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THE TEACHING MACHINE AS A STUDY AID AT THE COLLEGE LEVEL

by

John R. Cragun

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Psychology

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John R. Cragun

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INTRODUCTION

One of the most interesting and challenging problems to confront those interested in the learning process in recent years is the entire area of the self-instructional device, or "teaching machine." The idea of the teaching machine is not new, for Pressey (49) in 1926 wrote concerning a device he had developed, and at the same time indicated that he had had such a device in mind for "a number of years." After this introduction by Pressey, the teaching machine movement lay dormant for several years with only an occasional article written that had any direct relationship to this area. This was not to last indefinitely, however, because during the past ten years the interest has gradually been growing to the point that at the present time this movement demands consideration.

It is difficult to identify precisely why this has been the case, but a few reasons might be suggested. The demand on education is greater now than it has ever been before (47, 57): there are more people wanting education, there are more students receiving education, the percentage of school-age persons participating is increasing, and the teacher-pupil ratio is not remaining at a desirable level. To further intensify this problem, much more is being demanded from education in the general areas of curriculum and desired levels of competence. Since this presents the educational system with the obvious task of keeping abreast of these demands, the educator has been forced to search for more effective and efficient methods of instruction. Glaser (28) in his review suggests that the trend is toward closer cooperation and coordination of effort between "educational psychology" and the "science of learning." The

experimentalist and the learning theorist are working more closely together on training and learning problems than they ever have before. A final reason for this increased interest, according to Holland (31), is that in the past the interest has been largely on the device itself, but in recent years this has shifted to focus upon the fact that a person's behavior can be altered in situations outside of the laboratory by the application and utilization of certain psychological principles. These same principles can be incorporated in the teaching machine.

Not only is this movement intriguing, but it presents a great challenge, for there are a great number of problems, first to be identified, and second to be solved. From all indications this interest will not dissipate, but rather will become more universal with widespread implications for the student, the teacher, the administrator, the psychologist, and the parent (4, 18, 47). The implications are not confined to those associated with a school setting, for as Skinner (57) indicates there is additional application in home study, industrial training, military training, and special education of the exceptional individual. No doubt there are others but this will serve to illustrate the potentially wide-spread effects.

Statement of the Problem

The present interest in teaching machines is relatively new, and consequently the writing in this area has been largely speculative concerning problems, limitations, implications, and advantages.

There have been some studies designed to determine the effect of the machine in certain learning situations, or to investigate some of the other obvious problems. However, to a great extent these studies have, among other things, suffered from poor experimental control, control of

previous knowledge of the subject matter, designs inadequate to provide an analysis of the learner, equating of initial proficiency of experimental and control groups, control of motivation, and of the novelty effect or the time spent in study (9). Pressey (51) feels it important to design research to incorporate control and experimental groups in as normal a situation as possible. He suggests that large sections in certain college courses are ideal for such experimentations. It is impossible to control and measure all of these variables in any one study, but it is hoped that this study has been so designed as to control a good many of them.

Objectives

The overall objectives of this study are twofold: to determine the effectiveness of the machine as a study aid at the college level, and to determine, if possible, for whom the machine is best suited.

REVIEW OF LITERATURE

The primary objective of this review is to provide the reader with a basic understanding of the literature written on teaching machines. It is desirable at this point in teaching machine research that the interested person be provided with some idea of the entire scope, as opposed to a more restricted review that may very well be expected at such a time as the area matures and becomes somewhat better defined.

It has been suggested by Barlow (5) that the teaching machine method can be discussed under two headings: the machine itself, and the program to be put into the machine. This dichotomy is also supported by Carr (9) with the exception that he includes learner characteristics as being an important variable. In view of the nature of the existing literature this review will follow the suggestion of Barlow. This does not mean that the characteristics of the learner will be neglected, for these will be considered in connection with the other two. In addition to the basic sections on the machine and the program, there will be included a section on the relationship of machines and programming to the learning process and a section on the results of previous studies. The reader is informed at the outset that the lines separating these various subject areas are often very thin, and consequently, in some cases, there may appear to be some overlap.

Teaching Machines

Introduction

Technological advances in the field of education are falling into two general areas (18): technological growth as it pertains to group instruction, which includes devices such as television, radio, films, etc.; and technological growth as it pertains to individual instruction. It is within this latter category that the teaching machine is placed. In this regard, Barlow (4, p. 15) states "the central aim of this new medium of instruction is to duplicate functionally a person to person relationship in every possible way." Porter (45), in discussing the proper place of the teaching machine in relation to other devices, classifies all instructional devices into three categories.

