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ABSTRACT

This report is the second of a two-part document which presents the results of research conducted during the first implementation of a leadership, psychology and management course at the U.S. Naval Academy. Details on learner variables and performance are cited and discussed. The first part of this document is EM 010 490, the final report appears under EM 010 418, EM 010 419, and EM 010 484, and EM 010 418 through EM 010 447 and EM 010 451 through EM 010 512 are related documents. (Author/RH)

Westinghouse Learning Corporation

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REPORT OF PHASE II RESEARCH FINDINGS: THE DESIGN AND METHODOLOGY FOR RESEARCH ON THE INTERACTION OF MEDIA, CONDITIONS OF INSTRUCTION, AND STUDENT CHARACTERISTICS FOR A MULTIMEDIA COURSE IN LEADERSHIP, PSYCHOLOGY AND MANAGEMENT

PART II: STUDENT CHARACTERISTICS

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I. INTRODUCTION

The analysis of the relationship of student characteristics to conditions of instruction was conducted in the context of the development of a multimedia individualized course in Leadership, Psychology and Management by Westinghouse Learning Corporation for the United States Naval Academy. A comprehensive research plan was designed to test the effects of major variations in conditions of instruction involving media and presentation forms as discussed by Tosti and Ball (1969). Tests of five specific hypotheses were conducted with the effects of experimental manipulations measured by three types of tests reflecting accomplishment of three broadly different kinds of learning tasks. An indepth discussion of the total research plan and the results of the analysis of group differences in various media and presentation forms is given in the Report of Phase II Research Findings: Part I: Conditions of Instruction by Bessemer and Rivers (1970). This report deals specifically with the relationship of student learning in specific conditions of instruction to individual characteristics of the students.

The central idea motivating research into the relationship between student variables and instructional

effectiveness has been to find methods of better tailoring educational systems to the needs and abilities of individual students. Obviously, this is an area of concern intimately related to the management of instruction, but the emphasis here is on determining what student characteristics can be assessed to permit management decisions, rather than on what decisions to make given some data on the student.

Several approaches to the investigation of learning and individual differences have been reviewed by Cronbach (1967). Historically, there has been much interest in selection for advancement or ability-grouping, and for this reason, research largely centered around variables predicting general academic success. On the basis of such predictors, low-ability students have been weeded out, or assigned to courses of instruction of lesser difficulty or longer duration.

An alternative approach has been to assess individual long-range goals, and areas of ability and interest, and to provide optional courses of study which appear suitable for the individual. This has been the general approach of guidance and advisement programs, providing impetus for much research on tests in the areas of differential

aptitudes and interests. More recently, this approach has been the basis of the development of large-scale computer-managed-instruction (CMI) systems, such as PLAN (Brudner, 1969). However, CMI systems are yet too new to assess their ultimate impact on the research on individual differences, since such systems have been operated primarily on the basis of a direct assessment of areas of competence, leaving the selection of goals to the teacher and student.

Only recently has major interest developed in a third approach involving the selection of a particular instructional method optimizing individual progress toward preselected goals. In the past, the selection of instruction method has been the prerogative of the teacher, who inevitably modifies and utilizes methods according to his own abilities and history of success with various methods. Without standardized conditions, research on student variables predicting success under particular conditions has been difficult, if not impossible.

As Cronbach (1967) pointed out, individualized prescription of a method of instruction requires that alternative conditions of instruction designed for the same subject matter be compared in relation to student variables to discover interactions between method and student. That is, one should seek to discover variables for which students in one score range find one condition

superior, and students in another score range find a different condition superior.

The recent developments in the use of standardized programed instructional materials have provided the necessary context for meaningful research into student-method interactions. Findings in this area have been reviewed by Stolurow and Davis (1965) and Briggs (1968).

Sufficient evidence is available to conclude that student-method interactions are quite common, if not the rule. Interestingly, variables in the areas of personality, motivation, and attitudes appear to be as important, or more important than traditional academic predictors in the findings reported thus far.

In the context of the United States Naval Academy Leadership, Psychology and Management course developed by Westinghouse Learning Corporation, the question of general academic performance is largely moot. The students at the USNA represent a select group in terms of academic ability, and it is unlikely that general academic predictors would relate to any aspect of performance in the Leadership, Psychology and Management course.

The purposes of research on student variables in the present case concerned the prediction of overall course performance, and, more importantly, the prediction of achievement with particular media and presentation forms. Because of the number of conditions of instruction compared in the Leadership course, an invaluable opportunity was provided for one of the first large scale investigations of student-method interactions. To this end, a large battery of potentially predictive variables was included in the student data base.

First, the investigation attempted to identify variables predicting final course achievement. Such variables may permit the identification of students unlikely to attain satisfactory levels of course performance. Further investigation of the source of difficulty for such students may be used to find some means of remedying their deficiency. The investigation of overall performance was of general educational interest, as well, since there are few previous studies of the prediction of course achievement in the area of the social and management sciences.

Second, student variables were related to performance with particular media. Such investigations provide information relevant to the assignment of

alternate media, and may also provide some suggestions for better accommodating or programing particular media to the needs of individual students.

Finally, relationships between student variables and achievement with various presentation forms were investigated. The findings of these investigations may permit the utilization of the existing alternative presentations in an individually managed instructional system. In addition, some basic insights into the strengths and weaknesses of particular forms of instruction for individual students may be achieved.

Although the background of the research is discussed in Section III, the reader is referred to Part I of the research report (Bessemer and Rivers, 1970 [TR-6.12a]) for a complete discussion of the research setting in which the analyses of the student characteristics were conducted. A previous document reporting on the development and analysis of the effectiveness of the course and the media used (Hubert and Rivers, 1970 [TR-6.11]) will also be fruitful reading prior to this report.

II. REVIEW OF THE LITERATURE

The adaptation of media to individual differences has placed emphasis on the manipulation of media to adjust for these individual differences in human ability. According to Briggs (1968) this is what Gagne would describe as "adapting media to the learner." However, given that a proven system for media instruction has been developed, a reasonable strategy to consider is one of assigning persons to the media. This is especially true when the demand to use the media system is greater than the system's capability to provide the service, and expansion of the system is economically unfeasible. Lumsdaine and May (1965) express their attitude toward this strategy in this manner: "Just as one medium cannot be shown best across the board or even for one subject matter area, so also one cannot show that one medium is best for one type of student." They argue that the proper use of media will be best determined by the comparison of learners having particular characteristics to learners having other characteristics when particular media are programed in well defined ways.

Particularly relevant at this point to the general discussion of individual differences are the questions which have been generated by Ingersol (1967)

and Bush et al. (1965): Ingersol asks, "What kind of individual prefers independent learning to more traditional classroom learning?" And Bush et al. ask, "What interacts between individual differences and conditions of instruction?"

Snow (1969) reports a study which follows this line of questioning in the area of primary grade reading research. He reports interactions of ability and program method which lead to the conclusion that the phonic method of instruction appears more appropriate for low ability subjects, while higher ability subjects seem to learn better with the look-say method. Snow (1969) also reports interactive results which provide evidence that prospective teachers differentially perform on hypothesis generation training and cue attendance training contingent upon GRE verbal performance achievement. He found that hypothesis generation training produces more information search behavior among subjects with GRE-V scores above 550, while production is higher after cue attendance training for subjects scoring below 550 on the GRE-V.

Aptitude-Treatment interactions are also reported by Kropp et al. (1967). They found interactions to exist in a variety of subject matter contents including mathematics learning, vocabulary learning, reading and

chemistry achievement. Kropp et al. feel that the implication of their results is that it is reasonable to think that achievement of students can be enhanced by assigning them to instructional materials known to be optimally related to their ability patterns. Mitzel (1967) and Silberman et al. (1960) reported similar results for the relationship between aptitude and achievement.

The question which now arises is, "How does one assign students to alternative instructional treatments in a manner that optimizes the learning payoff?" (Ripple, Millman, and Glock, 1969). Many current practices and research projects are operating under the assumption and expectation that students should be provided with the mode of instruction best suited to their cognitive styles, interests, personality characteristics, etc. (Flanagan, 1967).

Using a programed instruction unit, Doty and Doty (1964) have shown that achievement appears to be related to a series of personality characteristics. Their results indicate that the students who learned best using the materials had low social needs and scored low on various creativity measures. There was no correlation between achievement needs and performance; however, there was a high positive correlation between grade point average and attitude toward the instructional mode.

Another investigation of the effects of personality characteristics was that of Woodruff, Faltz, and Wagner (1966). They reported significant correlations of achievement motivation (r=.53), cautioness (r=.50), original thinking (r=.74), and personal relations (r=.81) with performance on a programed text. They used the Edwards Personal Preference Schedule (EPPS) and the Gordon Personal Inventory to obtain their measures. Also using the EPPS, Lublin (1965) reported that low autonomy students do better than high autonomy students in an individualized setting using programed instruction. Knight and Sassenrath (1966) have reported that high-achievement motivated students performed better in a PI setting on time to complete the course, number of errors, and on short-term retention scores than did a group of students with low-achievement motivation.

In considering other learner characteristics, Levin and Baldwin (1959), and Levin, Baldwin, Gallwey, and Paivo (1960) reported that learners scoring low on tests of exhibitionism do relatively better on an individualized PI course than those scoring high. Exhibitionism is exemplified by the degree of an individual's positive attitude toward showing himself and his products to an audience and the tendency to approach situations involving performance.

Considering another individual difference, Grimes and Allinsmith (1961) found similar results for compulsivity regarding achievement in structured and unstructured learning situations. Learners scoring high on tests of compulsivity did relatively better in PI learning tasks.

One of the more comprehensive studies that has concerned itself with a series of learner characteristics and their relationship to learning in a CAI setting has been that of Majer (1969). He concluded that certain attitude, personality, and background characteristics differentially predict performance. He also concluded that course structures and procedures may be more effectively designed to provide an optimal learning environment for the individual student.

Stolurow and Davis (1965) reviewed a series of studies on the interaction of individual difference variables with method of instruction and concluded that such interactions did, in fact, occur in a variety of instructional settings and methods. They also concluded that the computer will play an important role in identifying these differences and their implications for maximizing the instructional setting.

III. BACKGROUND OF THE RESEARCH

The objective of WLC's plan of research in the USNA Leadership Management course was to obtain experimental evidence relevant to the following general empirical questions:

a. Are substantial effects on student achievement produced by manipulation of presentational variables at the macrotaxonomic level as conceived by Tosti and Ball (1969)?

b. Are substantial differences in student achievement produced between different media delivering the same presentation, when measured over segments of material typical of a unit of instruction in most educational systems?

c. Are variations of conditions of instruction in the presentation design domain of greater or lesser importance than variations in the media domain?

d. Are the effects of presentation and media variables generalizable over different types of instructional objectives, or are different effects produced in relation to the acquisition and application of knowledge?

e. Are effects of particular presentation conditions and media similar for students varying according to established standardized tests of individual differences, or do the optimal conditions of instruction differ for different students?

