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ABSTRACT

This project determines the extent to which similarity of teacher and student structuring of class materials is related to student performance on tests covering the materials. Information about how student and teacher structure the materials was obtained through a matching test. During the second stage of the project, three alternative procedures were considered. In terms of the amount of information obtained per unit of time spent by subject, the following procedure was adopted. Fifteen statements were selected from each of the four sets of learning materials to be used in the study proper. Subjects were given a 15-page booklet in which a different one of the statements appeared at the top of each page. The remaining 14 statements appeared below, and the subject was asked to check which of the 14 statements was similar in content to the statement at the top of the page. The results show that the particular teacher does not affect student achievement, that student reading facilitates achievement, as does teacher presentation, and that no teacher presentation is more important if students have had prior exposure to learning materials. Differences in agreement on classification of learning materials has no effect upon student achievement, on the average. However, the correlation between student categorizing of learning materials and teacher classification of learning materials is negative, indicating that student and teacher alike must view learning materials before student achievement is accelerated. (Author/DEP)

FINAL REPORT

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ROLE OF TEACHER STRUCTURING AND STUDENT STRUCTURING OF LEARNING MATERIALS IN STUDENT LEARNING

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FINAL REPORT

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1. Major Activities of Report Period.

The primary purpose of the project is to determine the extent to which similarity of teacher and student structuring of class materials is related to student performance on tests covering the materials. Information about how student and teacher structure the materials was to be obtained through a matching test. During the second stage of the project, three alternative procedures were considered. In terms of the amount of information obtained per unit of time spent by the subject, the following procedure was adopted. Fifteen statements were selected from each of the four sets of learning materials to be used in the study proper. Subjects were given a 15-page booklet in which a different one of the statements appeared at the top of each page. The remaining 14 statements appeared below, and the subject was asked to check which of the 14 statements was similar in content to the statement at the top of the page.

The third stage of the project was devoted to data collection for the study proper. In a first run of the study, 104 undergraduate volunteers (primarily General Psychology students) were randomly assigned to treatments formed by crosshatching conditions of prior exposure (reading or no reading of materials prior to lecture) and taped presentation (taped or no taped lecture on these materials). Due to subject attrition, the initial pool of subjects was reduced to 96 subjects, 24 per instructional combination. Taped presentations for the first run of the study were made by two different teachers in order to assess generalizeability of results. Each teacher could be thought of as a replication, a random group of 48 of the 96 subjects participating in each replication.

Learning materials consisted of four Scientific American reprints. Students in prior-exposure conditions read a reprint and then completed the 15-statement matching task before proceeding to the next reprint. The procedure of reading and then matching was repeated for remaining reprints. In no-prior-exposure conditions students read the 15 statements and completed the matching

task without benefit of having read the reprint. The order in which subjects covered content areas was dictated by a standard Latin-square, so that each content area was covered first, second, etc., equally often across subjects. Subjects were given a break period prior to introduction of videotape conditions. In tape conditions, subjects were tested on lectures immedately after viewing, subjects in no-tape conditions merely returning to take the tests. Taped presentations of the teacher consultants were about one hour long, 15 minutes being devoted to each content area. All content areas were presented prior to testing. Order in which content areas were tested was the same as the tape order, as described in the Second Progress Report, two 15-item multiple-choice tests were constructed for each reprint. Since the tests had been demonstrated to be parallel in form for each content area, one test from each content area was arbitrarily selected for assessment of performance immediately after exposure to the tapes. Two and one-half weeks subsequent to the initial testing, subjects returned and took the parallel forms of the tests on each content area.

A second run of the study was also completed in the third stage. The second run was identical to the first with the following exceptions. Videotaped presentations were made by two different teacher consultants. The number of subjects in the second run was 72, 18 per instructional treatment. Finally, whereas subjects in the first run were primarily lower-division undergraduates, subjects in the second run were primarily upper-division students. The predominance of upper-division students in the second run was necessitated by failure to get a sufficient number of volunteer lower-division students.

In the fifth project period, a comparison was made of the two runs, in order to see if the data from the two repetitions could be combined. Data from null conditions in each run (conditions in which no reprint was read and no videotaped presentation of the content of the reprint seen) was compared to see if the subject populations of the two runs differed. In addition, a program for computer analysis of sorting data was developed. Briefly, the program yielded probabilities of each statement selected from a given reprint of being classified with every other statement from the reprint.