1. Stimulus devices, which are designed to present information to the subject in one way or another. Falling into this category would be phonographs and braille, for example. Because of the nature of their purpose, they should be referred to as teaching aids.
2. Response devices, which are those devices such as typewriters and desk calculators which provide the subject with practice and activity. These devices, however, do not in and of themselves provide subject matter and, therefore, should also be referred to as teaching aids.
3. Stimulus-response devices, which may appropriately be referred to as teaching devices. They gain this distinction because they not only present information to the subject, but they require some response. In addition, in responding, the device generally takes into consideration the behavior of the subject. It requires no special attention from the teacher other than maintenance. Teaching machines, as we shall refer to them, fall into this category. Porter (45) further categorizes the

stimulus-response devices into: the simulator which requires, from time to time, some appropriate response from the learner, but provides no feedback; the immediate reinforcer which presents a problem and provides immediate knowledge of results after the response--this is learner paced; and the pacer which is machine paced in that after the problem has been presented, the machine--after a given period of time--provides feedback of the correct response even if the learner has not responded.

Another way in which teaching machines differ from some of the more conventional teaching aids such as books, blackboards, workbooks, flash-cards, etc., is that the machine enables the teacher to exercise more control over the learning situation (31, 47).

Characteristics common to all teaching devices

There are several different kinds of teaching devices, each having its own unique characteristics. Some of these devices will be considered later in the review. There are, however, certain characteristics that are common to all teaching devices. Three writers (12, 39, 47) indicate that teaching machines must meet the following qualifications:

1. Present certain information to the subject in the form of questions, exercises, etc. that will require a response on the part of the subject.
2. The student is required to make some response to the subject information presented, and the machine must provide the facilities necessary for the response.
3. The machine must provide immediate feedback (knowledge of results) to the student concerning the correctness of his response.

Lumsdaine (39) adds the additional point that the machine must allow the student to move through the material at his own rate of speed.

In another approach to the common characteristics of teaching

devices, Carr (9) lists as being common, display or input characteristics, response or output characteristics, and reinforcement characteristics. Silberman (56), using the same approach as Carr, lists four common characteristics.

1. The output unit which is concerned with the presentation of information to the student--this includes the presentation of the correct answer to the student as well as the initial presentation of the problem to be solved.

2. The input unit which is designed to provide a means by which the student can place his response into the machine.

3. The storage unit which is designed to provide storage for the information in the machine.

4. The control unit which decides specifically what the machine will do under various situations--this includes such things as space, sequence order, and amount of information.

Silberman (56) also makes the point that the complexity of the machine depends to a large extent upon the goal or objectives for which the machine has been designed.

Specific teaching machines

Present teaching machine methods center around either the method of Sidney L. Pressey or the method of B. F. Skinner. This division is referred to by writers (18, 22) as the Skinner-Pressey dichotomy. This dichotomy will be discussed in more detail in the section on programming, but it is significant at this point to mention the basic disagreement between Pressey and Skinner as it relates to the machine itself.

Pressey's device (9, 22, 39, 49, 56, 57) presents multiple choice questions to the subject. Upon reading a question the student pushes the button that corresponds to the alternative selected. If correct, the

student moves to the next item, but if incorrect, he must continue to respond until he selects the correct answer.

Skinner's device (5, 31, 39, 56, 57) also presents questions to the student, but it is important in this case that the machine be designed to allow the student to construct his own response. After constructing his answer, the student is then allowed to compare his answer with the programmed answer within the machine.

The basic difference then, is that in Pressey's method the student selects his response from a set of alternatives, and in Skinner's method the student must construct his response. Though present day teaching machines each have their unique characteristics, they all are essentially designed to employ one or the other of these methods. The fact that there is a difference in methods suggests an obvious question (39) as to which device is best, the device allowing for multiple choice items, or the device allowing for student construction of his answer. There is a wide divergence of opinion in this regard. It perhaps should be mentioned at this point, lest there be some misunderstanding, that there are several features common to both methods (57). Both feel that the student should play an active role in the learning process, that the machine should provide feedback, and that the student should be allowed by the machine to move at his own rate of speed.

In reviewing the different kinds of devices, this writer has split them on the basis of the two previously mentioned teaching machine methods.

Devices providing for multiple choice responses.--Pressey (49) describes a device about the size of a small typewriter in which is placed a program consisting of multiple choice items. As the subject reads the question he indicates his response by pushing one of four keys. If

correct, a new question appears in the window, if incorrect, the subject must continue to make his selections until the correct choice is made. The device may be transformed into a testing machine by manipulating a lever on the back of the machine; however, in so doing the subject receives no knowledge of results. In both cases, however, a record of errors made is kept by the machine. This machine is the basic Pressey machine to which the literature makes extensive reference (9, 39, 49, 56, 57).

Two years later Pressey (48) describes a modification in his earlier machine in which an item may be eliminated by the machine, after the subject gives the correct answer twice in succession.