Simultaneous accomplishment of research relevant to all of these objectives within a single ongoing course presented a number of difficulties requiring a complicated research plan. Several considerations important both to the achievement of clear-cut research findings and to the educational objectives of the USNA students in the Leadership Management course were taken into account in the development of WLC's research plan.

In performing several experiments within a single course sequence requiring repeated use of the same students, it was necessary to arrange the experimental manipulation of materials and measurements so as to avoid the mutual entanglement of the effects of different experiments. Substantial variation of the level of difficulty in particular course content and test items required control to prevent obscuring of experimental effects. The small number of students available for

enrollment in a developmental course required that special techniques for reducing random variation be employed to increase the precision of the experimental comparisons, yet without interfering with the investigation of individual differences in relation to experimental variables. Finally, experimental procedures were needed which would not place an excessive burden of time and effort on the individual student, or handicap his overall achievement through placement in ineffective learning conditions, thus leading to an undeserved reduction in course grade.

On careful consideration of all factors, a research plan was devised which substantially satisfied the criteria given above with minimal compromise among objectives. The ability of the research plan to reconcile such apparently contradictory requirements commends the WLC design approach as a model for research in ongoing courses undertaken under similar limitations.

The topic of this part of the research report deals with point e above. Points a through d are discussed in detail in Part I of the research report (see Bessemer and Rivers, 1970 [TR-6.12a]).

A. Course Structure. The Leadership Management course was first organized in terms of elemental blocks of content and related tests of student achievement, which were temporally sequenced without regard to research constraints. Additional elements of structure were then inserted for research purposes. This procedure ensured that a basic course structure was achieved from which the research elements could easily be detached for purposes of final course packaging and implementation. The course structure may be described in terms of the four categories outlined below.

Part. The content is divided into 12 parts, corresponding to 12 chapters of the basic content outline. Each part is a formal designation of a large topic area, representing a substantial number of closely related terminal objectives relatively independent of the objectives of other parts. The objectives of any one part could be considered to be subsumed under one of the broad aims (macro-objectives) of the course. The part served primarily as an aid in fractionating the developmental work on materials.

Segment. In terms of content, a segment is a sub-collection of learning objectives within a part, which are closely related in the development of a behavioral hierarchy of competence and in the sequencing of instructional events. A total of 59 segments were incorporated in the 12 parts of the course. The content headings of each segment are listed in Table 1 under their respective parts.

Conceived operationally, the segment is the basic instructional unit in the development and production of materials, and serves as the logistical unit in implementation for purposes of scheduling and assessment of progress through the course materials. Essentially, the segment is analogous to a class period or lesson in other instructional systems, requiring 40 to 80 minutes of student time, and provides the basis for manipulation of the real-time parameters of the course.

At the completion of each segment, a progress check (PC) test is administered to assess the student's attainment of the terminal and enabling objectives of the segment. PC's are composed of 10 criterion-referenced items, developed directly from the behavioral statement of segment objectives.

Table 1

OUTLINE OF COURSE STRUCTURE AND MEDIA

Part and Segment Number	Content Heading	CPT Unit[a]	Medium[b]
	PART ONE: OVERVIEW OF LEADERSHIP		
1.1	Concepts of Leadership	NR	ST
1.2	Standards of Leadership in the Naval Service	NR	F-GD
	PART TWO: INDIVIDUAL BEHAVIOR		
2.1	Introduction to Psychology	NR	ST
2.2	Behavior and its Observation	1	AT- or VT-PB
2.3	Learning	1	AT- or VT-PB
2.4	Factors Affecting Learning	1	AT- or VT-PB
2.5	Attention and Perception	1	AT- or VT-PB
2.6	Motivation	2	ST
2.7	Conflict	2	ST
2.8	Neurotic and Psychotic Reactions	2	ST
2.9	Personality	NR	LAS
	PART THREE: GROUP DYNAMICS		
3.1	Characteristics of Groups	3	AT- or VT-PB
3.2	The Relationship of the Leader to the Group	3	AT- or VT-PB
3.3	Group Interactions	3	AT- or VT-PB
3.4	Conformity as a Factor of Group Behavior	3	AT- or VT-PB
3.5	Relation of the Individual to the Group	NR	ST
	PART FOUR: ACHIEVING EFFECTIVE COMMUNICATION		
4.1	Importance of Interpersonal Communication	4	LT
4.2	Types of Communication	4	LT
4.3	The Communication Process (Receiver and Barriers)	4	LT
4.4	The Communication Process (Sender and Feedback)	5	AT-IPB
4.5	Formal Communication and Its Dimensions	5	AT-IPB
4.6	Informal Communication	5	AT-IPB
4.7	Communication Under Battle Situations	5	AT-IPB
	PART FIVE: MILITARY MANAGEMENT		
5.1	Introduction to Management and the Management Process	NR	ST
5.2	Decision Making and Creativity	NR	ST
5.3	Objectives	NR	ST
5.4	Planning	6	LT
5.5	Organizing: Principles and Process	6	LT
5.6	Organizing: Structure	6	LT
5.7	Organizing: Charting	7	AT- or VT-PB

Part and Segment Number	Content Heading	CPT Unit[a]	Medium
	PART FIVE: MILITARY MANAGEMENT (CON'T)		
5.8	Directing	7	AT- or VT-PB
5.9	Controlling	7	AT- or VT-PB
5.10	Coordinating	7	AT- or VT-PB
	PART SIX: AUTHORITY AND RESPONSIBILITY		
6.1	Concept of Authority	8	ST
6.2	Why People Accept/Resist Authority	8	ST
6.3	Delegation of Authority; Line-Staff Relationship	8	ST
6.4	Responsibility	NR	ST
	PART SEVEN: LEADERSHIP BEHAVIOR AND STYLE		
7.1	Leadership Behavior	9	AT- or VT-PB
7.2	Leadership Style	9	AT- or VT-PB
7.3	Determiners of Leadership Style - The Leader	9	AT- or VT-PB
7.4	Determiners of Leadership Style - The Group and The Situation	9	AT- or VT-PB
7.5	Participative Leadership	NR	VT-PB
	PART EIGHT: SENIOR-SUBORDINATE RELATIONSHIPS		
8.1	Organizational Structure & Social Distance in Senior-Subordinate Relationships	10	LT
8.2	Officer-Enlisted Relationships	10	LT
8.3	Assumption of Command and Formal & Informal Leader Relationships	10	LT
8.4	Introduction to Counseling	11	LAS
8.5	The Counseling Process	11	LAS
8.6	Relations with Seniors and Contemporaries	11	LAS
	PART NINE: MORALE - ESPRIT DE CORPS		
9.1	Morale	NR	VT-PB
9.2	Group Solidarity and Esprit	NR	VT-PB
	PART TEN: DISCIPLINE		
10.1	Introduction to Discipline	NR	AT-IP
10.2	Development and Maintenance of Discipline	NR	AT-IP
	PART ELEVEN: PERSONNEL EVALUATION		
11.1	The Role of Evaluation	12	ST
11.2	Enlisted Performance Evaluation	12	ST
11.3	Officer Evaluation	12	ST

Part and Segment Number	Content Heading	CPT Unit[a]	Medium
	PART TWELVE: APPLIED LEADERSHIP		
12.1	Measurement of Effective Leadership	13	CAI
12.2	Generally Recognized Characteristics of an Effective Leader	13	CAI
12.3	Techniques of Assuming Command	13	CAI
12.4	"That's an Order!"	13	CAI

[a] NR refers to a nonresearch segment, thus not assigned to a CPT unit.

[b] ST=Syndactic (multi-level) Text; F-GD=Film, Group Discussion; AT=Audiotape; VT=Videotape; PB=Panelbook; LAS=Learning Activities Summary; LT=Linear Text; IP=Intrinsic Program; CAI=Computer Assisted Instruction.

Module. A module is a particular instructional condition used to prepare and deliver materials for a segment, identified in terms of the categories of the Tosti and Ball (1969) model. Several parallel modules were prepared in each segment utilized for research purposes, representing variations specified by the experimental designs. The different modules of a segment are distinguishable from one another by differences in presentation design and/or media, although the content is the same. Specifications of the modules for each segment are outlined in later sections of the paper giving the design of each experiment.

Cumulative posttest unit. The cumulative posttest (CPT) unit is a group of three or four adjacent segments within a part. There are 13 CPT units involving 45 of the 59 segments of the course, as listed in Table 1. The primary criteria for grouping segments into CPT units were that the segments dealt with similar types of content and objectives, and that the instructional sequences relating to particular concepts which were initiated in the unit would also terminate in the same unit. All segments in a CPT unit were developed in the same medium and with the same variations in instructional conditions between modules.

B. Analysis of Student Characteristics. The CPT unit is the fundamental unit of instruction for research purposes, providing the framework on which the experimental designs were constructed, and the student characteristics analyzed. The students were divided into groups assigned to different modules in the CPT unit. A student in any one group would thus encounter the same experimental conditions in progressing through the three segments of the unit, and would take three PC's, one after completing his module of each segment. After completing the segments and PC's all students then take the CPT, a test administered to assess overall achievement level under the experimental conditions represented in the CPT unit.

Performance on the CPT was the primary dependent measure for research purposes. Each CPT was composed of 10 multiple-choice items for each segment in the unit, so that CPT's for 3 segment units had 30 items, and CPT's for 4 segment units had 40 items. There were approximately equal numbers of two types of items: Type I, representing acquisition of knowledge of the concepts and principles in the unit, and Type II, representing application of those concepts and principles

in the unit in relation to realistic examples of leadership situations.

CPT items were designed to have content validity in relation to the objectives of the unit, but unlike the PC items, also to have high difficulty and discrimination power. The CPT tests thus provided norm-referenced rather than criterion-referenced measures of achievement level. Many items were designed to measure the ability to integrate behaviors from different segments in the unit. An effort was made, however, to maintain an equitable representation of content from the several segments of the unit.

Following completion of the CPT, each student is given remediation on segments where his PC test performance is below 80%. The remediation consists of repetition of the same instructional materials previously used with the segment, or materials of an alternative module thought to be more effective. On completing remediation, the student repeats the PC's for those segments and then proceeds to the next segment.

In addition to the cumulative posttest, the administrative posttest was utilized in the analysis of the student characteristics. The administrative

pre and posttest was an 80 point criterion-referenced test composed of items representatively sampled from the total test item pool. There was at least one administrative test item for each segment of the course.

The initial analysis of the relationship of student characteristics to performance involved prediction of final course achievement. This analysis involved the regression of posttest performance on the battery of student variables. This type of analysis provides insight into identifying students unlikely to attain a satisfactory level of achievement. Although this is certainly an important goal in itself, it does not provide direction in how to design and program the instruction in order to optimize performance for each student. Therefore, subsequent analyses involved the investigation of student variables relating to performance with particular media and various presentation forms or conditions of instruction. These analyses were conducted as a subset within the scope of the overall research program investigating group or mean performance. See Part I of this report (Bessemer and Rivers, 1970: TR-6.12a) for a detailed description of the research plan.

