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AUTHOR Kalin, Maurice F.; McAvoy, Rogers
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ABSTRACT

The purpose of this study was to investigate the strategy of allowing a student to choose the sensory channel in which he learns most efficiently and to determine if this choice results in increased learning rates. It was hypothesized that allowing a student to learn in channels of his choice would result in higher learning rates than when he was learning in modes not of his choice. Three-hundred students enrolled in an introductory educational psychology course at a state supported university in West Virginia during the second semester, 1971-72, were selected for this study. Findings indicated that a student has a preference for learning in a sensory input channel; that a student knows in which sensory channel he learns most efficiently; and that allowing a student to learn in the sensory channel in which he thinks he learns most efficiently results in significantly higher learning rates than in channels unlike his choice. (Author/RB)

THE INFLUENCE OF CHOICE ON THE ACQUISITION AND RETENTION OF LEARNING MATERIALS IN DIFFERENT MODES OF INSTRUCTION

Maurice F. Kalin, Ed.D.
West Virginia University

Rogers McAvoy, Ph.D.
West Virginia University

The purpose of this study was to investigate the strategy of allowing a student to choose the sensory channel in which he learns most efficiently and to determine if this choice resulted in increased learning rates.

The data indicate the following: (1) that a student has a preference for learning in a sensory input channel; (2) that a student knows in which sensory channel he learns most efficiently; and (3) that allowing a student to learn in the sensory channel in which he thinks he learns most efficiently results in significantly higher learning rates than in channels unlike his choice.

Introduction

The channel preference literature states that if a learner is placed in optimal sensory contact with instructional material, then he learns at his maximum rate of speed. This implies that the key to making learning effective is to match instructional methods to the optimal learning style of the individual. Therefore, the problem facing educational researchers is one of determining which instructional approach is optimal for a particular learning style.

Most investigators who have studied this aptitude-treatment relationship have used aptitude tests to identify the learning style of the individual. This kind of preference identification strategy has led these researchers to conclude that the learning style of the individual cannot be measured with the instruments that are now available.

In order to avoid the lag between measurement and theory, it is necessary to operationally define channel preference as a dominant learning style through which a student masters information at accelerated learning rates and secondly, conceptualize a strategy of asking a student to choose the instructional mode that would allow him to learn most efficiently. This strategy may provide a useful interim approach of matching a learner's optimal sensory preference channel with an instructional mode. This position assumes that a student has a preference for learning in one sensory channel and/or channels, that a student knows in which sensory channel he learns most efficiently, and that his selection of an optimal channel will result in greater learning efficiency.

Hypothesis

Specifically, it was hypothesized that allowing a student to learn in channels of his choice will result in higher learning rates than when he is learning in modes not of his choice.

This hypothesis assumes that if the learners dominant sensory channel can be identified and information presented through this channel, then the learner will either gain more information in the same amount of time or learn the same amount of information in shorter amounts of time. In either case, the dependent variables rate, gain divided by time, would identify the differences.

Methods

Sampling procedure. An entire population of three hundred students enrolled in an introductory educational psychology course at a state supported university in West Virginia during the second semester, 1971-72 was selected for this study.

The population was chosen for three basic reasons: (1) aptitude as measured by ACT was normally distributed in the previous two populations of students involved in this instructional program; (2) this population has the largest N possible that satisfies the requirement of the Ss not being aware of their involvement in a study and in addition, satisfies the requirement of the Ss having some previous experience with the presentation modes used in this research; and (3) the educational environment was controlled so that time, gain, and rate were accurately determined.

The population was stratified by sex and randomly assigned to seven groups of equal size. One of the seven groups was randomly assigned as a control group.

Content. The content used in this study is a three step program called Diagnostic, Formative, and Summative Evaluation. It is one program in a measurement unit that was taught in an individualized introductory education program.

Each program has four elements in its linear model; (1) question frames that are in short essay or multiple choice formats; (2) support frames that offer additional explanation for adjoining frames; (3) word summary frames with color cues; and (4) content that is presented in paragraph form. A program is introduced with a review of pre-test questions that are followed by frames that explain the answers. Content is presented in paragraph form at this point. The program concludes with a series of linear frames that review the new content. These linear frames are made up of the four elements previously discussed.