Several investigators (2, 7, 19, 52) have reported using a punch-board device designed to provide knowledge of results to multiple choice items. Briggs (7) refers to this as a "pocket tutor." This is a relatively small device, about three by five inches. The device has a face and a back cover with sufficient room between them to place a key indicating correct and incorrect answers. On the face cover are several rows of four holes each. The subject is provided with a list of multiple-choice questions, and to each of the questions he indicates his response by placing a pencil in the appropriate hole. In most cases, a plain sheet of paper is placed between the key and the face cover of the device to prevent obtaining a cue to the correct answer by looking at the key. With Briggs' (7) device, the correct answer is indicated when the pencil does not penetrate the paper covering the key. If an answer is wrong, the pencil point will penetrate the paper, thus providing an accurate record of the number of errors made. In Pressey's punchboard device (52), the correct answer is indicated by the pencil making a deep penetration through the paper into a hole in the answer key. If the response is

incorrect, the pencil point barely breaks the surface of the key covering the sheet of paper. Not all punchboard devices, however, utilize the Briggs and Pressey methods of indicating the correctness of a response. Freeman (19) reports using a punchboard device employing an electrical stylus. When the stylus is touched to the key, a pen light would glow indicating the correctness of the response.

Holland (31) describes two devices employing the multiple choice method. One is a relatively elementary machine that is to be used with pre-school children; in this case the subject is to select the appropriate answer from three alternatives. The other device described by Holland (31) is used with lower organisms such as the pigeon. The pigeon selects the proper name plate for a given color with food serving as reinforcement. In humans, knowledge of results usually is sufficient reinforcement.

Keislar (36) used an adaptation of the Film Rater used by the Navy. Items were presented on a viewing plate utilizing a "Kodachrome strip-film" to which the subject responded by pressing one of five buttons. If correct, a green light would flash and the subject would advance to the next item; however, if incorrect, a red light would flash and the subject would be required to make additional responses until he made the correct selection.

Devices providing for constructed responses.--The Skinner machine, to which much attention is given in the literature (5, 31, 39, 56, 57), also presents a series of questions one at a time. As the student reads a question, he constructs, by writing, his response in the space provided to the right of the question. After answering the question, he works the machine and his response moves under a transparent cover to prevent any correction or change in the constructed answer. At the same time,

the correct answer appears allowing the student to compare his response with the correct answer. If the two answers are comparable, the student works the machine in such a way that the item will not be presented again, and the next question appears. When an answer is wrong, the question remains in the machine, and is presented after all of the remaining items are presented. This process continues until the student responds correctly to all of the items. If the student works the machine to indicate a correct answer, the machine punches a hole along side the response to indicate which response the student felt compared favorably with the correct answer.

Skinner (57) and Holland (31) describe a device which requires the student to construct his response by manipulating sliders that have printed numbers or letters on them. If the answer is correct after it has been constructed by manipulation of the sliders, the student is allowed to progress to the next item. If incorrect, the student must start again until such time as the correct answer is given.

Porter (46) used a machine that presented a question in the upper of two existing windows. The student reads the question, and then in the lower window constructs his response. Upon working the handle of the machine, the answer moves into the upper window and the correct answer is revealed in the lower window thus allowing the student to compare his response with the correct answer. The machine continues to feed the program past the two windows in this sequence until finished.

Rath, Anderson, and Brainerd (54) describes the use of a general purpose digital computer, the IBM 650, in a role of simulating teaching machines. The student responded by typing the answer into the machine. The machine provided for individual differences in that it could go back and repeat material, or the machine could skip material, depending upon

the student's previous responses.

In presenting the various kinds of teaching machines no effort was made to cover all the devices previously developed, or that presently are in the process of development. Such would be beyond the scope of this brief review. An attempt has been made, however, to illustrate to the reader the unique characteristics presented in various devices. Several writers (1, 8, 39, 48, 50) have written concerning different devices and it is suggested that the interested person review these sources. An excellent review of the existing devices, as presented by Fry, Bryan, and Rigney (20), is recommended to the reader. In this review the authors present a summary of existing devices (20, pp. 12-17), in addition to a bibliography, with brief descriptions of commercially developed teaching machines (20, pp. 75-79).

Additional self-instructional devices

Two non-mechanical self-instruction devices which have received consideration in relationship to teaching machines are the "Programmed Textbook" (23, 34, 39) and the "Scrambled Textbook" or "TutorText" (14, 15).

The programmed textbook is described by Glaser, Homme, and Evans as follows:

The programmed textbook is simply and easily described. Its external appearance will not differ from an ordinary textbook, but its interior is quite different. Each page consists usually of four or five panels. The sequence in which the panels are to be responded to is not from the top of the page to the bottom as in a conventional textbook; but only one panel is "read" or responded to before the student turns the page. The student begins with the top panel on page 1, i.e., Step 1; he responds to it, turns to page two to get his answer confirmed on the top panel, then goes to the top panel of page three for Step 2. He responds to it, confirms his answer by turning the page, and so on, to the end of the unit or chapter where he is instructed to return to page 1 and respond to the second panel on each page and so on to the end of the chapter. Since each panel is numbered, no confusion results in this procedure. (28, pp. 2-3)

Homme and Glaser (34) point out that the main difference between the programmed textbook and a machine is that the book does not prohibit cheating. In this connection they indicate that it is not known how harmful cheating is to the learning process; and as techniques of programming become perfected and refined, it may be that cheating will not be a problem. Lumsdaine (39, p. 171) supports this by posing the question of how important is it to make a device cheat-proof.