In the sixth project period, test scores from the two runs were combined for a single Analysis of Variance with unequal ns in the treatment combinations. For the Analysis of Variance, Teacher (1-4), Reading-No Reading, and Videotaped or No Videotaped Presentations were between factors and Content Area (1-4) a within factor. An Analysis of Variance done in the fifth report period showed that subjects from the two runs were from the same population, making it possible to combine the data from the two runs for a single Analysis of Variance.

2. Problems.

No major problems were encountered. The initial intent was to employ approximately 120 subjects in each run. Due to a lack of sufficient volunteers, the number of subjects was 96 and 72 for the first and second runs, respectively. The smaller number of students is still sufficient to provide the necessary redundancy for statistical analyses.

3. Significant Findings and Events.

Initial data analyses were restricted to immediate test performance from the first run of the study. Variance estimates based upon results combined across the two teachers but separated by content area were compared for the prior-exposure conditions. Depending upon how the teacher structured learning materials, addition of the lecture in prior-exposure conditions might facilitate or interfere with student learning and thus result in increased variability in test scores. For only one content area did variance appear markedly discrepant, the larger variance being obtained for the prior-exposure condition which was not followed by the lecture. The ratio of the larger to the smaller of the two variances yielded an F (23, 23) = 2.67, $p > .01$. Hence, there was no reason to think instructional treatments affected variability of test performance.

Mean correct was compared in an analysis of variance in which Prior Exposure to Reprints (P), Teacher (T), and Videotaped Lecture (V) were "between" factors, Content Area (C) a "within" factor. Since exposure to teachers was done by videotape, those conditions in which no tapes were seen were "dummy" conditions with respect to the T factor. In terms of statistical analysis, presence of dummy conditions meant that some interactions (e.g., T x V), if obtained, could be more simply interpreted in terms of T main effects, since it is not meaningful to talk of teacher effects when no lecture is presented. Presence of dummy conditions did not pose a problem since no reliable interactions were obtained.

For each of the 15 F tests, the probability of rejection of the hypothesis of no effect was .01. Since the research is partially concerned with educational practice, it was thought necessary to maintain a rather stringent rejection criterion. Secondly, although F tests represent independent comparisons, the probability of a false rejection in at least one of the tests is appreciable with 15 tests and a significance level of, for example, .05.

Mean correct with prior reading exceeded mean correct without prior reading (41.88 vs. 37.65), F (1,88) = 11.07. Also, whether the teacher was subsequently seen affected exam performance, F (1, 88) = 7.14. Mean correct for lecture and no-lecture conditions was 41.46 and 38.06, respectively. The remaining reliable effect was the C main effect, F (3, 264) = 21.32. Effect of content area may reflect either differences in difficulty of the reprints or differences in difficulty of the tests on the reprints.

The P and V factors affected performance but did not interact is of interest, since it indicated that an additive model can accomodate the results. The critical factor appears to be degree of familiarity with learning materials, tape and prior-reading experience exerting a cumulative effect on test performance. Lack of interaction is also consonant with results from the comparison of variances. Had the lecture interfered with the learning of some students and facilitated the learning of other students, effect of the V factor would have been depressed in prior-exposure conditions, producing a P x V interaction.

Two other findings are worth mentioning. Consistent with prior studies finding little effect of teacher differences on student achievement, the T effect was not significant. Secondly, lack of significant interactions indicates that the effect of instructional treatments was generalizeable across the two teachers. Although the P and V effects were significant by a rather stringent criterion, the proportion of variance accounted for by prior reading and exposure to a lecture was not substantial, the estimated $w^2 = .05$ for the V factor and .08 for the P factor. A greater proportion of variance was accounted for by content area (est. $w^2 = .17$).

In the fourth report period, immediate test performance from the second run of the study was analyzed in an Analysis of Variance which included the same sources of variation as the analysis of the data from the first run. The same pattern of results emerged as for the first run. In terms of statistical significance, one discrepancy emerged. Whereas the V effect was significant in the first run at the .01 level, it was not in the second run, F (1, 64) = 6.66, $>.05$ $p>.01$. Since the effect was close to significance at the .01 level, the inconsistency may be due to the larger N in the first run (96 subjects in the first run vs. 72 in the second run of the study).