Table 2 presents a summary of the research conducted in implementing the individualized multimedia Leadership, Psychology and Management course. A total of 44 midshipmen were enrolled in the course. Although a larger number of students might have been desirable, with the statistical controls employed, this number was sufficient for analysis of mean performance for each of the variables investigated. However, certain restrictions were necessary in the analysis of the relationship of student characteristics to performance in the various conditions of instruction. Considering the relatively small number of students, the only regression analyses that could be conducted were those that dealt with the relationship of student characteristics to overall performance on media, and conditions of instruction involving comparisons within subjects, which in both cases would provide data on all 44 students.

As can be seen in Table 2, experiment I involved sixteen segments in which three variables were manipulated. Only the variable of media (audiotape vs. videotape) was a within student comparison. That is, each student worked through half of the segments with videotape and the other half with audiotape.

TABLE 2

SUMMARY OF THE RESEARCH PLAN

EXPERIMENT	CPT & SEGMENT	MEDIA	VARIABLES	CONDITIONS
				A B
I	CPT 1 2.2-2.5 CPT 3 3.1-3.4 CPT 7 5.7-5.10 CPT 9 7.1-7.4	Taped Lecture, Audio & Video (with Panel Book)	A. Response Demand Frequency (RDF) B. Form of Response Demand (RD) C. Media (Audiotape vs. Videotape)	1. High RDF-Overt RD 2. High RDF-Covert RD 3. Low RDF-Overt RD 4. Low RDF-Covert RD These conditions apply for both audio & video presentations.
				A B
II	CPT 4 4.1-4.3 CPT 6 5.4-5.6 CPT 10 8.1-8.3	Linear Text	A. Response Demand Frequency (RDF) B. Form of Response Demand (RD)	1. High RDF-Overt selected RD 2. High RDF-Overt spoken RD 3. High RDF-Covert RD 4. Low RDF-Overt selected RD 5. Low RDF-Overt spoken RD 6. Low RDF-Covert RD
				A B
III	CPT 5 4.4-4.7 CPT 13 12.1-12.4	Audiotape/Intrinsically Programmed Booklet (AT/IP) Computer Assisted Instruction (CAI)	A. Response Demand Frequency (RDF) B. Management Frequency (MF)	1. High RDF-High MF 2. High RDF-Medium MF 3. High RDF-Low MF 4. Low RDF-Low MF These conditions apply for both AT/IP & CAI.
IV	CPT 2 2.6-2.8 CPT 8 6.1-6.3 CPT 12 11.1-11.3	Syndactic Text	Remediation method	1. High RDF Remediation 2. Low RDF Remediation 3. No Remediation
V	CPT 11 8.4-8.6	Learning Activity Summary (LAS)	Peer Interaction	1. Peer Interaction 2. No Peer Interaction

Therefore, an analysis of the relationship of student characteristics to performance with audiotape as opposed to videotape could be conducted. In addition, since each of the 44 students used both audiotapes and videotapes across these segments, an analysis of the relationship of student characteristics to performance in taped media (audiotape and videotape combined) was also conducted.

Again referring to Table 2, it can be seen that experiment II involved nine segments in which two variables were manipulated with the medium of linear text being used consistently throughout these segments. Only the variable of the form of the response demanded of the student (overt selected, overt spoken and covert) was a within student comparison. Each of the 44 students worked with each of the three types of response demand. Therefore, in this experiment an analysis of the relationship of student characteristics to performance in each condition of responding as well as to performance with linear text in general was conducted.

Experiment III covered eight segments in which two variables were manipulated. Neither of these variables listed in Table 2 was a within student

comparison. Each student saw only one of the four conditions listed for this experiment, thus leaving only 11 students in each condition. With the large number of student characteristics investigated it was not feasible to conduct regression analysis on this data. However, since all 44 students used an audiotape with an intrinsically programed booklet (AT/IP) in the first four segments and in the other four segments all 44 students worked with computer-assisted instruction (CAI), an analysis of the relationship of student characteristics to performance on AT/IP vs. CAI and branching media in general (a combination of AT/IP and CAI) was possible.

Experiment IV involved nine segments, all using the medium of syndactic text, as indicated in Table 2, in which the type of remediation method was manipulated. This was a within student comparison in which each student studied under each of the three conditions. Therefore an analysis of the relationship of student characteristics to performance in each of these conditions as well as performance with syndactic text was conducted.

Since the variable being investigated in

experiment V was not a within student comparison and since the decision was made to change the medium used in the three segments involved, no analysis of student characteristics was conducted in this experiment.

In summary, there were 13 basic types of analyses conducted relating student characteristics to performance on various media and conditions of instruction as well as to overall performance as measured by the posttest (see Table 3). In all cases but the posttest, the criterion variable or measure of performance used was the cumulative posttest. For each of these conditions of instruction three separate regression analyses were conducted. The student characteristics were analyzed in relation to the acquisition of knowledge (Type I CPT test items), and the application of knowledge (Type II CPT test items) as well as the two types of tasks combined (total CPT items). The classification of these two types of test items roughly corresponds to Bloom's categories of knowledge and applications. (Bloom et al. 1956). Specifications for development of these two types of items is given in Appendix A.

TABLE 3

SUMMARY OF REGRESSION ANALYSES CONDUCTED*

Experiment	Criterion	Segments	Predicted Performance
---	Posttest	1.1-12.4	1)Final Course Achievement
I	CPT-1 CPT-3 CPT-7 CPT-9	2.2-2.5 3.1-3.4 5.7-5.10 7.1-7.4	2)Audiotape vs. Videotape 3)Taped Lecture (Audio & Video combined)
II	CPT-4 CPT-6 CPT-10	4.1-4.3 5.4-5.6 8.1-8.3	4)Linear Text 5)Overt selected response demand 6)Overt spoken response demand 7)Covert response demand
III	CPT-5 CPT-13	4.4-4.7 12.1-12.4	8)Computer-Assisted Instruction (CAI) vs. Audiotape/Intrinsically Programed Booklet (AT/IPB) 9)Branching Media (CAI and AT/IP combined)
IV	CPT-2 CPT-8 CPT-12	2.6-2.8 6.1-6.3 11.1-11.3	10)Syndactic Text 11)High response demand remediation 12)Low response demand remediation 13)No remediation

* For each of the conditions of instruction 2 through 13, three separate regression analyses were conducted. The student characteristics were analyzed in relation to the acquisition of knowledge, the application of knowledge, and the two types of tasks combined as measured on the Cumulative Posttest (CPT).

As can be seen in Table 3, analyses 2, 3, 4, 8, 9 and 10 involved an investigation of the relationship of student characteristics to performance within a particular medium. Analyses 5, 6 and 7 involved the relationship of student characteristic to performance within linear text, but specifically to the conditions of instruction where the response required of the student was varied. In analyses 11, 12 and 13, the relationship of student characteristics to performance on a particular form of remediation (or lack of it) within syndactic text presentations was investigated.

A syndactic text is essentially a series of linear programed frames each preceded by a brief but complete summary of the information presented in the frames. Students worked through the syndactic text by reading the first summary statement and taking a summary quiz of five to eight questions. If the student answered all summary quiz questions correctly, he read the second summary, took summary quiz 2, etc. The student who incorrectly answered one or more questions of a summary quiz was required to remediate through the linear programed sequence associated with that summary.

IV. METHOD

A. Test Battery. A battery of 137 predictor variables was used in the regression analyses. Included in the battery were common standardized tests in the major areas of aptitude, achievement, personality, motivation, and interest. Also included were items of student questionnaire data. Emphasis in the selection of tests was on commonly used and well-standardized tests, with considerable established validity to aid in the interpretation of findings. Emphasis in the student questionnaire items was on face validity.

In addition to such achievement variables as cumulative grade point average, converted rank in class, and high school recommendation score, the battery included the SAT-Verbal, SAT-Math, CEEB English Comprehension, CEEB Math Achievement and the various scales of the Edwards Personal Preference Schedule, the 16 Personality Factor Scale, the Ohio State Psychological Examination, the Strong Vocational Interest Blank and the 22 questions on the Student Questionnaire. The Student Questionnaire dealt with topics such as high school or college subjects studied, methods of previous instruction, study habits and college related abilities. A complete listing of the predictor variables is given in Appendix B and the complete Student Questionnaire is given in Appendix C.

Because of the large number of predictors and the small number of students available, and the fact that little confidence could be placed in most a priori hypotheses relating performance and predictors, the analyses of Phase II of the USNA Leadership course development project were designed as a variable selection process. The aim was to filter out potential important predictors from the many candidates available, thus setting the stage for a cross-validation of results in Phase III of the project.

B. Criterion Variables. Three types of dependent measures were used as the basis of the multiple regression analyses. First was the administrative posttest used as the criterion variable for prediction of overall course achievement. The second type of criterion variable was the student total residual derived from average student performance in each condition of instruction, which was used as the criterion variable in prediction of achievement with a particular medium. The third type of criterion variable was the within-student residual derived from scores on a module, used as the criterion variable in predicting achievement in a particular presentation form or condition of instruction. The latter two types of criterion variables are identified as sources

of error variance in the analyses of variance and represent unexplained individual differences in student performance after overall treatment conditions and Cumulative Posttest (CPT) unit differences are removed. In every experiment, residuals were derived for total CPT scores, CPT Type I scores, and CPT Type II scores.

A total residual was obtained from a student's mean performance over all CPT units of an experiment by subtracting the mean of the group (to which the student belongs in that experiment) from the student's mean. The resulting deviation score represents how well the student learned in relation to his group over the entire experiment. Since each experiment involved a particular medium, this score indicates how well the student learns in connection with that medium, at least for the kinds of content and presentations used with the medium. Regression of the total residuals on the battery of student variables could thus be used to identify variables associated with variation in achievement with particular media.

A within-student residual was derived by subtracting the mean for the student's group in a particular condition of instruction from the student's score in that condition, and secondly, subtracting the total residual for the student from the result

of the first subtraction. The resulting deviation score represents how well the student learned in relation to his average standing in the group, and in relation to the average performance of the group in that particular condition. When the within-student residuals for a particular condition of instruction are regressed on the battery of student variables, variables are identified predicting performance in the presentation conditions defining that condition.

C. Preliminary Variable Selection

The analyses for each criterion variable were conducted in three stages. The first stage involved the identification of potential predictor variables for input to the step-up multiple linear regression analysis. The following rules were employed in selecting these variables from the total pool of 137 student variables. A variable was selected if its first-order correlation with the criterion was .20 or greater. For each of the primary variables selected according to this first rule, its major correlate was included in the step-up regression analysis if it correlated less than .20 with the criterion variable but .40 or greater with the primary predictor. This latter rule was intended to select possible suppressor variables. In addition, 15 preselected predictor variables

were added if they were not included according to the above rules. The 15 preselected predictor variables were those that have commonly been used in predicting course achievement, and were preselected variables in the regression analyses in order to give them maximum opportunity to demonstrate their predictive power. These 15 variables are identified in Appendix B.