These materials are specifically designed to change student behaviors at the knowledge, comprehension and application levels of the cognitive domain. In addition to being described in terms of lower cognitive skills in Bloom's Taxonomy, these materials may be described as having low levels of abstraction, i.e. the material is easy to understand and has a practical rather than a theoretical orientation.

Instructional media. It was the intent in the preparation of material to take one compound-complex message and transmit that message through different communication channels and at the same time maintain message equivalency. Since the message characteristics required pictorial capability and color capability if equivalency across communication channels was to be maintained, media was chosen that would demonstrate each capability.

The media chosen for the task were the printed page and slide-tapes. Each contributes characteristics that allow communication in different channels and, at the same time, demonstrates both pictorial and color capability. In addition, both are being used extensively in self-instructional programs in general and specifically in teacher education programs.

The following three by three matrix may be helpful in conceptualizing the operational differences that a student must demonstrate if he is to master a message when using an instructional medium. The matrix is characterized by columns that represent content elements and the rows represent instructional media. The cells contain the student behaviors.

	CONTENT BY PARAGRAPH	FRAMES OF EXPLANATION	QUESTION FRAMES AND WORD SUMMARIES FRAME
PRINT	READ	READ	READ
SLIDE-TAPE	LISTEN	LISTEN	LISTEN & VIEW
COMBINATION	READ	LISTEN	READ

Each medium controls the manner in which the message is transmitted and, at the same time, does not alter the message. For example, one may only learn in a visual channel in the print medium; one learns primarily in an auditory channel in the slide-tape medium; and one may learn in both an auditory and a visual channel in the combination medium.

Collection of data. A modality choice questionnaire was administered to the subjects during the pre-treatment period. The subjects ranked the three presentation modes into first choice, second choice, and third choice.

The participants also responded to paper and pencil criterion tests made up of twenty, four and five alternative, multiple choice questions. These tests were designed to measure acquisition of information acquired as a result of the treatments.

Process design. A rotation design was used to process students through three experimental treatments. The design was made up of seven randomly assembled groups, one of which was randomly selected as a control. The six experimental groups were processed through the content in different choice sequences. This particular design was chosen for several reasons : First, protection was needed for the confounding effect of choice ordering. It may well be that students receiving first choices first will do better across modes than those students receiving first choices last. Secondly,

it may well be that the content accounts for any difference detected rather than choice; this needs analysis. And finally, protection was needed for the interaction of groups and content. The rotation design gives protection in each case and therefore gives the design maximum internal validity.

In presenting this rotation design, a uniform code and graphic presentation will be used to aid the reader. In reviewing the design one should note the sequences of treatments and observations that each group experiences and the duplication of design for both the control and treatment groups.

The design is as follows:

R_1	O_{C1}	O_D	$O_1X_{123F}O_1$	O_2X_{123S}	$O_3X_{123T}O_3$	O_{C2}----O_{123}
R_2	O_{C1}	O_D	$O_1X_{123F}O_1$	O_2X_{123T}	$O_3X_{123S}O_3$	O_{C2}----O_{123}
R_3	O_{C1}	O_D	$O_1X_{123S}O_1$	O_2X_{123F}	$O_3X_{123T}O_3$	O_{C2}----O_{123}
R_4	O_{C1}	O_D	$O_1X_{123S}O_1$	O_2X_{123T}	$O_3X_{123F}O_3$	O_{C2}----O_{123}
R_5	O_{C1}	O_D	$O_1X_{123T}O_1$	O_2X_{123F}	$O_3X_{123S}O_3$	O_{C2}----O_{123}
R_6	O_{C1}	O_D	O_1X_{123T} O_1	O_2X_{123S}	$O_3X_{123F}O_3$	O_{C2}----O_{123}
R_7	O_{C1}	O_D	O_1P_1 O_1	O_2 P_2	O_3 P_3	O_{C2}----O_{123}

CODE:

X_1 = reading mode

X_2 = slide-tape mode

X_3 = slide-tape-reading mode

X_{123F} = First choice

X_{123S} = Second choice

X_{123T} = Third choice

O = observation

R = random assignment

$P_1 = P_2 = P_3$ = placebo

---- = thirty day waiting period

Column A = diagnostic testing period

Column B = formative testing unit

Column C = summative testing unit

O_{C1} = pre choice

O_{C2} = post choice

O_D = Davis Reading Test

Statistical design. A two-way analysis of covariance with interaction adjusting for pre-test score was used to test the null hypothesis. The analysis of covariance matrix was a three by three design with columns designated as first, second, and third choice and row designations as reading, slide-tape, and slide-tape reading modes of instruction. An F-test was used for the purpose of analysis. A multiple comparison test was used to determine which population means fail to be significantly different. The alpha was set at .05 level.