In the fifth project period, an Analysis of Variance (unweighted means analysis) was performed to see if the subject populations from the two runs differed significantly. Only under consideration was data from the null condition in both runs: the condition in which students neither read a reprint nor saw a videotaped presentation of the content of the reprint. The Analysis of Variance showed no main effect of run, p of obtained $F>.05$, so that in subsequent report periods data from the two runs were combined.

The Analysis of Variance on the data combined from the two runs was completed in the sixth period. As in the two separate analyses, the Teacher effect was not significant, F (3, 152) = 2.53, $p>.01$. The Prior Exposure factor had a significant effect, F (1, 152) = 21.04, $p<.01$, consistent with the separate analyses on the two runs. The Videotape factor was significant in the analysis done on the first run, but not in the analysis of data from the second run. Analysis of the combined data yielded a significant effect of the Videotape factor, F (1, 152) = 13.77, $p<.01$. The discrepancy from the analysis of the second run probably reflects the less powerful test of the second-run analysis due to the smaller N of the second run.

Neither of the separate analysis revealed a statistically significant interaction of Prior Exposure and Videotape factors, although the obtained data did show interaction. In the analysis on the data combined from the two runs, the interaction was significant, F (1, 152) = 7.89, p .01. The interaction was such that prior reading of the reprints facilitated test performance to a grater extent in the condition in which no videotape presentation was given. The combined analysis showed a significant effect of Content Area, F (3, 456) = 36.64, p .01, as had been obtained in each of the separate analyses; the Content Area by Prior Exposure interaction was obtained in the combined analysis, F (3, 456) = 4.93, p .01, prior reading being more beneficail for some reprints than for others. The two interaction effects were probably not significant in the separate analyses because of the smaller Ns of the separate analyses.

The final analyses were completed in the seventh project period and consisted primarily of determination of the dimensions underlying the similarity judgements of the matching task. For the matching task, each subject and each teacher had compared each statement with every other one of the statements extracted from the reprint, the task being done for each of the reprints. The raw data entering into analyses of the matching data were the number of times each of the 15 statements from a reprint was sorted into the same category as each of the remaining 14 statements. Raw data were then transformed to pairwise proportions interprtable as estimates of the probability that Statement i is in the same class as Statement j. For each subject and each teacher, the result was four 15 x 15 matrices of pairwise proportions. The $4(N + 1)$ probability matrices (N subjects + instructor) were then transformed into $4(N + 1)$ x 105 matrices, the rows corresponding to subjects and the instructor to which they were assigned, the columns corresponding to separate statement pairs. The four $(N + 1)$ x 105 probability matrices were analyzed into principal components following the procedure outlined by Tucker and Messick (1963) and Tucker (1967). The result of the analysis identifies the number of"points of view" mediating the pairwise proportions. The number of principal components retained may also be viewed as the number of bases for classification of statements.

A judgement as to how many components to retain is affected by various criteria. In the present work, a variant of a criterion suggested by Cattell (1967) was employed. In the 16 analyses (four topics for each of the four instructors), the number of retained components varied from one to four, two components being modal. Two components were retained in all subsequent analyses. For each of the two components, the "factor"

or "component" loading, indicating the extent of use of the basis for making similarity judgements, was determined for instructor and subject. Then, the difference in loading between subject and teacher was determined. The difference represented a component difference in point of view between subjects and instructor. A composite of component-wise differences was used to compute differences between subject and teacher. Composite differences were then used to predict achievement (test scores) of students, in later analyses.

Differences in component scores were analyzed in an Analysis of Variance, one Analysis of Variance for each component. In the Analysis of Variance, the factors of interest were the particular teacher, content area, and whether students had prior knowledge of materials. In all cases, prior knowledge of learning materials did not affect distance scores, all Fs taking on values about 1. Hence, it would appear that on the average, there was no difference between student and teacher structuring of learning materials.

Since the F test is only sensitive to differences among means, correlations between distance scores and achievement scores were examined. Of the correlations, four were significant (negative correlations), indicating that the greater the component difference between student and teacher, the poorer the student performance.

It appears, then, in summary, that the particular teacher does not affect student achievement, that student reading facilitates achievement, as does teacher presentation, and that no teacher presentation is more important if students have had prior exposure to learning materials. Differences in agreement on classification of learning materials has no effect upon student achievement, on the average. However, the correlation between student categorizing of learning materials and teacher classification of learning materials is negative, indicating that student and teacher alike must view learning materials before student achievement is accelerated.