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ABSTRACT

A study to determine some conditions to be used to communicate desired instructional outcomes to students in order to produce learning was conducted. A commercial game called "Think-A-Dot" consisting of a series of flip-flops encased in plastic was employed as the learning task. Three independent variables were experimentally manipulated: (1) behavioral objectives presented at the beginning of instruction, (2) behavioral objectives presented in the middle of instruction, and (3) a precriterion test given during the instructional period. A test conforming to the theoretical requirements of the motive of need for achievement and the Alpert and Haber Test Anxiety Scale were given prior to the experiment. The following four treatments influenced achievement more than the other treatments: (1) all three variables combined, (2) only a precriterion test, (3) objectives presented twice: at the beginning of instruction and during instruction, and (4) only objectives presented during instruction. The following treatment groups scored consistently lower: (1) precriterion tests combined with objectives presented at the beginning, (2) precriterion test combined with objectives presented during instruction, and (3) the absence of all three variables. The results of this study point the way to further research. Future research should explore ways to maximize the effects on learning of complex combinations of variables including objectives. (CK)

The Effects of the Placement of Objectives Within an Instructional Period and a Precriterion Test on the Acquisition of a Cognitive Task

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The results of experimental studies concerning the effects of objectives on student learning have been mixed and inconclusive. Yelon and Schmidt (1972) found that the presentation of objectives is not necessarily beneficial for student learning. Cook (1969) concluded that informing students of behavioral objectives does not necessarily enhance their performance on an immediate achievement test, but may increase resistance to forgetting. Jenkins and Deno (1971) reported that neither knowledge of objectives nor type of objectives differentially influenced performance on a criterion test. Schneiderwent (1970) stated that objectives were more effective than no objectives for boy's performance on an achievement test, but not any more effective for girls. Dwyer (1971) reports that specific instructions (objectives) to focus a subject's attention on relevant learning cues in some cases is not effective for increasing the student's achievement. Hartley (1971) demonstrated that the effect of pretests (another means for informing students about the course requirements) depends on the efficiency of the instruction. Under certain conditions the effects may not be manifest.

Perhaps the experimental questions to be asked about the effect of objectives on learning should be more complex: simply asking if objectives are effective in producing learning is like asking if rockets are effective for travel. A comprehensive answer would depend on the conditions imposed. A more appropriate question for objectives research might be: Under what conditions can we communicate desired instructional outcomes to students so as to facilitate learning? Thus, the purpose of this study is to determine some conditions to be used to communicate desired instructional outcomes to students in order to produce learning.

When searching for the best technique to produce a given result in an instructional process, there is the danger of losing the effect in interaction with other variables. To check interactions we arrange the variables in this study in a completely crossed design.

There are many techniques to communicate instructional intent to a student; one of these is presenting objectives to the student. Another is having the student take practice tests. Using an objective, a student should be able to collect and organize pertinent information more efficiently and arrange conditions of learning for himself. (Merrill, 1971 and Mager, 1961)

Might there be an optimal time for presenting an objective to the student? Would it be at the beginning of instruction or at some time during the instructional period? An objective presented at the beginning of instruction seems logical. A student would be directed from the start. But, at the beginning of an instructional period the student might not comprehend the full meaning of the objectives. It may be that only after he has acquired some basic concepts and principles he is able to understand and use the objectives. Thus, presentation of objectives during an instructional period may add effectiveness. Would the resulting learning be greater if these two variables were combined? Would the outcome be greater yet if conditions included actual practice on tests of the desired outcome during the instructional period? To answer these questions, we study the effects of combining objectives presented at different times during instruction with a precriterion test.

Some factors which may influence the effects of conditions to communicate instructional intent are: the student's need to achieve, the student's test anxiety, and the student's interest in the task. (Atkinson, 1964) These variables should be accounted for in the study. Thus, the study takes into account a student's need to achieve and test anxiety.

Method

Materials: A commercial game called "Think-A-Dot" consisting of a series of flip-flops encased in plastic was employed as the learning task. When a marble is dropped in one of the three holes on the top of the game, the marble follows the direction based on the contingency set by the flip-flops and changes certain of the eight blue or yellow dots on the face of the game.