D. Step-Up Regression Analysis. The second stage of each analysis involved the input of the potential predictor variables identified in the preliminary variable selection process to a step-up regression analysis. The step-up multiple regression analysis involves the computation of a sequence of multiple linear regression equations in a stepwise manner. At each step one variable is added to the regression equation. The variable added is the one which makes the greatest reduction in the error sum of squares. Equivalently, it is the variable which has the highest partial correlation with the dependent variable partialed on the variables which have already been added. This amounts to being the variable which, if it were added, would have the highest F value. The computation was set to stop when the F value for a variable was not significant at the .10 level or less.

E. Step-Down Regression Analysis. In the final stage of the analyses, the variables surviving the step-up regression analysis served as input to the step-down regression analysis. In essence the step-down analysis is a reversal of the step-up analysis. It involves the computation of a sequence of regression equations in a stepwise manner. At each step it selects the variable with the smallest computed t value and looks at it as though it were the last variable entered. If this variable does not make a significant reduction in the error sum of squares, it is dropped from the analysis and the t values for the remaining variables are recomputed and the process is repeated. The accepted significance level was set at .01. When a predictor variable is significant at this level (when the loss in prediction dropping that variable is significant at the .01 level), the computation stops. All the remaining variables are significant predictors of performance in the particular condition being investigated. Procedures of the step-up and step-down analyses are based on those described in Draper and Smith (1966).

V. RESULTS

A. Final Course Achievement. The administrative pretest and posttest scores were entered in the step-up regression program (BMD02R) with the posttest as the criterion variable and the pretest as a forced predictor. The residuals obtained were used as the criterion variable for the first order correlation preliminary variable selection, the step-up and step-down regression analyses.

The predictor variables and related statistics resulting from the step-up regression analysis are given in Table 4. The variables are listed in order of their selection from first to last.

The variables in Tabel 4 plus the fifteen preselected variables and their major correlates were entered in the step-down regression analysis. These additional variables were: 1) SAT-Verbal, 2) SAT-Math, 3) CEEB Math Achievement, 4) Converted rank in class, 5) Grade point average, 6) Order (EPPS), 7) Concrete vs. abstract thinking (16PF), 8) Placid vs. apprehensive (16PF), 9) Independence (16PF), 10) Same-Opposite (OSU), 11) Reading comprehension (OSU), 12) Total reading (OSU), 13) Veterinarian (SVIB), 14) Mortician (SVIB), and 15) Academic achievement (SVIB).

The final predictor variables and related statistics obtained as a result of the step-down regression analysis are given in Table 5.

TABLE 4

POSTTEST: STEP-UP PREDICTORS AND STATISTICS

Variable Name	Number	Regression Coefficient	F Value to remove
Pretest	138	0.436	36.121
Pharmacist	96	0.158	15.148
English Comprehension	8	0.333	16.456
Achievement	8	-0.188	17.206
Psychology Courses Taken	116	2.483	8.864
Humble vs. Assertive	27	0.933	20.321
Autonomy	12	0.220	20.259
Average Hours of Study	129	-0.655	9.909
Analogies	48	-0.100	4.070

Multiple R = .898 Intercept = 37.532

TABLE 5

POSTTEST: STEP-DOWN PREDICTORS AND STATISTICS

Variable Name	Number	Regression Coefficient	Computed t Value
Pretest	138	.426	5.317
Pharmacist	96	.002	5.114
Humble vs. Assertive	27	.011	4.600
Autonomy	12	-.002	-4.299
Average Hours of Study	129	-.019	-3.209
Achievement	8	-.002	-3.181
English Comprehension	3	.002	3.168

Multiple R = .858 Intercept = .408

B. Media Predictors. The criterion variable in all of the following analyses was performance on the cumulative posttests (CPT's) as outlined in Section III. The relationship of student characteristics to performance in each of the media used was investigated with relation to total performance on the cumulative posttest as well as to performance on Type I and Type II questions on the test.

Audiotape vs. videotape. The residuals used in these analyses reflect individual differences in performance using audiotape and videotape materials in relation to the average difference in performance using these materials. The predictor variables and related statistics resulting from the step-up regression analyses for Type I, Type II and total CPT performance are given in Table 6. The variables are listed in order of their selection from first to last.

The variables in Table 6 plus the fifteen preselected variables and their major correlates were entered in the step-down regression analyses. The final predictor variables and related statistics obtained as a result of the step-down regression analyses for Type I, Type II and total CPT performance are given in Table 7.

TABLE 6

AUDIOTAPE-VIDEOTAPE DIFFERENCE: STEP-UP PREDICTORS & STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F value to remove
Vocabulary	132	1.439	1.212
Osteopath	54	0.463	23.177
Certified Public Accountant Owner	87	0.596	17.674
Previously had Team Teaching	121	1.838	15.500
Previously had Television	125	-1.278	5.801
Academic Achievement	108	-0.292	10.317
Managerial Orientation	115	0.248	6.005
Average Hours of Study	129	-2.240	5.442
Multiple R = .809		Intercept = -23.210	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F value to remove
Physician	56	0.793	10.642
Sociology Courses Taken	117	6.931	1.189
Music Teacher	86	0.907	8.830
Verbal Participation in Class	136	-8.177	5.115
Managerial Orientation	115	0.590	3.687
Academic Achievement	108	-0.557	3.352
Multiple R = .695		Intercept = -28.019	

TABLE 6 (Cont'd)

Type II CPT Performance (Cont'd)

Variable Name	Number	Regression Coefficient	F value to remove
Reading Ability	133	8.728	19.925
Previously had Team Teaching	121	2.735	6.819
Sober vs. Happy-go-lucky	28	6.776	23.576
Previously had Audiotape	127	-4.971	27.230
Senior CPA	88	-0.522	9.620
Previously had Teaching Machine	123	6.994	24.638
Previously had Television	125	-6.119	28.652
Average Hours of Study	129	-10.308	32.432
Same-Opposite	47	0.835	25.386
SAT-Verbal	1	-1.723	32.039
Carpenter	68	-1.227	45.000
Printer	72	0.382	1.822
Reserved vs. Outgoing	24	-2.587	5.402
Heterosexuality	21	-0.479	8.171
Occupational Level	111	-0.724	4.558
Recommendation Score	6	65.982	6.460
Extraversion	40	-3.362	3.380

Multiple R = .974 Intercept = 122.939

TABLE 7

AUDIOTAPE-VIDEOTAPE DIFFERENCE:

STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Osteopath	54	0.488	4.595
CPA Owner	87	0.612	4.127
Previously had Team Teaching	121	1.783	3.617
Academic Achievement	108	-0.296	-3.013
Managerial Orientation	115	0.303	3.001
Multiple R = .730		Intercept = -31.386	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Physician	56	0.691	2.693
Multiple R = .392		Intercept = -24.718	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Reserved vs. Outgoing	24	-7.528	-3.370
Extraversion	40	6.844	2.800
Reading Ability	133	12.886	2.554
Multiple R = .593		Intercept = -42.058	

Taped lecture (audiotape-videotape combined). The residuals used in these analyses reflect individual differences in performance averaged over both taped media in relation to average performance for the group with these media. The predictor variables and related statistics resulting from the step-up regression analyses for Type I, Type II and total CPT performance are given in Table 8. The variables are listed in order of their selection from first to last.

The variables in Table 8 plus the fifteen preselected variables and their major correlates were entered in the step-down regression analyses. The final predictor variables and related statistics obtained as a result of the step-down regression analyses for Type I, Type II and total CPT performance are given in Table 9.

TABLE 8

TAPED LECTURE (AUDIOTAPE-VIDEOTAPE COMBINED):
STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to Remove
Reading Comprehension	49	0.118	13.539
Oral Expression	135	1.693	11.577
Sociology Courses Taken	117	-2.579	11.739
Previously had Audiotape	127	0.615	11.394
Psychologist	58	0.092	7.766
Masculinity-Femininity	110	0.080	5.204
General College Achievement	131	0.732	3.356
Multiple R = .805		Intercept = -20.252	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to Remove
Oral Expression	135	5.893	58.472
Previously had Audiotape	127	1.517	43.850
Naval Officer	51	0.069	1.610
Reading Comprehension	49	0.172	14.541
Human Relations Courses Taken	119	-4.236	31.000
Music Teacher	86	-0.238	11.228
Previously had Team Teaching	121	-1.853	63.332
Heterosexuality	21	-0.451	54.251
Autonomy	12	0.353	47.379
Anticipated Hours Studying Leadership	130	6.019	73.972
Predicted Job Tenure	109	0.983	89.671
Interpreter (language)	106	-0.766	75.611
NROTC Officer (predicted tenure)	114	0.482	58.470
Business Courses Taken	118	7.665	50.860
Psychiatrist	57	0.447	64.925
SAT-Verbal	1	0.588	50.284
Policeman	73	-0.390	44.637

TABLE 8 (Cont'd)

Type I CPT Performance (Cont'd)

Variable Name	Number	Regression Coefficient	F Value to Remove
Production Manager	65	0.494	27.744
Vocabulary	132	-3.541	25.086
Reading Ability	133	1.628	8.321
Carpenter	68	-0.277	14.257
Occupational Level	111	-0.280	8.876
Musician Performer	85	0.150	3.200
Converted Rank in Class	5	-0.008	3.184
Multiple R = .987		Intercept = -109.233	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to Remove
Reading Comprehension	49	0.483	21.324
SAT-Verbal	1	0.383	5.011
Concrete vs. Abstract Thinking	25	-1.300	9.779
Human Relations Courses Taken	119	-4.504	10.133
Autonomy	12	0.280	8.240
Computer Programmer	105	0.259	7.626
Policeman	73	-0.233	5.379
Multiple R = .815		Intercept - -58.535	

TABLE 9

TAPED LECTURE (AUDIOTAPE-VIDEOTAPE COMBINED):
STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Reading Comprehension	49	0.131	3.452
Oral Expression	135	1.504	2.715
Multiple R = .610		Intercept = -12.318	

Type I CPT Performance

[Computer Error -- Analysis Being Recalculated]

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Reading Comprehension	49	0.506	4.366
Multiple R = .568		Intercept = -27.683	

Linear text. The residuals used in these analyses reflect individual differences in performance averaged over segments of material programed in linear text format. The predictor variables and related statistics resulting from the step-up regression analyses for Type I, Type II and total CPT performance are given in Table 10. The variables are listed in order of their selection from first to last.

The variables in Table 10 plus the fifteen preselected variables and their major correlates were entered in the step-down regression analyses. The final predictor variables and related statistics obtained as a result of the step-down regression analyses for Type I, Type II and total CPT performance are given in Table 11.