Analysis of Data

Student choice of an instructional mode had a significant effect on rate during the first exposure to the content. These differences were significant by choice after adjusting for pre-test score (F = 0.0468, F ratio 3.047) in a design that compared each student with himself across modes. No significant differences were detected with the dependent variable total rate. The significant data is shown in Table I and Table II. The choice means across modes are graphically represented in Figure 1.

When a Duncan's Multiple Comparison Test was used to identify differences at the .05 alpha level, it was determined that first choice resulted in significantly higher first learning rates than either second or third choices.

The reader may note from Figure 2 that within channels, first choices generally had higher learning rates during the first exposure to content than either second or third choices.

An analysis of auditory subjects. Data presented in Figure 2 shows that first learning rate in choice one in the slide-tape mode is similar in quantity to third choice in the reading mode. When all the possible second and third choice alternative combinations of the fifty-three students who selected the auditory mode as choice one were examined and compared, it was found that the mean first choice first learning rates in the auditory mode were not different from the third choice mean first learning rates in the reading mode. In addition, Figure 3 indicates that fifteen of these students were clearly auditory in learning style, i.e. they performed significantly better in an auditory mode than in other communication modes. This would imply that even though the mean observations in the reading mode are higher across all students, sub-populations of auditory subjects who selected the auditory mode as first choice have higher learning rates in this auditory mode.

TABLE I

ANALYSIS OF COVARIANCE TABLE FOR FIRST LEARNING RATE BY STUDENT CHOICE WHEN ADJUSTED FOR PRE-TEST SCORE

Source	DF	Sum of Squares	MS	F	Prob. F
Mode	2	1.1079	0.55	14.66	0.0001
Choice	2	0.2302	0.11	3.04	0.0468
Mode *Choice	4	0.1574	0.03	1.04	0.03855
Pre-test (reg.)	1	5.2551	5.25	139.09	0.0001
Error	524	19.7975	0.71		
Total	533	26.2025	0.03		

TABLE II

ADJUSTED MEANS OF ANALYSIS OF COVARIANCE FOR FIRST LEARNING RATE BY STUDENT CHOICE WHEN ADJUSTED FOR PRE-TEST

First Choice	Second Choice	Third Choice
0.2698 (0.2647)*	0.2382 (0.2461)	0.2475 (0.2446)