The Scrambled Textbook, or TutorText, is designed to do automatic tutoring by utilizing a method known as "intrinsic programming." Not all devices utilizing intrinsic programming are non-mechanical, however, for Crowder (14) refers to an elaborate mechanical device called "The Tutor." The Scrambled Textbook, or TutorText is the simplest form of all of the devices utilizing this concept. Crowder describes automatic tutoring as follows:

"Automatic tutoring" is an individually-used, instructorless method of teaching which represents an automation of the classical process of individual tutoring. The student is given the material to be learned in small logical units (usually a paragraph or less in length) and is tested on each unit immediately. The test result is used automatically to control the material that the student sees next. If the student passes the test question he is automatically given the next unit of information and the next question. If he fails the test question, the preceding unit of information is reviewed, the nature of his error is explained to him, and he is retested. The test questions are multiple-choice questions and there is a separate set of correctional materials for each wrong answer that is included in the multiple choice alternative. (14, p. 1)

Throughout the literature reference is made to problem areas that require additional research, and at this point it seems appropriate to suggest a few problems related to the machine that should be considered. Skinner (59) poses three questions:

1. To what extent does the use of mechanical devices lower the level of the student to that of an animal.

2. To what extent will this form of automation bring about technological unemployment.

3. Will the cost of these devices be too great?

Pressey (51) cautions against letting the machine serve a role of replacement rather than the role of an addition to the teaching process. Another factor (58) to consider is the physical aspects of the machines, the size and dimensions of frames, sets, etc. Other factors (57) include the relationship of the machine to other devices such as workbooks or self-scoring test forms, the effect of the machine upon the teachers role, and what are the implications of the machine upon individual differences?

Programming

Importance of programming

As was mentioned previously, the two major factors in the teaching machine process are the device itself and the program. Of these two, the program is the most important (16, 29, 33, 34, 38, 47). One of the real problems, explaining why teaching machines have not been used more universally, is not because there is an inadequate supply of machines, or that they are poorly designed, but rather because there is an insufficient supply of adequate programs to use in the machine (33, 38, 47). Homme and Glaser (33) suggest that not only do teachers lack adequate programs for their specific courses, but rules of programming sufficiently helpful to enable teachers to construct their own do not exist. Porter (47) feels that the design of the device is fairly well along, but that the problem of programming will remain indefinitely.

The importance of the program in relation to the machine is further emphasized by certain writers (16, 29, 34) who raise the question as to how important the machine really is in view of the fact that the emphasis

is placed on the program, and that the principles of programming, with or without the machine, are essentially the same. Those posing this question are the advocates of the programmed textbook.

Homme and Glaser (33) feel that an investigation into programming and its related psychological concepts is important because the additional development of programming techniques should serve to stimulate research, as well as perhaps causing a change in the research problems encountered.

Problems in programming

The programming problems facing investigators are numerous and challenging. Several have written concerning these problems (4, 9, 24, 29, 39, 58, 61). Galanter presents several of the existing problems, most of which pertain to programming:

1. The programming problem--what is the correct order of presentation of material?
2. The error rate problem--is there an optimum number of errors that should be made?
3. The step size problem--How far apart (in some sense) should adjacent items of the program be spaced?
4. The prompting problem--should prompts be used, and if so how and what kind?
5. The constructive vs. multiple choice response problems.
6. The pacing problem--experimenter-controlled rate vs. self-pacing.
7. The multiple track problem--is one program satisfactory for all students?
8. The economic problem--how much is additional education worth?
9. The generalization or testing problem--how do you know that the student has learned? (24, p. 3)

Each of these problem areas posed by Galanter could be elaborated on in more detail. However, this will not be attempted in this review. The significant point is that numerous problems, of which investigators are aware, do exist. If the reader is interested in this area he may refer to references provided. Those problems that have been investigated will be reviewed in later sections.

Programming methods

In all of the research on programming techniques there does not appear to be any one proven method of program construction. Several have written concerning the problem of programming methods, some considering concepts essential to effective programming (33, 38, 60), some concerning specific types of programming methods (3, 33, 47, 60) and another concerning means for identifying different programs (6).

Lumsdaine (38) feels that the first thing to do in programming is "to define the field." This simply means to specify in some detail the exact objectives, what behavioral pattern is desired to result from the machine procedures, etc. Smith (60) lists eight principles which should be considered in program construction:

1. Defining the objective in terms of desired behavior
2. Determining the steps to be used in developing the desired behavior
3. The introduction of the concept
4. The "web of learning," or tying the new to the old
5. The use of prompts
6. The application of vanishing, or cue reduction
7. The summation which integrates the concepts into a whole
8. The presentation of a review

Smith (60) has observed that programmers tend to be of the classical introvertive type, and he therefore suggests that selection of program writers might be aided by utilizing some measure of extroversion-introversion.