TABLE 10

LINEAR TEXT: STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to Remove
Librarian	83	-0.051	2.318
Converted Rank in Class	5	0.011	29.265
Community Recreation Administration	78	-0.245	23.466
Writing Ability	134	-0.106	0.140
Real Estate Salesman	99	-0.388	23.474
Sociology Courses Taken	117	-1.889	14.385
YMCA Secretary	77	0.167	11.816
Sales Manager	98	0.198	9.149
Predicted Job Tenure	109	0.126	13.005
Credit Manager	91	0.088	6.959
Mathematician	61	0.084	4.141
Grade Point Average	7	-0.767	3.206

Multiple R = .899 Intercept = -0.757

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to Remove
Reading Comprehension	49	0.379	14.914
Sociology Courses Taken	117	-6.725	9.627
Nurturance	18	0.193	3.806
Psychologist	58	0.206	4.635
Business Education Teacher	93	-0.197	4.662
Anticipated Hours Studying Leadership	130	2.608	3.314

Multiple R = .761 Intercept = -28.846

TABLE 10 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to Remove
Librarian	83	0.106	0.648
Converted Rank in Class	5	0.030	11.986
Senior CPA	88	0.488	21.151
Dentist	53	0.334	12.444
Psychiatrist	57	0.231	5.327
Predicted Job Tenure	109	0.329	5.864
Pace in Classroom Activities	137	-2.832	4.048
Multiple R = .808		Intercept = - 55.997	

TABLE 11

LINEAR TEXT: STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Converted Rank in Class	5	0.009	4.930
Community Recreation Administrator	78	-0.220	-4.702
Real Estate Salesman	99	-0.342	-4.628
Predicted Job Tenure	109	0.087	3.702
YMCA Secretary	77	0.153	3.331
Sociology Courses Taken	117	-1.568	-3.140
Sales Manager	98	0.185	3.080

Multiple R = .860 Intercept = 0.875

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Senior CPA	88	0.514	4.677
Dentist	53	0.337	3.418
Converted Rank in Class	5	0.031	3.352
Predicted Job Tenure	109	0.367	3.344
Psychiatrist	57	0.299	3.149

Multiple R = .772 Intercept = -68.338

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Reading Comprehension	49	0.367	3.461
Sociology Courses Taken	117	-8.112	-3.304

Multiple R = .603 Intercept = -11.248

Computer-Assisted Instruction (CAI)-Audiotape/ Intrinsically Programed Booklet (AT/IPB) difference.

The residuals used in these analyses reflect individual differences in performance using materials prepared for computer-assisted instruction and audiotape/ intrinsically programed booklets in relation to the average difference in performance using these materials. The predictor variables and related statistics resulting from the step-up regression analyses for Type I, Type II and total CPT performance are given in Table 12. The variables are listed in order of their selection from first to last.

The variables in Table 12 plus the fifteen preselected variables and their major correlates were entered in the step-down regression analyses. The final predictor variables and related statistics obtained as a result of the step-down regression analyses for Type I, Type II and total CPT performance are given in Table 13.

TABLE 12

COMPUTER ASSISTED INSTRUCTION (CAI)-AUDIOTAPE/ INTRINSICALLY PROGRAMED BOOKLET (AT/IPB) DIFFERENCE: STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Office Worker	90	1.043	11.834
Business Courses Taken	118	22.407	12.618
Previously had Team Teaching	121	-5.083	8.019
Sober vs. Happy-Go-Lucky	28	-4.821	9.123
Vocabulary	132	-7.938	3.130

Multiple R = .801 Intercept = 11.411

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Office Worker	90	0.351	5.745
Practical vs. Imaginative	33	2.094	4.489
Osteopath	54	0.291	3.790
Business Courses Taken	118	5.406	3.021

Multiple R = .572 Intercept = -35.354

TABLE 12 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Accountant	89	0.409	17.076
Neuroticism	44	4.430	72.064
Previously had Television	125	-1.439	8.316
CEEB Math Achievement	4	-0.642	28.764
Exhibition	11	-0.048	0.455
Nurturance	18	0.096	1.513
Oral Expression	135	10.761	43.671
SAT-Verbal	1	-0.642	18.904
CEEB English Comprehension	3	0.879	38.664
Vocabulary	132	-6.860	23.286
Therapists (with Schizophrenics)	107	-0.413	29.860
Business Courses Taken	118	5.523	13.850
Extraversion	40	1.772	9.831
Achievement	8	0.216	6.703
Masculinity-Femininity	110	-0.351	8.819
Architect	60	0.208	4.778

Multiple R = .973 Intercept = -8.128

TABLE 13

COMPUTER-ASSISTED INSTRUCTION (CAI)-AUDIOTAPE/ INTRINSICALLY PROGRAMED BOOKLET (AT/IPB) DIFFERENCE: STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Business Courses Taken	118	22.704	3.493
Office Worker	90	1.066	3.415
Previously had Team Teaching	121	-5.721	-3.157
Sober vs. Happy-Go-Lucky	28	-4.646	-2.829
Multiple R = .780		Intercept = -16.645	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Reading Comprehension	49	3.791	3.823
Total Reading	50	-7.408	3.758
Analogy	48	3.658	3.686
Practical vs. Imaginative	33	3.321	3.289
Same-Opposite	47	1.226	2.923
Academic Achievement	108	-0.435	-2.862
Multiple R = .655		Intercept = -58.834	

TABLE 13 (Cont'd)

Type II CPT Performance

(Computer Error--Analysis Being Recalculated)

Branching media (CAI and AT/IPB combined). The residuals used in these analyses reflect individual differences in performance averaged over both branching media in relation to average performance for the group within these media. The predictor variables and related statistics resulting from the step-up regression analyses for Type I, Type II and total CPT performance are given in Table 14. The variables are listed in order of their selection from first to last.

The variables in Table 14 plus the fifteen preselected variables and their major correlates were entered in the step-down regression analyses. The final predictor variables and related statistics obtained as a result of the step-down regression analyses for Type I, Type II and total CPT performance are given in Table 15.

TABLE 14

BRANCHING MEDIA (CAI AND AT/IPB COMBINED):

STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
CEEB English Comprehension	3	0.195	16.599
Librarian	83	0.073	7.443
Nurturance	18	0.091	14.283
Academic Achievement	108	-0.062	4.390
Analogy	48	-0.199	12.712
Total Reading	50	0.155	7.920
Multiple R = .757		Intercept = -12.220	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Musician Performer	85	0.106	1.180
Anticipated Hours Studying Leadership	130	1.671	3.333
CEEB Math Achievement	4	0.394	18.560
Naval Officer	51	0.499	47.352
Specialization Level	113	-0.558	43.065
Librarian	83	0.383	18.075
Nurturance	18	0.357	26.216
Total Reading	50	0.190	9.219
Tough-Minded vs. Tender-Minded	31	-0.803	3.598
Multiple R = .895		Intercept = -67.400	

TABLE 14 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Business Courses Taken	118	-4.039	5.667
Writing Ability	134	-3.709	13.558
Dominance	16	-0.240	8.318
CEEB English Comprehension	3	0.216	3.376

Multiple R = .681 Intercept = 16.221

TABLE 15

BRANCHING MEDIA (CAI AND AT/IPB COMBINED):

STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Analogy	48	-0.222	-3.730
Nurturance	18	0.090	3.554
Total Reading	50	0.199	3.503
CEEB English Comprehension	3	0.169	3.428

Multiple R = .685 Intercept = -13.285

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Specialization Level	113	-0.525	-5.414
Nurturance	18	0.348	4.793
Librarian	83	0.375	4.467
Naval Officer	51	0.351	4.105
Reading Comprehension	49	0.280	3.610

Multiple R = .803 Intercept = -35.796

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Business Courses Taken	118	-5.060	-2.648

Multiple R = .399 Intercept = 5.968

Syndactic Text. The residuals used in these analyses reflect individual differences in performance averaged over segments of material programed in syndactic text format.

The predictor variables and related statistics resulting from the step-up regression analyses for Type I, Type II and total CPT performance are given in Table 16. The variables are listed in order of their selection from first to last.

The variables in Table 16 plus the fifteen preselected variables and their major correlates were entered in the step-down regression analyses. The final predictor variables and related statistics obtained as a result of the step-down regression analyses for Type I, Type II and total CPT performance are given in Table 17.

TABLE 16

SYNDACTIC TEXT:

STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Conservative vs. Experimenting	36	0.591	14.656
Extraversion	40	-0.403	4.612
Reading Comprehension	49	0.058	3.065

Multiple R = .632 Intercept = -4.254

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Analogy	48	0.460	11.212
Leadership	45	-2.041	7.889
Independence	43	1.509	3.530
Same-Opposite	47	-0.238	3.221

Multiple R = .659 Intercept = -9.863

TABLE 16 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Conservative vs. Experimenting	36	2.889	23.956
Occupational Level	111	-1.215	41.679
Farmer	70	-0.192	3.409
Sales Manager	98	1.006	21.802
Real Estate Salesman	99	-0.825	10.873
Leadership	45	-2.590	22.937
Achievement	8	0.240	6.207
Printer	72	-0.641	19.037
Independence	43	-2.031	8.520
Order	10	0.294	11.715
Psychologist	58	0.281	6.354
CEEB English Comprehension	3	-0.246	2.976

Multiple R = .900 Intercept = 85.036

TABLE 17

SYNDACTIC TEXT: STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Conservative vs. Experimenting	36	0.605	3.654
Multiple R = .500		Intercept = -3.116	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Independence	43	3.583	4.460
Neuroticism	44	2.635	3.551
Reading Comprehension	49	0.431	3.516
Human Relations Courses Taken	119	-5.798	-3.219
Multiple R = .704		Intercept = -51.649	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Occupational Level	111	-1.127	-5.176
Sales Manager	98	1.145	4.624
Leadership	45	-2.194	-3.674
Printer	72	-0.581	-3.638
Conservative vs. Experimenting	36	1.695	3.514
Psychologist	58	0.405	3.491
Real Estate Salesman	99	-1.001	-3.477
Order	10	0.325	3.445
Multiple R = .839		Intercept = 60.292	

C. Conditions of Instruction Predictors. The remaining analyses involved varying conditions of instruction within a particular medium. Within the medium of syndactic text the condition investigated involved variations in the type of remediation provided if a summary quiz was not passed. Within linear text the condition varied was the type of response required of the student.

Remediation type. The residuals used in these analyses reflect individual differences in performance averaged over materials programed in syndactic text format where the type of remediation was varied. The predictor variables and related statistics resulting from the step-up regression analyses for Type I, Type II and total CPT performance for high response demand remediation, low response demand remediation and no remediation (control) are given in Tables 18, 19, and 20.