To master the game, the player must be able to predict the changes that will occur. Learning the workings of this game is analogous to learning the principles governing certain machines or logical sets of events. This game was chosen because the learning required was complex and because the subjects were not likely to have had any previous experiences directly related to the task.

To investigate the aforementioned research problem, three independent variables, each with two levels, were experimentally manipulated. These included the presence or absence of each of the following: 1) behavioral objectives presented at the beginning of instruction, 2) behavioral objectives presented in the middle of the instructional period, and 3) a precriterion test given during the instructional period. The three variables were completely crossed resulting in 2^3 factorial design with eight treatment combinations. The experimental task for all groups consisted of learning the principles of the Think-A-Dot Game. All subjects were given directions which said they would be given time to play a game. Those subjects assigned to groups receiving the objectives were given the following explicit behavioral objectives either at the outset of the learning period or right after the precriterion exam or at both times:

> Later you will be given a drawing of any pattern that might appear on the face of the game.
>
> > You will be asked to circle your prediction (blue or yellow) when asked what color a certain dot will be when a marble is dropped in a certain hole.
> >
> > You will be asked to draw a line from one dot to another to show the predicted <u>direction</u> a marble will take when dropped in a certain hole.
> >
> > You will be asked to shade a second drawing (shade = blue, blank = yellow) to indicate your prediction of the <u>pattern</u> resulting from one or two marble drops.
>
> The standard for correct performance will be judged according to the actual results and workings of the game. Each prediction will be limited to a time, for example, 15 seconds.

The third independent variable was the presence or absence of a precriterion test administered half way through the 20 minute practice period. The precriterion test was a shorter version of the test used as the dependent variable.

The experimental treatments were administered to each group at different times. The information appropriate to the treatment combination was first read to the subjects of that group and then given to them to reread if they so desired. Each subject was provided with a pencil and paper to use as he wished. The variables appropriate for each treatment were presented in the following general sequence: introduction, objectives, information about the game, 10 minutes of practice, precriterion test, objectives, affective measure, 10 minutes of practice, measure of knowledge of instructional outcomes, posttest, affective measure. All groups were given the same introduction, the same practice time, and the same measures of the dependent variables.

The experimenters were instructed not to give cues of any sort to the subjects. When the experimenters were asked questions by the subjects they replied they could not answer.

Subjects

The subjects were 48 graduate students from the College of Education at Michigan State University. The subjects were urged to participate in this experiment as a course requirement. They were randomly assigned to each of the eight treatment combinations.

Covariate

Two tests, one self made measure to conform to the theoretical requirements of the motive of need for achievement and the Alpert and Haber Test Anxiety Scale, were given prior to the experiment to act as covariates. It was thought that subjects with a high need to achieve would persist at a complex cognitive task as would those subjects with facilitative test anxiety.

Subjects were given a third measure to assess their degree of interest in mental tasks. We believed that their interest in the type of task might influence their performance.

Criterion Measures

There were three types of dependent variables: an achievement test to measure the learner's knowledge of principles and workings of the task, an affective measure of the subject's interest in the task, and a measure to assess the subject's knowledge of the instructional outcomes required of him.

The achievement test consisted of five subtests. The first two of which were very similar in complexity. They were composed of items that required the subjects to predict color changes a marble would take and to predict the direction the marble would take when dropped in the game. These two subtests are termed color prediction and direction prediction respectively. In the third subtest, termed pattern prediction, the subject was shown the pattern and where a marble would be dropped and then asked to predict the pattern on the game. In the fourth subtest, called pattern prediction 2, the subject was required to make a pattern prediction for two marble drops. A fifth subtest was included as an incidental measure. The subject was shown a start pattern and a desired pattern and asked to show where he would place one or two marbles to create the desired pattern. This test is considered an incidental measure because students receive no forewarning of this measure through objectives or precriterion tests. The last three subtests were designed to be succeedingly more complex than the first two subtests. The questions were prerecorded on cassette tape to maintain better control of the test stimuli and reduce the complexity of test administration. The tape was played by the experimenter. At the same time, the experimenter held up cards showing patterns related to the questions. After each question was answered, feedback was given auditorially by the tape and visually by the experimenter.