Porter describes the programming techniques that have been followed at Harvard. The steps are:

1. The content to be taught is broken down into a large number of small steps.

2. Successive steps in the lesson are "prompted" by preceding items or by hints provided explicitly for that purpose.
3. Prompts and hints are gradually "vanished" or removed so that by the time a student has completed a lesson he is "on his own." (47, p. 4)

The general procedure that Homme and Glaser (33) feel to be successful in programming is that the programmer first constructs the program completely so that it teaches the subject matter intended. After this has been done the remaining steps are all centered around refining the program: shortening the program without losing effectiveness; adapting it for different groups of people--age, mental capacity, etc.; increasing the effectiveness of reinforcement; etc.

Homme and Glaser feel that a desirable method to use in programming is the "rule programming system." This system is essentially that of first presenting a rule or principle, and then illustrating this principle through the presentation of several examples.

Another method of programming referred to by Barlow (3) is "Conversational Chaining" or "Conversational Programming." In describing conversational chaining Barlow states:

In building up a response chain we bring the S's behavior under the control of a discriminative stimulus (required prior to a reinforced response). We then find that we can reinforce a new response by making the presentation of the S^D contingent upon the emission of this second response. The second response may then, in turn, be brought under the control of a further S^D and the process thus extended. Within the chain each S^D after the first in the chain also functions as an S^R and each S^R is also an S^D . This is not at all analogous to a self-instruction program consisting of sequential but discrete question answer pairs. This reflection on chaining was the initial basis for Conversational Programming.

In "Conversational Programming" the comparison answer selected by the programmer to some extent serves as both an S^R and an S^D . (3, pp. 1-2)

Barlow (3) contrasts Conversational Programming with the more common method of developing programs which usually follow the pattern of response

"chaining." Response chaining is simply a chain of stimulus-response sequences, as opposed to the conversational chaining which has as an objective the integration of information. Barlow comments in support of conversational chaining that it is unfortunate that response chaining retains the flavor of the conventional test which presents an answer and requires an appropriate response. He feels that Conversational Chaining in programs is valuable in that the student actually becomes involved as part of the entire lesson, as opposed to becoming involved simply on an item to item basis.

Beck (6) suggests that one way in which different programs can be compared is by identifying their essential features. These features can be identified by utilizing what he calls teaching rules.

Teaching rules describe the way a student's responses are controlled. They can differ in the degree to which they restrict behavior, the way in which they restrict behavior, whether they involve stimuli in addition to the discriminative stimuli which set the occasion for the response and whether they are explicit or implicit. (6, p. 56)

Schutz (55) provides a classification system for programmed items.

He feels that items fall into one of the following categories:

1. Lead-in items, which are neutral items designed to introduce the student to the area.
2. Augmenting items, which supply new information but do not require a response on the part of the student.
3. Review items, which are designed to review previous content-- these can emphasize rote review, restated review, or delayed review.
4. Fading or vanishing items, which are designed to reduce the number of cues presented.
5. Specifying items, which are designed to present specific examples in support of a general concept.

6. Generalizing items, which are designed to summarize common content of several previously presented items.

7. Dovetailing items, which require separate responses to separable stimuli that possibly might be confusing.

From the preceding discussion, it is obvious that there is no concept of programming that is universally followed. This is an area, however, that is receiving increased attention, although much of the attention is pointed at exploring the specific problems encountered as opposed to a general overall method of program development. This has merit, however, for after the factors have once been explored it will be possible to more consistently give consideration to the essentials in good program construction.

Factors in programming

One of the greatest controversies in programming stems from the methods of Pressey and Skinner. This difference was referred to in an earlier part of the paper as it related to the machine itself. The differences existing between the two approaches will again be treated in this section, but the discussion will be designed to explore them as they apply to factors in programming.

In Pressey's original device (9, 22, 39, 49, 56, 57) the program consisted of multiple choice items with the student being required to select the correct response from four alternatives given. There was no provision made for a constructed response. In addition, the items were not arranged in any special sequence. Recently, the Pressey method has received a great deal of criticism, essentially from Skinner (57). Skinner's approach (9, 22, 55, 57), calls for the items to be of a short-answer nature which requires the student to construct his answer. The items must be presented in a logical sequence with only small steps

of difficulty separating items. Those using constructed items in preference to multiple choice items do so, according to Schutz (55), because in most cases recall is more important than recognition and wrong alternatives in the multiple choice items tend to be learned. Skinner (57) suggests that when selecting the correct answer from alternatives, the person actually is selecting his answer from several possible wrong answers, which could have the effect of strengthening certain undesirable characteristics. It is important to present the items in a well designed sequence of steps, progressing gradually from the elementary to complete subject mastery, because it is vital that the student is almost always correct (57). Porter (47, p. 4) states that "through these techniques almost all wrong responses are eliminated (in a perfect program a student would make no errors at all), which makes it unnecessary to unlearn incorrect responses at a later time--a notoriously inefficient process." In considering the problem that material might be too easy, Skinner (57) leans toward making the material too easy rather than too hard, especially if the students can remain motivated by other means in working through the program.