TABLE 18

HIGH RESPONSE DEMAND REMEDIATION:

STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Change	19	-0.140	51.834
Psychology Courses Taken	116	0.997	10.956
Previously had Television	125	0.684	34.997
Nurturance	18	-0.112	46.518
Reading Comprehension	49	-0.129	44.989
Endurance	20	0.084	11.037
Conservative vs. Experimenting	36	-0.547	38.835
CEEB English Comprehension	3	0.119	16.270
Oral Expression	135	1.047	16.144
Achievement	8	-0.096	26.064
Rate Study Habits	128	-0.715	10.891
Previously had Videotape	126	-0.325	7.575
Autonomy	12	0.048	8.170
Sober vs. Happy-Go-Lucky	28	-0.277	6.840
CEEB Math Achievement	4	0.064	5.938

Multiple R = .954 Intercept = 11.280

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Rate Study Habits	128	-4.752	6.782
Osteopath	54	-0.288	3.603
Concrete vs. Abstract Thinking	25	-1.701	6.104
Leadership Courses Taken	120	-20.410	5.146
CEEB English Comprehension	3	0.468	4.090
Change	19	-0.360	3.566

Multiple R = .700 Intercept = 41.404

TABLE 18 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Engineer	64	0.448	20.430
Biologist	59	0.442	16.363
Reading Ability	133	2.013	7.831
Oral Expression	135	-1.956	5.605
Carpenter	68	0.073	0.698
Author-Journalist	103	0.535	33.461
Banker	95	-0.086	0.832
Leadership	45	0.670	6.127
Physician	56	-0.485	23.279
Veterinarian.	55	0.510	19.739
Real Estate Salesman	99	-0.495	13.588
SAT-Math	2	0.227	6.136
Academic Achievement	108	0.201	5.508

Multiple R = .979 Intercept = -29.588

TABLE 19

LOW RESPONSE DEMAND REMEDIATION:

STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Accountant	89	0.079	5.879
Multiple R = .358		Intercept = -1.813	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Anticipated Hours Studying Leadership	130	5.181	6.106
Accountant	89	0.289	3.948
Previously had Audiotape	127	-1.482	3.491
Multiple R = .534		Intercept = -14.926	

TABLE 19 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Architect	60	-0.481	22.316
Sales Manager	98	-0.767	77.463
Reading Ability	133	5.581	35.984
Academic Achievement	108	-0.176	3.146
Sociology Courses Taken	117	-8.599	30.461
YMCA Secretary	77	0.346	15.019
Therapists (with Schizophrenics)	107	-0.377	26.300
Author-Journalist	103	0.639	22.696
Army Officer	66	0.153	7.931
Achievement	8	-0.190	8.575
CEEB English Comprehension	3	-0.272	6.542
Succorance	15	-0.230	9.316
CEEB Math Achievement	4	0.253	5.741
Validity	23	-0.122	4.464

Multiple R = .937 Intercept = 39.482

TABLE 20

NO REMEDIATION:

STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Physician	56	0.082	20.027
Tough-Minded vs. Tender-Minded	31	0.495	9.997
Policeman	73	-0.116	14.911
Converted Rank in Class	5	0.007	13.597
Order	10	-0.050	6.197
President, Manufacturing Concern	104	-0.090	11.063
SAT-Math	2	-0.116	7.298
Librarian	83	-0.075	6.511

Multiple R - .875 Intercept = 7.063

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Physician	56	0.827	114.776
Converted Rank in Class	5	0.039	42.180
Previously had Programed Textbook	124	-2.213	41.235
Analogy	48	-0.443	44.854
President, Manufacturing Concern	104	-0.834	75.522
Rate Study Habits	128	5.517	49.188
Predicted Job Tenure	109	0.299	7.988
Office Worker	90	0.299	12.894
CEEB Math Achievement	4	-0.487	25.091
Air Force Officer	67	-0.416	21.870
Occupational Level	111	0.299	12.030
Production Manager	65	0.256	7.156
SAT-Verbal	1	0.210	3.749

Multiple R = .959 Intercept = -31.300

TABLE 20 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Production Manager	65	-0.367	9.760
Order	10	-0.268	5.624
Trusting vs. Suspicious	32	1.330	3.829
Multiple R = .615		Intercept = 20.142	

The variables resulting from these analyses plus the fifteen preselected variables and their major correlates were entered into step-down regression analyses. The final predictor variables and related statistics for each of these analyses are given in Tables 21, 22, and 23.

TABLE 21

HIGH RESPONSE DEMAND REMEDIATION:

STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

(Computer Error - Analysis Being Recalculated)

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Rate Study Habits	128	-5.805	-2.740
Multiple R = .398		Intercept = 15.348	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Order	10	0.544	5.126
Total Reading	50	-0.523	-4.746
Occupational Level	111	0.408	2.811
Multiple R = .713		Intercept = -22.512	

TABLE 22

LOW RESPONSE DEMAND REMEDIATION:

STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Accountant	89	0.079	2.425
Multiple R = .358		Intercept = -1.813	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Anticipated Hours Studying Leadership	130	5.545	2.531
Multiple R = .372		Intercept = -13.375	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Architect	60	-0.453	-4.699
Therapists (with Schizophrenics)	107	-0.357	-4.450
Advertising Man	101	-0.597	-3.814
Author-Journalist	103	0.763	3.342
Reading Ability	133	3.797	3.145
Purchasing Agent	94	-0.310	-2.809
Multiple R = .809		Intercept = 18.499	

TABLE 23

NO REMEDIATION:

STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Policeman	73	-0.138	-4.474
Physician	56	0.087	4.424
Tough-Minded vs. Tender-Minded	31	0.647	4.179
President, Manufacturing Concern	104	-0.089	-3.068
Converted Rank in Class	5	0.006	3.063
Librarian	83	-0.089	-2.909
SAT-Math	2	-0.127	-2.765

Multiple R = .849 Intercept = 5.735

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Physician	56	0.567	8.758
President, Manufacturing Concern	104	-0.723	-7.103
Converted Rank in Class	5	0.039	5.332
Rate Study Habits	128	5.140	5.329
Analogy	48	-0.360	-4.842
Previously had Programed Textbook	124	-1.744	-4.627
Air Force Officer	67	-0.331	-4.309
CEEB Math Achievement	4	-0.465	-3.951
Occupational Level	111	0.312	3.027

Multiple R = .926 Intercept = 8.047

TABLE 23 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t Value
Production Manager	65	-0.430	-3.434
Multiple R = .477		Intercept = 15.421	

Response demand type. The residuals used in these analyses reflect individual differences in performance averaged over materials programed in linear text where the type of response demanded of the student was varied. The predictor variables and related statistics resulting from the step-up regression analyses for Type I, Type II and total CPT performance for overt selected, overt spoken and covert response demand are given in Tables 24, 25, and 26.

TABLE 24

OVERT SELECTED RESPONSE DEMAND:

STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Concrete vs. Abstract Thinking	25	0.277	9.428
Physicist	62	0.065	4.452
Anticipated Hours Studying Leadership	130	0.758	6.611
Change	19	0.113	17.222
Accountant	89	0.097	14.523
Expedient vs. Conscientious	29	0.357	9.068
CPA Owner	87	0.054	4.784
Credit Manager	91	-0.069	4.429

Multiple R = .837 Intercept = -14.094

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Average Hours of Study	129	-2.535	3.027
Psychology Courses Taken	116	-6.424	6.796
Leadership Courses Taken	120	-14.713	3.955
Carpenter	68	0.228	5.938
Concrete vs. Abstract Thinking	25	1.007	3.287

Multiple R - .658 Intercept = 19.972

TABLE 24 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Business Education Teacher	93	-0.182	2.778
Achievement	8	0.119	1.013
Anticipated Hours Studying Leadership	130	4.491	7.987
Writing Ability	134	-4.289	10.316
Previously Had Audiotape	127	-1.800	8.697
Reading Ability	133	4.706	9.477
Real Estate Salesman	99	-0.263	3.494
Multiple R = .730		Intercept =	-1.725

TABLE 25

OVERT SPOKEN RESPONSE DEMAND:

STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Chemist	63	-0.040	5.916
Writing Ability	134	0.475	4.699
Undisciplined Self-Conflict vs. Controlled	38	0.198	4.526
Verbal Participation in Class	136	0.455	3.195
Multiple R = .661		Intercept = -2.733	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Life Insurance Salesman	100	0.176	5.620
Multiple R = .351		Intercept = -4.437	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Chemist	63	-0.175	3.034
Undisciplined Self-Conflict vs. Controlled	38	1.507	6.529
Minister	82	0.205	5.353
Converted Rank in Class	5	0.022	4.319
Multiple R = .635		Intercept = -17.589	

TABLE 26

COVERT RESPONSE DEMAND:

STEP-UP PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Concrete vs. Abstract Thinking	25	-0.359	14.484
Expedient vs. Conscientious	29	-0.425	10.789
Change	19	-0.087	10.083
Anticipated Hours Studying Leadership	130	-0.689	4.824
Pace in Classroom Activities	137	-0.582	3.498
Multiple R = .769		Intercept = 12.361	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Concrete vs. Abstract Thinking	25	-1.674	6.394
Previously had Teaching Machine	123	-2.636	7.387
Change	19	-0.408	4.874
Multiple R = .534		Intercept = 34.221	

TABLE 26 (Cont'd)

Type II CPT Performance

Variable Name	Number	Regression Coefficient	F Value to remove
Anticipated Hours Studying Leadership	130	-4.113	10.610
Verbal Participation in Class	136	-3.487	11.137
Policeman	73	0.287	9.559
Expedient vs. Conscientious	29	-1.960	14.768
Converted Rank in Class	5	-0.028	11.630
Concrete vs. Abstract Thinking	25	-0.914	5.202
Music Teacher	86	0.553	13.948
Purchasing Agent	94	0.214	3.464
Masculinity-Femininity	110	0.256	3.376
Multiple R = .839		Intercept = 14.086	

The variables resulting from these analyses plus the fifteen preselected variables and their major correlates were entered into step-down regression analyses. The final predictor variables and related statistics for each of these analyses are given in Tables 27, 28 and 29.

TABLE 27

OVERT SELECTED RESPONSE DEMAND:

STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Concrete vs. Abstract Thinking	25	0.412	3.501
Physicist	62	0.075	2.884
Multiple R = .549		Intercept = -4.128	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Concrete vs. Abstract Thinking	25	1.429	2.363
Multiple R = .350		Intercept = 7.255	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Writing Ability	134	-2.678	-1.674
Multiple R = .256		Intercept = 8.859	

TABLE 28

OVERT SPOKEN RESPONSE DEMAND:

STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Chemist	63	-0.063	-3.842
Multiple R = .534		Intercept = 2.206	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Life Insurance Salesman	100	0.176	2.371
Multiple R = .351		Intercept = -4.437	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Farmer	70	-0.242	-1.889
Multiple R = .286		Intercept = 8.229	

TABLE 29

COVERT RESPONSE DEMAND:

STEP-DOWN PREDICTORS AND STATISTICS

Total CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Concrete vs. Abstract Thinking	25	-0.425	-4.021
Expedient vs. Conscientious	29	-0.402	-2.899
Multiple R = .610		Intercept = 4.445	

Type I CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Concrete vs. Abstract Thinking	25	-1.442	-2.084
Multiple R = .313		Intercept = 7.613	

Type II CPT Performance

Variable Name	Number	Regression Coefficient	Computed t value
Purchasing Agent	94	0.251	2.049
Multiple R = .308		Intercept = -7.013	

VI. DISCUSSION

In analyzing the relationships that have been found the authors recognize that there may be several different interpretations of why a particular variable relates to a particular medium or particular condition of instruction. Therefore, rather than going into an indepth discussion for each variable in every analysis, the discussion will concern itself with identifying general classes or clusters of variables that appear to relate to performance within the analyses and, where possible, to identify differences across the various analyses conducted.