A shortened but parallel form of the first four subtests was administered as the precriterion test. Feedback was complete for all tests on the precriterion and criterion measures.

The affective test was a self report measure of the subject's interest about the experiment. Specifically, the student was asked to indicate his degree of interest on a twelve point scale, and to state the amount of time he wished to continue the task, and if he thought the task was a think or a fun game. This measure was administered to individuals immediately after they were given the precriterion test and the objective presented during instruction. The affective measure was presented a second time after the posttest. In addition, at the end of the experiment a behavioral measure related to interest was given. The subjects were asked if they wished to leave the situation, continue the same task, or continue a similar task in another place.

A free response measure was used to assess one facet of a student's knowledge of the objectives. Just before the posttest was administered, subjects were asked to predict the types of questions they would be required to answer. They were asked to state a sample of the types of questions. Two scores were derived from this test; the number of items predicted correctly and the number of incorrect test items predicted.

Results

Only the major analyses of the results are reported in this paper. The following dependent variables were employed: the four achievement tests; the incidental measure; the scores for predicting the nature of the posttest; and the two affective measures at the end of instruction, interest and time. The covariates considered were the measure of need achievement, the anxiety measure, and the time allotment for mental games. A multivariate analysis of covariance was employed. The X^2 test of the null hypothesis of no association

between the dependent variables and the covariates yielded a value of 46.98 (df = 27 and $p < .01$). This result suggests the importance of the covariates in predicting the dependent variables.

Step wise regression analysis was used to see which of the covariates were important in predicting the dependent variables. The first test of the covariate time allotted for mental games showed a $X^2 = 9.05$ with df = 9 and a $p < .43$. This result indicates that this variable is not important in predicting the dependent variables.

The test of the variable anxiety showed a $X^2 = 20.00$ with df = 9 and a $p < .02$. This result indicates that anxiety is a good predictor of the dependent variables. Since the anxiety variable is significant, the step wise testing is not continued.

Table #1

Analysis of Covariance Multivariate for the Nine Dependent Variables

Source	df	Mult. F	P ≤
Objectives at the beginning or not (OB)	1	.78	.64
Objectives in the middle or not (OM)	1	1.90	.09
Precriterion test or not (P)	1	2.13	.06
OB X OM	1	1.99	.08
OB X P	1	1.73	.13
OM X P	1	1.31	.28
OB X OM X P	1	2.13	.06

Table 1 gives the results for the multivariate analysis of covariance. A significant triple interaction between the variables is observed. Because of the nonorthogonal nature of the design and the significant triple interaction, the remaining tests are confounded and meaningless.

Table #2

The Univariate F and P Values for the Cognitive and Affective Dependent Variables

Variable	Univariate F	P ≤
1) Color Prediction	.30	.59
2) Direction Prediction	8.09	.007 *
3) Pattern Prediction	1.19	.28
4) Pattern Prediction 2	6.50	.01 *
5) Incidental Measure	5.30	.03 *
6) Predict Posttest, Number Correct	.32	.57
7) Predict Posttest, Errors of Commission	.23	.63
8) Interest in the Game	.17	.68
9) Time Subject Would Continue	.03	.84

The univariate F statistics for the triple interaction in Table 2 indicate that the significant multivariate effect resides primarily in the variables Posttest 2, 4, and the Incidental Measure. It reveals no effect as measured by the affective measures or prediction of items.

The cell means for Posttest 2 and 4 and the Incidental Measure adjusted for the covariates are graphed in Figure 1.