Pressey (51) raises the question as to the necessity of always programming the material in short-easy steps, for with some individuals it is possible to skip certain steps. He suggests also that investigation be conducted to determine the value of no errors, for it is possible that in some cases errors facilitate the learning process. For a more complete consideration of the Skinner-Pressey Dichotomy the reader is referred to Fry's article (22).

Pressey is not the only investigator to disagree with Skinner. Homme and Glaser (33) indicate that "the size of the step," which has been emphasized a great deal, is no longer of concern in the same way.

Previously the concern was how many steps are required to develop a concept, but the question now is how often should extensive variations occur in the examples used to illustrate certain concepts, and also how many examples are required to insure sufficient treatment of the principle.

A different approach than either Skinner or Pressey presents is discussed by Crowder (14, 15, 17) in relation to his concept of automatic tutoring by intrinsic programming. The reader will recall that, through intrinsic programming, the material the student receives is dependent upon what response was given immediately preceding. Skinner emphasized the closeness of the stimulus and the response in order to minimize errors, but Crowder's approach is different in that he feels the program and communication should be controlled by the feedback. That is, the response the student makes simply tells whether the communication of the programmed material to the student has been successful, and in so doing also indicates what information should be presented next. Crowder feels that if the response is incorrect the problem is not corrected by simply telling the student he is wrong. The real issue involved is why the student didn't get the right answer--where is the communication failing? Through intrinsic programming it is possible to go back and once again begin the communication process on the basis of the error made.

Relationship of the Teaching Machine Method with the Learning Process

Principles facilitating learning

Several have written (11, 31, 40, 52, 53) concerning the advantages of the machine, and for the most part these can be related to some way in which the machine facilitates learning. Characteristic of these advantages are those presented and summarized by Corrigan:

1. Quality control of the subject material presented.

2. Continuous student activity by providing a closed loop between the student and the "instructor" for each step in the learning process.
3. Immediate correction of errors thereby removing the possibility of misunderstandings that would impede a student's progress.
4. Pacing of material to be presented consistent with an individual student's learning capabilities.
5. Standardization of levels of achievement specified for each student.
6. A significant bonus in time for the teacher which can be applied to individual instruction and direction, the true professional role of the teacher.
7. Continuous testing of the student's progress instead of widely spaced examinations. (11, p. 29)

Carr in his review rephrases some principles essential to learning previously summarized by Skinner (59) and Gilbert (27):

1. Learning takes place most rapidly if the student is actively engaged with the subject matter....
2. Learning is most effective if the student develops the skills and knowledge in a form which will readily generalize to the "real life" situation for which they are intended....
3. Learning takes place most rapidly if immediate "knowledge of results" is given for each response....
4. Learning takes place most rapidly if the subject matter is organized in a hierarchic form....
5. Receiving frequent "knowledge of results" keeps students working at the assigned task....
6. Since learning takes place in individuals, the learning situation should be designed so that each student may proceed at his own pace.... (9, pp. 2-4)

Perhaps the learning principle that has received the most consideration by all writers is that of immediate reinforcement through feedback (1, 14, 25, 28, 30, 47, 53, 57, 59). Skinner (59) indicates that through immediate reinforcement an organism's behavior can be shaped quite readily. Not only is it possible to shape an organism's behavior, but it is possible to maintain this behavior at given strengths for some time. In relating reinforcement to the school situation, Skinner feels that the most serious criticism of the classroom is inadequate reinforcement in the learning process, and that one way in which this can be overcome is through the use of mechanical or electrical devices. Porter (47) supports

Skinner in his feelings that reinforcement in the classroom is far from perfect, and that the machine can appropriately be used to relieve the situation. In addition, Porter (47, p. 2) gives three conditions which must be met in order for reinforcement to be effective:

"1. Reinforcement must take place immediately after a response has been made....

2. The reinforcement must be made precisely contingent upon performance of the behavior that is being taught....

3. A sufficient number of reinforcements must be given."

An interesting and important application of feedback is its relationship to the programmer. Through feedback the programmer is constantly provided with a knowledge of the effectiveness of his program (5, 28, 32, 57). This places the programmer at a distinct advantage in that he is able to make modifications in technique and approach in order to make his instruction and presentation more effective. Such is not possible with the lecturer, the textbook author, or the film producer.

There are certain characteristics of the learning situation that seem essential to the Skinner approach (4, 5). Barlow lists four features:

1. The student is active as he studies. He interacts regularly with the instructor-programmer through the medium of the teaching machine.
2. The student is provided immediate confirmation of the correctness of each of his answers immediately after the answer is made.
3. Each student works at his own preferred rate of speed and at times (within limits) of his own choosing.
4. The instructor is provided a complete record of each student's "homework." (5, p. 1)

Much has been said in the literature about the importance of reinforcement in the learning process. Pressey (51) however, suggests that consideration should be given to the problems of recall (immediate and delayed) and transfer. Kendler (37) also indicates that he feels the

problem of transfer of training has been sadly neglected.