In interpreting the reported relationships of student characteristics to the various media and conditions of instruction the following factors should be kept clearly in mind: 1) the instructional system, 2) the content being taught, 3) the medium used, and 4) the variations of the conditions of instruction within and across each medium. The instructional system basically required the student to proceed with a segment of instruction programed in a particular manner, and then to take a criterion referenced progress check. If he achieved 80% or better, he could proceed to the next

segment of instruction. If he failed to achieve that level of performance, he was required to remediate the identified areas of deficiency using specific review materials. The research embedded in the course required the student in most cases to delay remediation over several segments involving a particular research question. Also the research involved in no way hindered any student's final performance. It did require him to follow specific procedures that varied from one unit of instruction to another. With respect to the content, a perusal of Table 1 indicates that many of the topics covered in the course are interrelated, but that there is a diversity of content area taught. A wide variety of media was utilized across this diversity of content area. In addition, specific conditions of instruction were employed within these media. These factors were taken into account in designing the research involving group comparisons of performance for specific conditions in instruction within media. (For a detailed discussion of the course system, materials, development, and course effectiveness, see Hubert and Rivers, 1970 [TR-6.12a]. For a complete discussion of the research plan and results of the group comparison, see Bessemer

and Rivers, 1970 [TR-6.12b].) It should be noted that some problems of interpretation of the analyses of student characteristics can arise if these factors are not kept in mind. In interpreting the relationship of the various aptitude, personality, and self-interest and self-report variables, it may be difficult to determine the relative effect of the system, the content, the media, and the conditions of instruction. The point is that some of these relationships may be obvious while many may not be. It is expected that many ambiguities that may arise will be clarified in the cross-validation of these results which is being conducted in Phase III of this project.

The prediction of final course achievement will be discussed first followed by the relationships of student characteristics to performance with the various media utilized. The section will conclude with a discussion of the predictors of performance and the various conditions of instruction.

A. Final course achievement. The prediction of final course achievement, it should be recalled, was different from the remainder of the analyses in that the criterion variable was performance on an 80-point criterion-referenced test and it did not involve separate analyses for different types of tasks. The interpretation of this

analysis is rather straightforward. The variables predicting posttest performance were quite diverse. In addition to the variables of prior knowledge (pretest) and general ability (English comprehension), there were three personality variables (achievement, autonomy, and humble vs. assertive), one occupational self-interest variable (pharmacist), and one self-report variable (average hours of study).

In an individualized course stressing a pre-set level of performance for each student, it would be somewhat surprising to find the pretest as a predictor of final course achievement if the instructional materials and tests had been completely validated. It should be noted that this data was tabulated on the basis of the first full scale implementation of the materials. Finding the pretest as a predictor does indicate a need for revision of materials and tests. In fact this revision cycle was planned, and it is expected that the pretest will be of much lesser importance in the cross validation of these findings with the revised learning materials.

It would appear that individuals who score high on the final examination tend to have good reading aptitude, particularly comprehension, which may be related to test taking ability. This may well account for the negative relationship of number of hours typically

spent studying. Personality characteristics found as predictors indicate that these individuals tend to be assertive, self-assured and independent minded yet do not avoid responsibilities and obligations, or rebel against authority. The negative relationship of achievement as measured on the Edwards Personal Preference Schedule indicates that these students are not highly motivated to accomplish tasks requiring skill and effort, or to do a difficult job well. It may well be, however, that they simply do not perceive the course as difficult or something that requires great skill and effort. The relationship of interest in the profession of pharmacist as measured on the Strong Vocational Interest Blank may indicate an interest in attending to small details which the profession of pharmacist certainly requires. There are indeed many details to be attended to in the individualized multi-media leadership course if a high level of performance is to be achieved.

B. Media predictors. When looking at the predictors resulting from the step-down analyses for the different types of tasks measured on the CPT's within media as well as across media, no clear pattern appears to emerge. However, when the step-down analyses are supplemented with the step-up analyses and the first-order correlations,

the predictors of overall performance under different media seem generally consistent. There appears to be a cluster of verbal skill variables such as CEEB English comprehension, reading comprehension and total reading from the Ohio State Examination, and the SAT-Verbal that are always related to overall performance regardless of the media or type of task involved. In addition to the standard variables which one might expect to find, there appears to be a cluster of variables related to performance that is unique to each of the media involved.

In the case of audiotape and videotape this second order cluster of variables is also in the verbal skills area, but it is more related to oral expression rather than reading and test taking ability. Several of the self-rating student report variables from the student questionnaire appear to relate to performance with the taped media. The self-report variables of previous instruction by audiotape, and college-related abilities with respect to vocabulary, reading, writing, and oral expression all show up in the first order correlation. These variables do not appear in linear text or syndactic text as they do with the taped lecture media. These self-report variables relate to ability to learn from oral presentations which, of course, is involved in both audiotape and videotape.

In contrast to the auditory learning cluster related to the taped lecture media, more frequent correlations with different personality and self-interest variables appear in relation to linear text and syndactic text. With respect to linear text, the first order correlations show negative relationships for shy vs. outgoing and exhibitionism, while interest in the profession of librarian is positively related to performance. It is generally the case that interest in psychology, musician performer, and music teacher for example, which are more related to public exhibitionism of products of work, are negatively related to the shy vs. outgoing, exhibitionism and librarian types of scales. Therefore, it would appear that there is a general introversion-extroversion cluster of variables that is involved in performance with linear text, where the more withdrawn type of personality achieves a higher level of performance. Some of the other interest and self-report variables may be as much related to the particular content as to the medium in which it was programed. The strong relationship of converted rank in class with linear text may be more related to motivation to study than to academic skills.

With respect to syndactic texts, another type of personality dimension relating to performance is found. This is the variable of conservative vs. experimental, where a higher level of performance is achieved for the experimental personality. This type of individual is more inclined to experiment in life generally and is more tolerant of inconvenience and change. It would appear that the novelty of syndactic texts is more readily adaptable to individuals with an experimental personality trait. As with linear text, there are a variety of self-interest variables that may be related to the content as well as to the medium itself.

The secondary cluster of variables relating to performance with computer-assisted instruction (CAI) and its parallel, audiotape with an intrinsically programed booklet (AT/IPB), is perhaps the most difficult to clearly identify. Although there are some consistencies, there are in these analyses a variety of personality variables and self-interest variables that are difficult to reconcile when going from Type I tasks to total CPT performance and when looking at the analysis of the CAI-AT/IPB differences as compared to the two media combined. It should be noted that these media are actually composite media. In addition, the experimental conditions

were slightly different for these media than for the others. In all other cases, the experimental conditions involved within student comparisons were where all students saw each of the varied conditions within the medium. The analysis of the experimental conditions within CAI and AT/IPB were between subject comparisons. These factors may be contributory to the lack of clear findings.

C. Conditions of instruction predictors. The relationships of student characteristics to the conditions of instruction involving variations in the response demanded of the student and the type of remediation appeared to be different from the analyses involving overall performance on media. This is the case even though the response demanded was varied within the medium of linear text and the remediation type of variable within the medium of syndactic text. In general, the verbal skills cluster of variables does not appear. In the main there are a variety of personality, self-report and self-interest variables that appear with no consistent pattern except perhaps for the overt selected and covert response demand forms. However, in this case, the finding that a concrete thinker would perform better with the

covert response demand and an abstract thinker would do better with the overt selected form seems somewhat intuitive. There were some procedural problems in implementing these conditions that causes the reliability of these particular findings to be questioned. The students generally reported that they did not always strictly follow the instructions. With respect to the remediation type, the students performed so well on the syndactic text summaries that many did not need the remediation at all. These problems have been corrected in the replication of the research and it is hoped that the course validation will provide a clear picture of the relationships as well as more reliable data.

VII. CONCLUSIONS AND RECOMMENDATIONS

In addition to finding significant predictors of final course achievement relating to aptitude, personality, and interest, this investigation identified the general cluster of verbal skill variables that related to performance regardless of the media involved. The fact that in general there were no particular variables or group of variables that were uniquely related to performance on a lower level learning task as opposed to a higher level learning task may be a reflection of too broad a classification of types of learning tasks. In addition to the cluster of verbal skill variables that relate to performance regardless of the media employed, a secondary cluster of variables was found that was generally unique to performance within each of the media involved.

Although there were some procedural problems in the implementation of the course that caused some difficulty in interpreting some of the analyses of the student characteristics, the methodology appears rather sound. It should be kept in mind that the cross validation of these analyses in the replication of the research will provide additional reliability in the findings and will clarify those areas where problems

presently exist. Even though it is felt that the methodology is sound, other possible methods of analysis that will allow for a reduction in the number of initial variables involved are being investigated for application in the cross validation. The identification of general clusters of variables is of definite value in this direction.

While it is not recommended that these findings be applied in an ongoing course until they are cross validated, the more reliable findings could be used to tentatively identify individuals who might have problems learning from a particular medium. In the Leadership, Psychology and Management course this would entail the determination of an acceptable base level of performance on the norm-referenced cumulative posttest and the determination of the relationship of these tests to overall performance in the course. It is felt, however, that the maximum benefit to be gained from this effort, particularly without cross validation, is in providing insight and direction for future research and application of the relationship of student characteristics to performance in individualized multi-media course presentations.

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APPENDIX A

CLASSIFICATION OF CUMULATIVE POSTTEST ITEMS

APPENDIX A

CLASSIFICATION OF CUMULATIVE POSTTEST (CPT) ITEMS

1. Type I items (acquisition of knowledge)

   a. Definition-identification: Item will require selection of the correct definition, description, purpose, or use of a given term, concept, or principle;

   or:

   Item will require selection of the correct term, concept, or principle which is defined or described by a given definition or description.

   b. Discrimination-comparison: Item will require selection of the correct distinction between or comparison of a given set of terms, concepts, and/or principles;

   or:

   Item will require the correct matching of a set of terms, concepts, and/or principles with a set of definitions and/or descriptions, as:

   Which matching of words and statements is correct?

1. Term 1	A. Definition 1
2. Term 2	B. Definition 2
3. Term 3	C. Definition 3
4. Term 4	D. Definition 4

   (possible answers, one of which is correct):

   a) 1-B, 2-C, 3-B, 4-A
   b) 1-D, 2-B, 3-A, 4-C
   c) 1-D, 2-B, 3-C, 4-A
   d) 1-C, 2-D, 3-A, 4-B

2. Type II items (application of knowledge)

   a. Generalization-problem identification: Item will require selection of the correct or most appropriate "real-life" application, example or illustration of a given concept or principle;

   or:

   Item will require selection of the correct concept or principle illustrated by a given "real-life" example or illustration.

   or:

Item will require correct matching of a set of concepts and/or principles with a set of "real-life" examples and/or illustrations.

b. Problem solving: Item will require selection of the correct or most appropriate solution of, resolution of, or reaction to a given "real-life" problem or situation;

or:

Item will require correct matching of a set of concepts and/or principles with a set of solutions of, resolutions of, and/or reaction to a given "real-life" problem or situation (i.e., how would alternative theories, methods, or approaches deal with the same situation or problem).