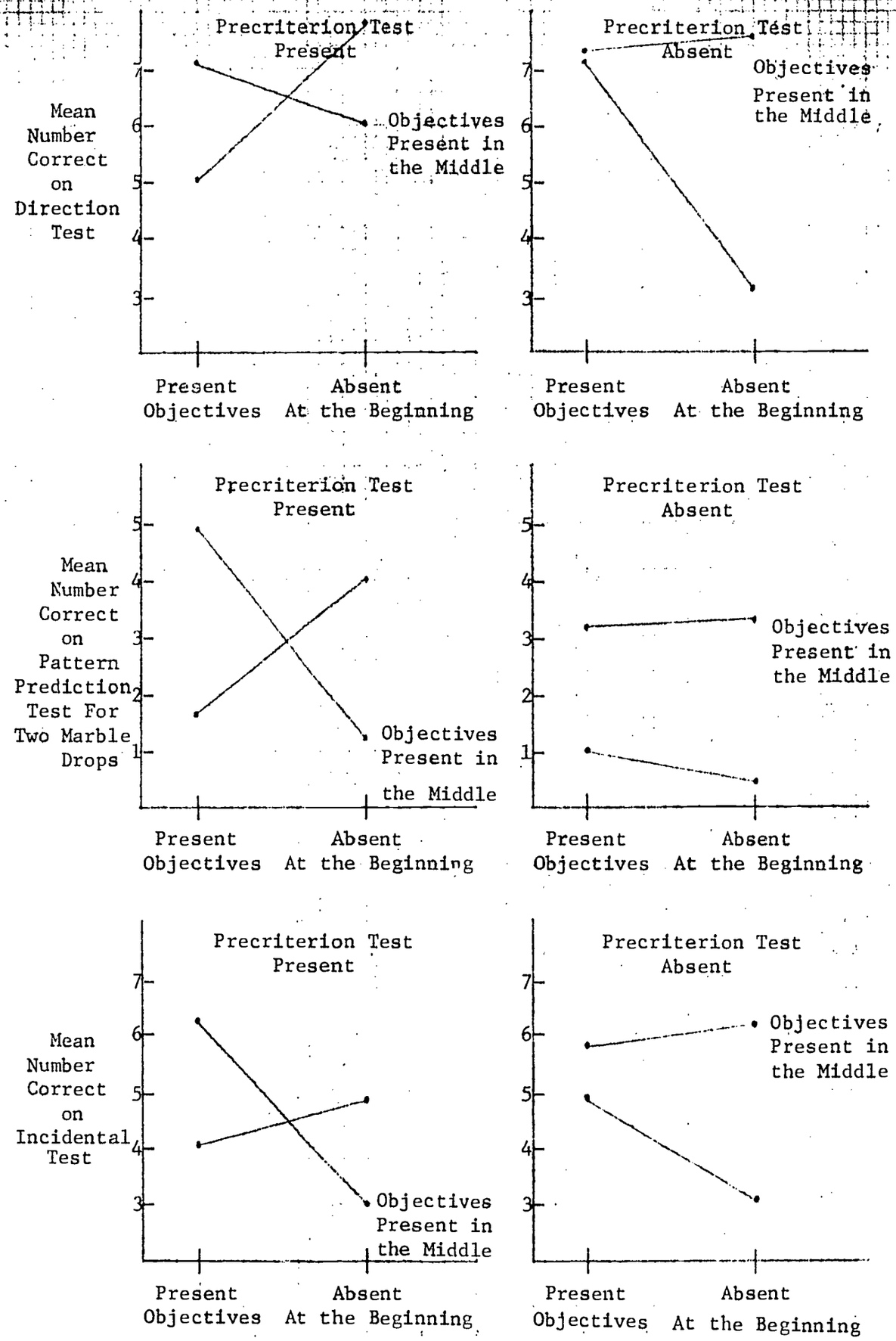
In all conditions but one, those combinations including objectives presented during instruction got higher scores than those without. The only condition which breaks that pattern is a precriterion test combined with objectives during instruction. Generally, those subjects in a treatment including a precriterion test and objectives at the beginning and during instruction, and those with a precriterion test only achieved more than those subjects with a precriterion test combined with objectives at the beginning or a precriterion test with objectives during instruction. Those subjects in treatments without a precriterion test that had objectives presented during instruction combined with objectives at the beginning, and objectives during instruction alone achieved more than subjects with objectives alone or no information at all.