* Significant at 0.0468 ( ) indicates adjusted means

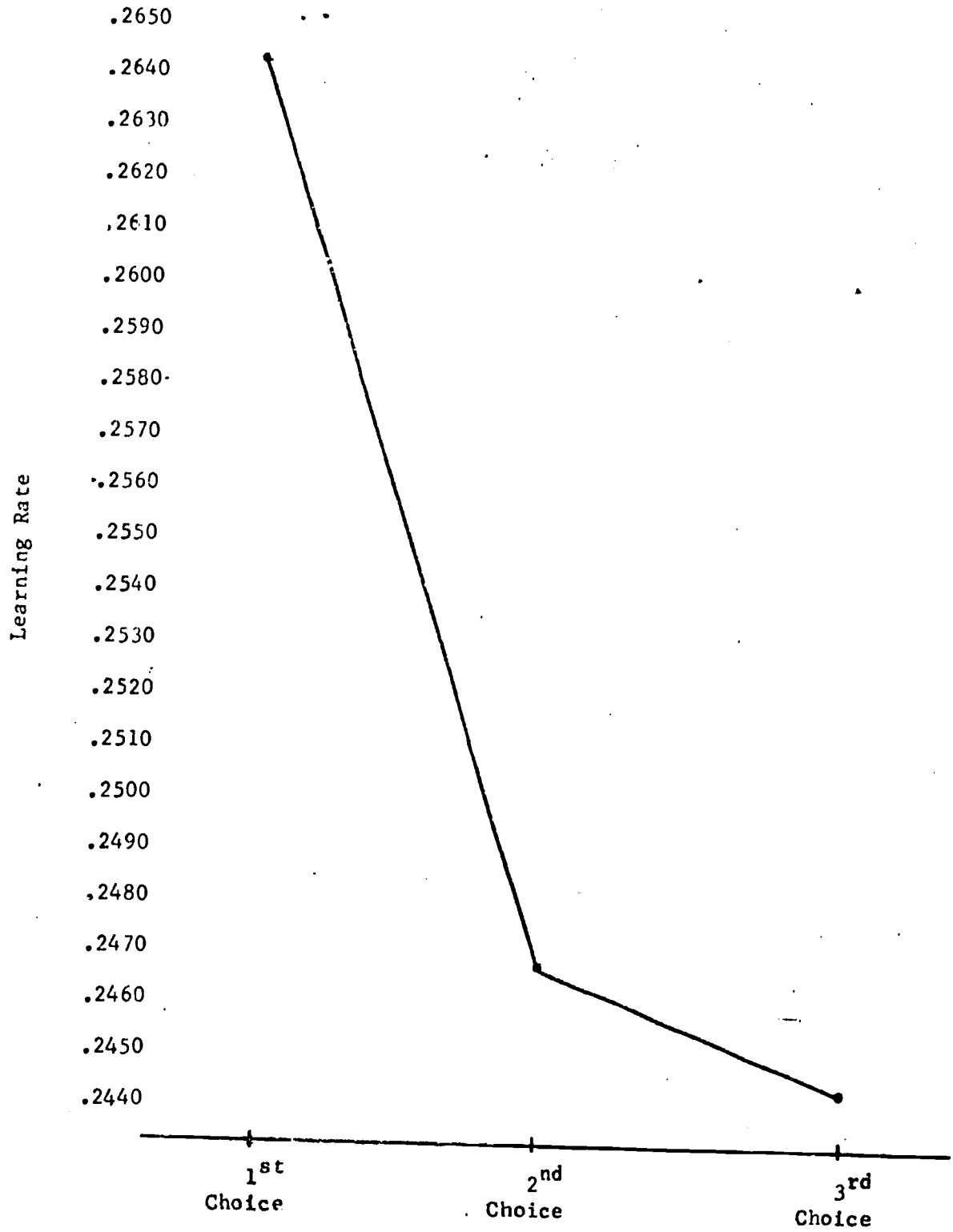

FIGURE I

FIRST LEARNING RATE ACROSS MODES BY CHOICE

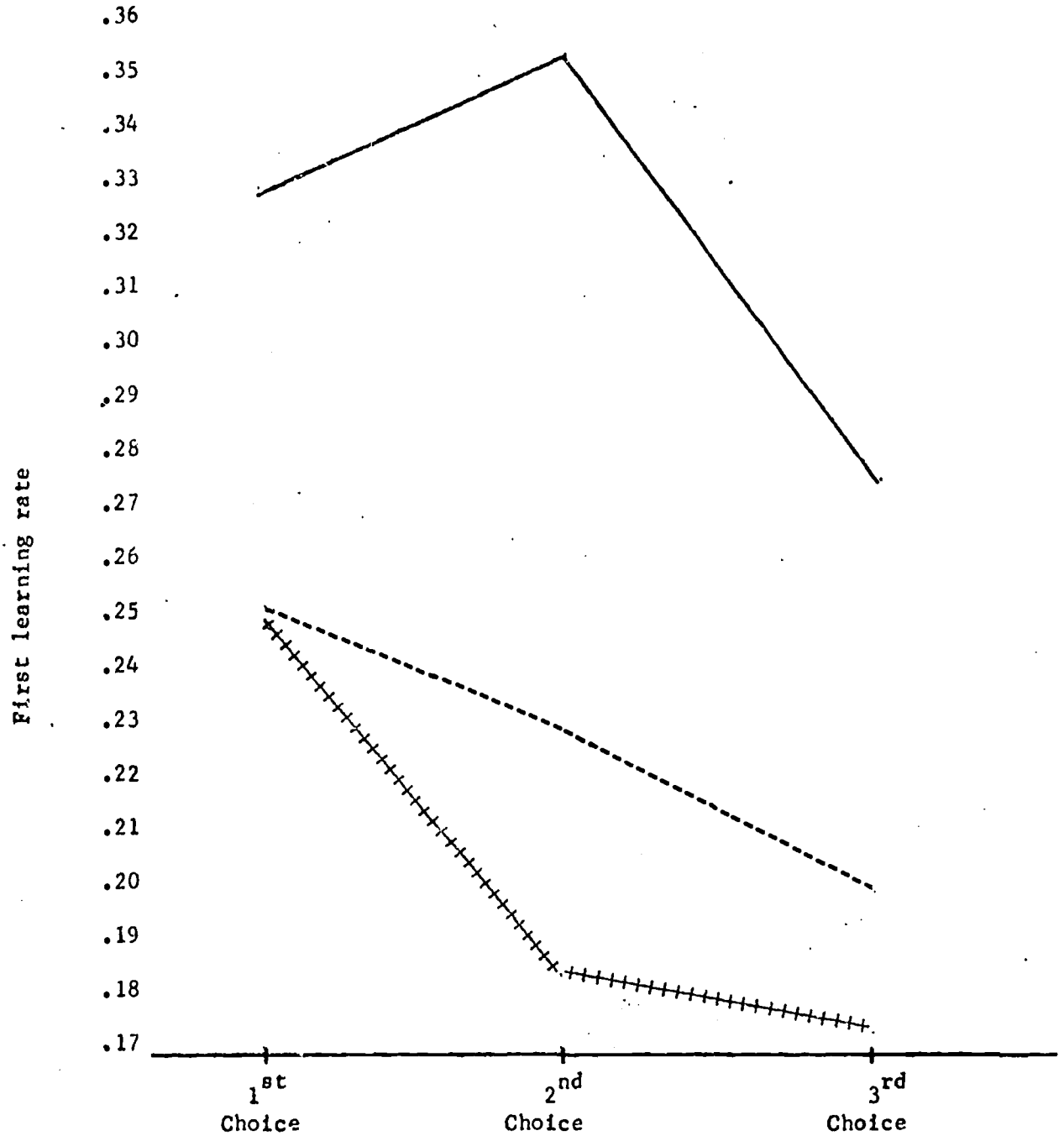

FIGURE 2

FIRST LEARNING RATES BY MODE BY CHOICE

——— = Reading mode
- - - = Slide-tape mode
+++ = Combination mode

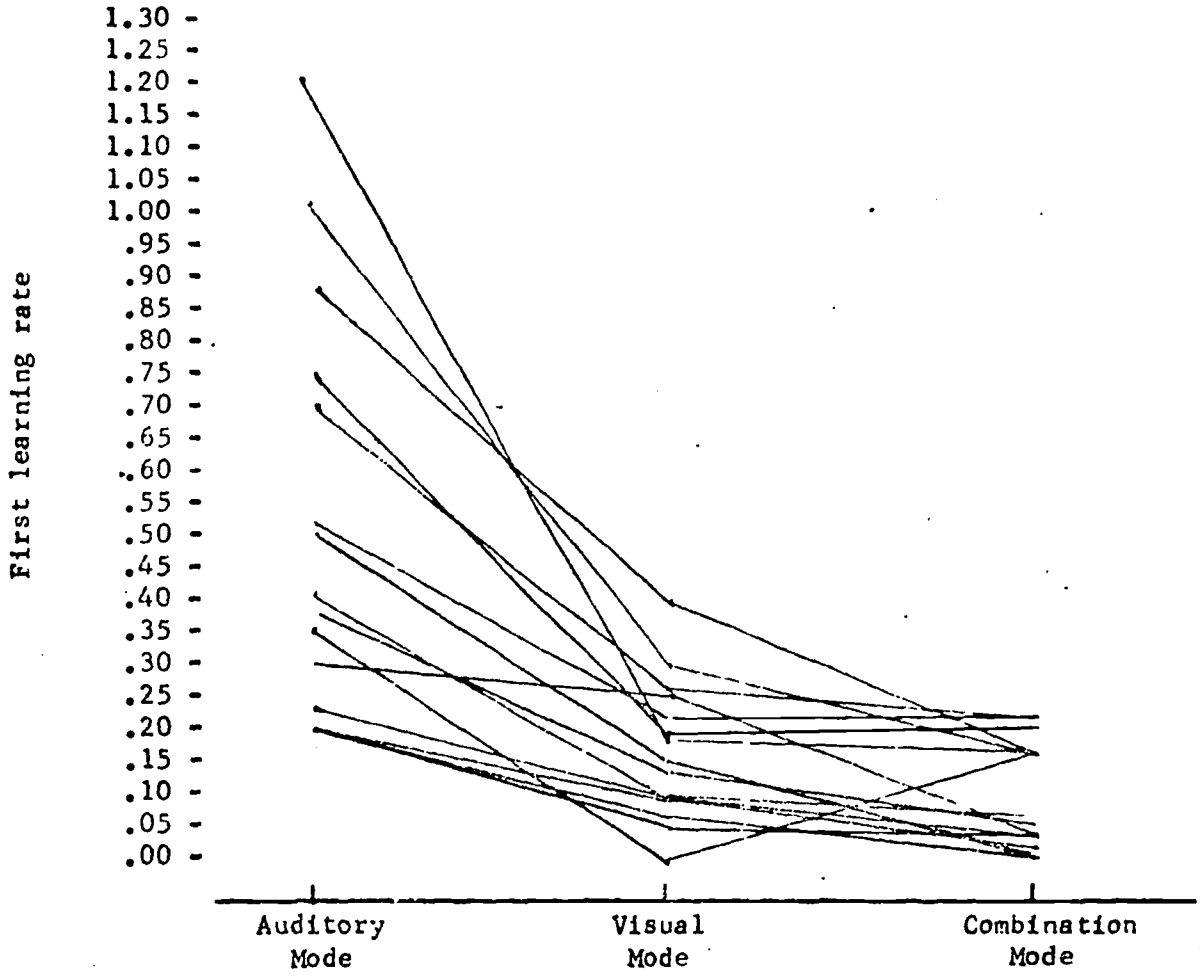

FIGURE 3

FIRST LEARNING RATES BY MODE OF FIFTEEN STUDENTS

WHO LEARN BEST IN AN AUDITORY CHANNEL

The influence of instructional mode on learning efficiency. These data were analyzed to determine if the differences reported are due to the influence of choice or to the influence of modality.