The teaching machine as a tutor

Barlow (4) and Skinner (57) both cite reasons why the machine can be compared to a private tutor. Skinner's reasons include:

1. There is a constant interchange between the student and the program.
2. The machine requires a certain item to be answered correctly before moving on.
3. It helps the student respond correctly by presenting items that have been carefully programmed to provide hints, prompts, and a step size that is not too difficult.
4. The machine reinforces every correct response through the process of immediate feedback.

Coulson (13) emphasizes that present teaching machines cannot be compared to the private tutor mainly because they do not possess the flexibility that is found in the private tutor. He does not feel that it is impossible to design a device which would possess the characteristics of flexibility found in a private tutor, but he feels that there are certainly many problems to be solved first.

Related concepts

In a previous section of this review the point was made that one of the advantages of the teaching machine was that it provided the teacher with more control over the learning situation. Beck lists four factors in the teaching process which he feels must be controlled in order to state that the learning situation has been controlled. The criteria he lists are:

- (1) a discriminative stimulus which sets the occasion for the desired response, (2) the response which it is desired an individual acquire, (3) a rule or rules--explicit or implicit,

with or without additional stimuli--that guide the student's responses, (4) reinforcement of the correct response. (6, p. 57)

In an extensive paper, Gagne and Bolles (23) give consideration to the factors in the learning situation that can be altered to facilitate greater learning efficiency. They divide the factors into two general classifications, readiness factors and associative factors. Readiness factors are those that relate to preparing the subject for learning, and associative factors are those which relate to the association of various stimuli with the resulting responses. Under the general classification of readiness factors the authors give consideration to important factors such as motivation (intrinsic vs. extrinsic motivation and levels of aspiration), reinforcement, set, and attention (intent to learn). Under the general classification of associative factors are included the nature of associations (stimulus similarity, response similarity, and similarity in serial tasks), intra-trial factors (number of stimuli, number of responses, and meaningfulness), inter-trial factors (massed or distributed practice, and task scheduling).

Zeaman (62) in discussing the problem of which learning theory exists in the teaching machine process indicates that there are three involved:

1. Free operant
2. Controlled operant
3. Classical conditioning

He feels that the controlled operant is the most appropriate and applicable, followed by classical conditioning and the last, the free operant. He suggests that he is different in philosophy than Skinner because the latter emphasizes free operant learning.

Results of Previous Studies

In this section no special effort will be made to identify the results of previous studies with the specific device used. Most of the research designs called for a different device and because of the limited number of studies it is impossible to make any comparison between the results obtained when various devices were used. The reader should keep in mind, however, that the basic method in all cases is similar. That is, a problem is presented, the student responds, and then immediately receives a knowledge of results. Five areas in which results have been obtained will serve as the basis for discussion: achievement gains and variability, programming, applicability for special groups, attitudes and interest of the student, and program revision.

Achievement gains and variability

According to Evans, Glaser, and Homme (16), one of the two categories into which studies of the teaching machine process can be divided is a comparison of the effectiveness of the teaching machine method with the more conventional methods of subject matter presentation. This almost always takes the form of a comparison between the gains of an experimental group, which receives training of the teaching device, and a control group, which receives no special training.

There are several studies that indicate that gains are significantly greater, or tend to be greater, by subjects using teaching devices than subjects used as a control group (2, 12, 29, 36, 41, 46, 52). One study (19), consisting of two phases to the experiment, found that one phase showed the experimental group making greater gains, while in the other phase there was no difference.

Keislar (36) used a control and an experimental group, fourteen

subjects in each group, to determine the effectiveness of the machine in teaching an understanding of rectangles. Multiple-choice items were used and the two groups were matched according to intelligence, sex, reading ability, and a pre-test (essay type). After the experimental group operated the machines on successive days for two or three periods each day a post-test was given to both groups. The total time spent on the machines ranged from one hour and thirty minutes to slightly over two hours. The results indicated that the experimental group made significantly greater gains than did the control group. It should be noted that the N in this case is quite small and also that the control received no training at all.

Angell (2) reports a study designed to determine the effect of immediate and delayed knowledge of quiz results in freshman chemistry. An experimental and a control group were given three mid-term quizzes at the same time and place. The experimental group used a punchboard device to provide immediate knowledge of results. The control group did not learn of their performance until the following day, at which time both groups participated in a detailed discussion of the tests. At the end of the course a final examination covering the material in the course was given to both groups. The results showed that the experimental group made significantly greater gains than did the control group.