The rank order of means scores indicated that 3 conditions scored consistently lower than the others. Precriterion tests combined with objectives presented in the beginning, precriterion tests and objectives presented in the middle, and the treatment with no information at all. Objectives only presented at the beginning fluctuated in ranking depending on the posttest.

Subjects were unable to predict the type of items to appear on the posttest with any proficiency. The means scores of numbers correct ranged from an average of less than one correct to an average of 1.5 correct.

The univariate analysis given in Table 2 and the step down F statistics for the triple interaction suggest the elimination of Variables 6 - 9. This was done and the multivariate analysis of covariance was rerun. The results for

Figure 1. Mean Scores for all Groups on 3 Tests of the Dependent Variable



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the test of the triple interaction was even more prounounced with a multivariate F of 3.95 which was significant at less than the .01 level.

Discussion

The results would tend to confirm the notion that there are some conditions which are better than others for presenting objectives to facilitate learning. It also appears that the influence on learning is not a simple function of the presence or absence of one variable but is likely to be the result of an interaction among variables.

The following four treatments influenced achievement more than the other treatments:

1) all three variables combined
2) only a precriterion test
3) objectives presented twice: at the beginning of instruction and during instruction
4) only objectives presented during instruction

There were three treatment groups that scored consistently lower than the top four listed above. The treatment in which only objectives were presented at the beginning of instruction fluctuated in its rank order between the top four and bottom three treatments on different tests. The following treatment groups scored consistently lower:

1) precriterion test combined with objectives presented at the beginning
2) precriterion test combined with objectives presented during instruction
3) the absence of all three variables

There is one noticeable characteristic which differentiates between the treatments that were consistently lower in achievement and those that were higher. Excluding the treatment in which all three variables were absent, the treatments

that scored relatively lower had two different ways of communicating the same message, a precriterion test and an objective. Two distinctly different symbolic expressions were used to communicate the same message. Only one other treatment, the one with all the variables, included two different means of communicating the same message. But, in that combination of variables the two presentations of objectives might serve to confirm each other, and outweigh the effect of the precriterion test message.

It may be that interference is likely when messages of instructional intent vary. We might hypothesize that the events take place in this fashion: the subject gets one form of a message. When he receives the same message delivered in the same way, he may process the message faster, confirm some of his original ideas and detect new ones. If the message appears in a form different from the original, the subject may slow down processing when forced to compare and contrast. Perhaps different forms of the same message have some unique attributes which may deviate from the major point to be communicated and may result in some reception errors and less time to practice the task to be learned. The process described may be somewhat analogous to the transfer of training paradigm in which a second task presents new stimuli but demands old responses. In our situation the stimuli are the precriterion tests and the objectives, and the response required is an interpretation of their meaning. The amount of transfer depends on the similarity of the second set of stimuli to the first. In the case of a new situation presenting similar stimuli and requiring an identical response, only a slight amount of positive transfer results. (Bruce, 1933, Yum, 1931, Gibson, 1941, Hamilton, 1943) To state our explanation more simply, the subjects may have become confused by two different forms of the same message.

The subject's ability to score well on the incidental measure given counters a widely held belief: when objectives are given to a student, he only learns what is required of him. Granted, the incidental measure was

closely related to the tasks described in the objectives, but one cannot deny that the conditions and the behavior were different than those described in the objectives. An intriguing research question might be: Given certain objectives, to what degree do subjects generalize to incidental tasks varying in relationship to the tasks described in the objectives?

Different combinations of variables did not differentially influence a student's ability to predict the posttest. From studying the student's answers, one might conclude that the question was ambiguously stated. The materials read, "In a moment we will ask you some questions to see what you have learned. What do you expect those questions to be like? Write out a sample question for <u>each type</u> of question you would expect us to ask." Such answers as "What do you think the variables in this experiment are?" convinced the experimenters that the measure was not valid.

Conclusion

The results of this study point the way to further research. There seem to be certain conditions which maximize the influence of objectives on learning. Future research should explore ways to maximize the effects on learning of complex combinations of variables including objectives. It may be that other instructional messages (like those dealing with instructional requirements) may influence learning best under different conditions.

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