There were significant differences by mode after analysis of covariance with adjustment for pre-test score, for the dependent variables first time (P = 0.0001, F ratio 12.73), first rate (P = 0.0001, F ratio 14.26) and first gain (P = 0.0435, F ratio 3.12).

The analysis of covariance means are illustrated in Table III. The data shows that the reading mode is superior in terms of time and rate.

TABLE III

ADJUSTED MEANS OF ANALYSIS OF COVARIANCE FOR INSTRUCTIONAL MODE WHEN MEASURED BY LEARNING EFFICIENCY WITH PRE-TEST AS A COVARIANCE

Mode	First Gain	First Time	First Rate
Reading	6.7528 (6.8706)*	28.4438 (28.5846)***	.3023 (.3063)***
Slide-Tape	6.9326 (6.9442)*	35.8315 (35.8460)	.7331 (.2333)
Combination	6.5955 (6.4661)	33.5169 (33.3615)	.2199 (.2158)

* Significant at 0.0435

** Significant at 0.0013

*** Significant at 0.0001

( ) indicates adjusted means

When these data were analyzed with a Duncan's Multiple Comparison Test at .05 alpha, the reading mode was detected as having significantly greater learning efficiency when measured with the dependent variables time and rate. The Duncan identified the mean gain in the slide-tape presentation as greater than the mean gain in the combination presentation but not different from the reading mode.

Data in Table IV shows that first choice has fewer students in the mode with highest learning efficiency across students and more students in the mode with the lowest learning efficiency across students than either second choice or third choice. Therefore, choice and not mode account for the differences detected in this study.