APPENDIX B

PREDICTOR VARIABLES

APPENDIX B

PREDICTOR VARIABLES

Variable Code:			Variable Name:
STV	1	*	SAT - verbal
STM	2	*	SAT - math
ENC	3	*	CEEB English Comprehension
MAT	4	*	CEEB Math Achievement
RNK	5	*	Converted rank in class
REC	6		Recommendation score
GPA	7	*	Grade point average
EDWARDS PERSONAL PREFERENCE SCHEDULE (EPPS)			
ACV	8	*	Achievement
DEF	9		Deference
ORD	10	*	Order
EXH	11		Exhibition
AUT	12	*	Autonomy
AFF	13		Affiliation
ISP	14		Intraspection
SUC	15		Succorance
DOM	16		Dominance
ABA	17		Abasement
NUR	18		Nurturance
CHG	19		Change
END	20		Endurance

EDWARDS PERSONAL PREFERENCE SCHEDULE (Cont'd)

HET	21		Heterosexuality
AGG	22		Aggression
VAL	23		Validity Scale

16 PERSONALITY FACTOR SCALE (16PF)

PFA	24		A	Reserved vs Outgoing
PFB	25	*	B	Concrete thinking vs Abstract thinking
PFC	26		C	Affected by feelings vs Emotionally stable
PFE	27		E	Humble vs Assertive
PFF	28		F	Sober vs Happy-go-lucky
PFG	29		G	Expedient vs Conscientious
PFG	30		H	Shy vs Venturesome
PFI	31		I	Tough minded vs Tender minded
PFL	32		L	Trusting vs Suspicious
PFM	33		M	Practical vs Imaginative
PFN	34		N	Forthright vs Shrewd
PFO	35		O	Placid vs Apprehensive
PF1	36		Q_1	Conservative vs Experimenting
PF2	37		Q_2	Group-dependent vs Self sufficient
PF3	38		Q_3	Undisciplined self-conflict vs Controlled
PF4	39		Q_4	Relaxed vs Tense

16 PERSONALITY FACTOR SCALE (SECOND ORDER FACTORS)

EXT	40		Extraversion
ANX	41		Anxiety
TOP	42		Tough Poise
IND	43		Independence
NEU	44		Neuroticism
LEA	45		Leadership
CRE	46		Creativity

OHIO STATE PSYCHOLOGICAL (OSU)

OS1	47	*	Test 1 Same-Opposite Section
OS2	48	*	Test 2 Analogy Section
OS3	49	*	Test 3 Reading Comprehension Section
OS4	50	*	Test 4 Total Reading

STRONG VOCATIONAL INTEREST BLANK (SVIB)

NAV	51	Naval Officer
PTH	52	Physical Therapist
DEN	53	Dentist
OST	54	Osteopath
VET	55	Veterinarian
DOC	56	Physician
PYI	57	Psychiatrist
PYO	58	Psychologist
BIO	59	Biologist
ARC	60	Architect

STRONG VOCATIONAL INTEREST BLANK

MTH	61	Mathematician
PHY	62	Physicist
CHE	63	Chemist
ENG	64	Engineer
PMR	65	Production Manager
ARM	66	Army Officer
AFO	67	Air Force Officer
CAR	68	Carpenter
FOR	69	Forest Service Man
FAR	70	Farmer
MST	71	Math-Science Teacher
PRI	72	Printer
POL	73	Policeman
PDR	74	Personnel Director
PAD	75	Public Administrator
RCO	76	Rehabilitation Counselor
YMS	77	YMCA Secretary
CRA	78	Community Recreation Admin.
SWO	79	Social Worker
SSC	80	Social Science Teacher
SSU	81	School Superintendent
MIN	82	Minister
LIB	83	Librarian

STRONG VOCATIONAL INTEREST BLANK (Cont'd)

ART	84	Artist
MUP	85	Musician Performer
MUT	86	Music Teacher
CPO	87	CPA Owner
CPA	88	Senior CPA
ACC	89	Accountant
OWO	90	Office Worker
CMR	91	Credit Manager
COC	92	Chamber of Commerce Exec.
BET	93	Business Education Teacher
PUR	94	Purchasing Agent
BAN	95	Banker
PHA	96	Pharmacist
MOR	97	Mortician
SMR	98	Sales Manager
RES	99	Real Estate Salesman
INS	100	Life Insurance Salesman
ADV	101	Advertising Man
ATY	102	Lawyer
AUT	103	Author-Journalist
PMF	104	President, Mfg. Concern
CPR	105	Computer Programmer
INT	106	Interpreter (language)

STRONG VOCATIONAL INTEREST BLANK (Cont'd)

A-B	107		Therapists (with Schizophrenics)
ACH	108	*	Academic Achievement
L-C	109		Confidential scale relating to predicted job tenure
M-F	110		Masculinity-Femininity
OCL	111		Occupational Level
SIN(OIE)	112		Occupational Introversion-Extroversion
SPL	113		Specialization Level
N-6	114		NROTC Officer (predicted tenure)
MGE(MO)	115		Managerial Orientation

STUDENT QUESTIONNAIRE - HIGH SCHOOL OR COLLEGE SUBJECTS STUDIED (SQ)

S01	116	Psychology
S02	117	Sociology
S03	118	Business
S04	119	Human Relations (or equivalent)
S05	120	Leadership

METHODS OF PREVIOUS INSTRUCTION (SQ)

S06	121	Team teaching
S07	122	Computer-aided instruction
S08	123	Teaching machine
S09	124	Programed textbook
S10	125	Television
S11	126	Videotape
S12	127	Audiotape

STUDY HABITS (SQ)

S13	128	Rate study habits
S14	129	Average hours of study
S15	130	Anticipated hours studying Leadership

COLLEGE-RELATED ABILITIES (SQ)

S16	131	General college achievement
S17	132	Vocabulary
S18	133	Reading ability
S19	134	Writing ability
S20	135	Oral expression
S21	136	Verbal participation in class
S22	137	Pace in classroom activities

* One of the 15 preselected predictor variables

APPENDIX C

STUDENT QUESTIONNAIRE

APPENDIX C

UNITED STATES NAVAL ACADEMY
LEADERSHIP MANAGEMENT COURSE

STUDENT QUESTIONNAIRE

NAME (print)_____
(Last) (First) (Middle)

ALPHA CODE ☐ ☐ ☐ ☐ ☐ ☐

CLASS

- ☐ 1. 1970
- ☐ 2. 1971
- ☐ 3. 1972
- ☐ 4. 1973

HIGH SCHOOL OR COLLEGE SUBJECTS STUDIED

1. Psychology.
   - ☐ 1. less than one semester
   - ☐ 2. one semester
   - ☐ 3. two semesters
   - ☐ 4. more than two semesters
2. Sociology
   - ☐ 1. less than one semester
   - ☐ 2. one semester
   - ☐ 3. two semesters
   - ☐ 4. more than two semesters
3. Business
   - ☐ 1. less than one semester
   - ☐ 2. one semester
   - ☐ 3. two semesters.
   - ☐ 4. more than two semesters
4. Human Relations (or equivalent)
   - ☐ 1. less than one semester
   - ☐ 2. one semester
   - ☐ 3. two semesters
   - ☐ 4. more than two semesters

HIGH SCHOOL OR COLLEGE SUBJECTS STUDIED, continued

5. Leadership

- ☐ 1. less than one semester
- ☐ 2. one semester
- ☐ 3. two semesters
- ☐ 4. more than two semesters

METHODS OF INSTRUCTION BY WHICH YOU HAVE BEEN TAUGHT

6. Team Teaching

- ☐ 1. none
- ☐ 2. less than 3 weeks
- ☐ 3. 3 to 6 weeks
- ☐ 4. 6 to 12 weeks
- ☐ 5. more than 12 weeks

7. Computer-Aided Instruction

- ☐ 1. none
- ☐ 2. less than 3 weeks
- ☐ 3. 3 to 6 weeks
- ☐ 4. 6 to 12 weeks
- ☐ 5. more than 12 weeks

8. Teaching Machine

- ☐ 1. none
- ☐ 2. less than 3 weeks
- ☐ 3. 3 to 6 weeks
- ☐ 4. 6 to 12 weeks
- ☐ 5. more than 12 weeks

9. Programed Textbook

- ☐ 1. none
- ☐ 2. less than 3 weeks
- ☐ 3. 3 to 6 weeks
- ☐ 4. 6 to 12 weeks
- ☐ 5. more than 12 weeks

10. Television

- ☐ 1. none
- ☐ 2. less than 3 weeks
- ☐ 3. 3 to 6 weeks
- ☐ 4. 6 to 12 weeks
- ☐ 5. more than 12 weeks

METHODS OF INSTRUCTION BY WHICH YOU HAVE BEEN TAUGHT, continued

11. Videotape

- ☐ 1. none
- ☐ 2. less than 3 weeks
- ☐ 3. 3 to 6 weeks
- ☐ 4. 6 to 12 weeks
- ☐ 5. more than 12 weeks

12. Audiotape (tape recorder)

- ☐ 1. none
- ☐ 2. less than 3 weeks
- ☐ 3. 3 to 6 weeks
- ☐ 4. 6 to 12 weeks
- ☐ 5. more than 12 weeks

STUDY HABITS

13. Would you rate your study habits

- ☐ 1. poor
- ☐ 2. fair
- ☐ 3. good
- ☐ 4. very good

14. On the average, do you study

- ☐ 1. less than 6 hours a week
- ☐ 2. 6 to 10 hours a week
- ☐ 3. 10 to 14 hours a week
- ☐ 4. more than 14 hours a week

15. Approximately how much time do you anticipate studying leadership per week (including class time)?

- ☐ 1. less than 4 hours
- ☐ 2. 4 to 6 hours
- ☐ 3. 6 to 8 hours
- ☐ 4. more than 8 hours

COLLEGE-RELATED ABILITIES

16. General College Achievement

- ☐ 1. very much below average
- ☐ 2. below average
- ☐ 3. average
- ☐ 4. above average
- ☐ 5. very much above average

COLLEGE-RELATED ABILITIES, continued

17. Vocabulary

- ☐ 1. very much below average
- ☐ 2. below average
- ☐ 3. average
- ☐ 4. above average
- ☐ 5. very much above average

18. Reading Ability

- ☐ 1. very much below average
- ☐ 2. below average
- ☐ 3. average
- ☐ 4. above average
- ☐ 5. very much above average

19. Writing Ability

- ☐ 1. very much below average
- ☐ 2. below average
- ☐ 3. average
- ☐ 4. above average
- ☐ 5. very much above average

20. Oral Expression

- ☐ 1. very much below average
- ☐ 2. below average
- ☐ 3. average
- ☐ 4. above average
- ☐ 5. very much above average

21. Willingness to participate verbally in class

- ☐ 1. very much below average
- ☐ 2. below average
- ☐ 3. average
- ☐ 4. above average
- ☐ 5. very much above average

22. Ability to keep pace in classroom activities

- ☐ 1. very much below average
- ☐ 2. below average
- ☐ 3. average
- ☐ 4. above average
- ☐ 5. very much above average