rate variable. This would seem particularly important for large group presentations because many of the subjects in the present study evidenced boredom while waiting for the S_3 (four at a time) slides to change.

6. Studies of communicator strategies should test the effect of practice over a series of problems. Perhaps a strategy which increases the rate of presentation during practice would facilitate learning more than maintaining a constant rate of presentation during practice.