TABLE IV

NUMBER OF STUDENTS IN EACH CELL BY CHOICE BY MODE

	First Choice	Second Choice	Third Choice	
Reading	31 (.3372)	48 (.3466)	99 (.2770)	178 (.3063)
Slide-tape	54 (.2449)	70 (.[illegible]1)	54 (.2249)	178 (.2334)
Combination	93 (.2518)	60 (.1875)	25 (.1589)	178 (.2156)
	178 (.2647)	178 (.2461)	178 (.2446)	

Choice ordering. Choice ordering was not significantly related to learning efficiency. The sequence first-second-third, first-third-second, second-third-first, second-first-third, third-first-second, and third-second-first were not significantly related to the dependent variables.

Results

The analysis of data resulted in the following conceptualized relationships between the variables choice and learning efficiency: (1) across modalities, students who were allowed to learn in channels of their choice have a significantly higher learning rate during the first exposure to content than when learning in modes not of their choice (P = 0.0468);

(2) within modes, first choices generally had higher learning rates during the first exposure to the content than second or third choices; (3) across all students, the linear program with illustrations reading mode was more efficient in terms of time and rate with the content used in this study than were the slide-tape and combination mode; (4) the order in which choices were experienced did not affect learning efficiency.

Discussion

In the past, practitioners who have attempted to look at learning efficiency in preferred modes in contrast with modes unlike that chosen have used criterion scores and in some cases gain as dependent variables. This study differed from previous studies in that rate was used as a dependent variable. One must keep in mind that if aptitude is a measure of learning time to reach criterion then time will vary and not the criterion score. Since rate, gain divided by time, will detect subtle changes in both gain and time then rate is more appropriate as a dependent variable in studies that deal with aptitude-treatment interactions. The findings of this study support this position.

In this study two measures of rate were calculated. The first rate variable represented both the gain calculated by subtracting the pre-test from the first post-test and the time a student spent interacting with the materials before the first post-test. This rate variable was identified as first rate.

Total rate represented the time and gain accumulated in the recycles after the first post-test added to the time and gain accumulated before the first post-test.

Differences by choice were detected at the .05 level for the first rate and not for total rate. The reason differences were not detected with the dependent variable total rate may be due to step size rather than channel preference. For example, if step size is optimal for a student then that student will master the material. If any step size is inappropriate for a student then that student will not master the material on his initial exposure nor on any later exposures. It would follow then that regardless of the number of times recycled or the preference for the communication mode, step size would have a limiting effect on additional gains and would tend to wash out differences that may have existed by choice when measured with the dependent variable total rate. This may account for the no difference finding.

It is the general conclusion that the results of this study give evidence in support of its assumptions and of its major contention.

In regard to the assumptions that a student has a preference for learning in one sensory imput channel and/or combinations of channels, this study is supportive with the results that indicate individuals differ in learning rate by channel and there is no one best channel and/or modality for all students. This conclusion also supports the mastery position that students need to be put into sensory contact with an instructional modality if learning efficiency is to be operationalized.

In regard to the second assumption that a student knows in which sensory channel he learns most efficiently, this study is supportive with results that indicate students have insight into their optimal channel preference and use this insight when making channel and/or modality selections.

A third assumption and major contention of this research is a logical extention of the first two. If a student has a preference for learning a sensory input channel and he knows in which sensory channel he learns most efficiently, then it would follow that putting that student into sensory contact with his selected modality would result in greater learning efficiency. In regard to this assumption, this study is supportive with data that clearly show that learning in a modality that a student perceives and selects as optimal results in significantly higher learning rates during the first exposure to the material than when learning in modes unlike his choice. This study did not detect rate differences by choice for total exposure to the content.

The implication of these findings is that in similar populations of students where aptitude as measured by reading scores and ACT scores are normally distributed, where the content is low in abstraction and at the knowledge and comprehension level in Bloom's Taxonomy, and where the modalities are auditory, visual, and a combination of auditory and visual, learning rate can be accelerated during the first exposure to content if institutions develop instructional programs that provide modality alternatives that allow students to select the alternative that enables them to learn most efficiently.

Recommendations

The following recommendation seems warranted in the light of the findings of this study. Since accelerating the rate at which people learn is highly desirable, it is recommended that institutions develop instructional programs that provide modality alternatives that consist of auditory, visual, and auditory-visual formats and allow students to choose the alternative that allows them to learn most efficiently.

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