In a study reported by Porter (46) in which the purpose was to determine the effectiveness of the machine in teaching spelling, it was found that the experimental group performed significantly better than the control group. The subjects in this case were second and sixth grade elementary school children. In addition to the gains made by the control group it was found that there was no relationship, in either group, of sex or attitude toward instructional method and achievement. Porter (46)

compared first half scores with second half scores and found no significant difference. This may give some indication that the novelty of the teaching machine is not a factor in the amount of gain made.

Coulson and Silberman (12) report a study in which eighty junior college students, acting as an experimental group, were given training in psychology with manually controlled teaching machines. Prior to the training sessions, a psychology pre-test was administered to both the experimental and control groups--both groups came from the same school classes, but the control did not receive special training. After the training sessions, a criterion test was administered to all subjects and then again three weeks later. The results showed the experimental group making significantly greater gains than the control. The second administration of the criterion test did not yield any differences from the results obtained with the first criterion test. Analysis of covariance was used when necessary to adjust the final scores on the basis of pre-test differences.

In studies designed to evaluate the effectiveness of a programmed textbook (verbal learning sequence) presentation with a conventional textbook presentation of the same material (16, 29, 34), it was found that the experimental group using the programmed text made significantly higher mean achievement scores. In addition, the authors report that the scores exhibited less variability.

Pressey (52) found that students using punchboards in taking a series of self-instructional tests throughout the quarter did substantially better than those not using the teaching device. Pressey feels that the self-instructional tests must be used systematically and be made an integral part of the teaching method, for those that did not use the device systematically did not make nearly as much gain. Pressey also

found that upon repetition of a test, the errors made by the group using the teaching device are less than the errors made by those not using the device. Learning of meaningful material is facilitated by the use of the device. One other factor Pressey found is that the range of scores of those using the teaching device was greater than the range of those not using the device. This latter finding is in contradiction to findings previously reviewed (29). It should be noted, however, that the measure of variability apparently used by Pressey is the range, which is not the most desirable measure of variability. Also the studies that differ in regard to the variabilities of scores are not of comparable design. This suggests that one of the problems which is presented is that of determining the implications of the device and subject matter upon the variability of scores.

Mayer and Westfield (41) were less conclusive in their findings. The purpose of this study was to determine the effectiveness of a teaching device in providing on-the-job training in the New York Air Defense Sector (NYADS). Two groups were selected, a control group that received training through the use of a handbook, and an experimental group that received training on the teaching device. Both groups made definite improvement after training, with the experimental group making slightly greater gains than the control group. The difference in gains, however, did not approach significance. There are two or three things about this study which seem worth considering. The size of each group was very small and because of the nature of the project it was not possible to control all of the variables in as much as the learning had to remain operational in both groups. This writer could not find where any consideration was given to the initial group differences in knowledge.

Freeman (19) reports on a series of studies designed to determine

the relationship of multiple choice items with immediate reinforcement. In one study the experimental groups took two scheduled exams about four weeks apart using a punchboard device. The control group, which was matched with the experimental group (criterion not given) received no reinforcement. A final test was then administered to both groups. A comparison of the performance by the two groups on the items previously reinforced showed that there were no effects of the reinforcement as measured by the final examination. The authors suggest three reasons why such a result might have occurred. They suggest: that it is possible there was insufficient reinforced practice; that the final items were not precisely identical with the items in the reinforced items of the previous tests, and consequently transfer of training may be a factor; and that the reinforced tests had not been systematically programmed. Freeman feels the latter point to be a crucial factor.

In another phase of this study by Freeman (19) it was found that a group taking a final test performed better, though not significantly on the items previously reinforced than on the items receiving no reinforcement. In still another phase the performance of matched groups were compared in a test-retest situation. In the initial test the reinforced experimental group scored significantly better than the control, and in the retest situation given two days later the experimental group retained their superiority. Even though the overall effects of conditions were not significant, the interaction between mean gains and conditions was significant. The mean gain for the reinforced group was five points while the gain for the control was .15, or a ratio of about thirty.

From the studies reviewed, the evidence leans heavily toward the machine as being a device to aid in achievement, although certain studies do not entirely support this. The studies done in this area are relatively

few and are for the most part designed quite differently. It will be necessary to develop more consistent designs that control more of the variables before it can conclusively be stated that a certain type of behavior will always occur under given conditions. The present state is one of a general recognition that the machine evidently has some favorable effect upon learning.

Programming

The second category into which Evans, Homme, and Glaser (16) divide studies on the teaching machine process consists of those designed to determine the effects on performance when the properties of the program are varied.

In studies designed to determine the importance of the size of step used in program development (16, 29), it was found that better performance resulted immediately, and was retained longer when programs requiring more steps to finish were used. With the smaller steps there were fewer errors made and the time required for each item was lessened. After a point, however, increasing the number of steps did **not** result in additional increases in achievement. On the basis of these results the authors suggest that there may be an empirical way to determine the optimal step size. The findings of Coulson and Silberman (12) support these conclusions in that achievement test scores were higher for those using the shorter step programs. They found, however, that when the program was of a constructed answer type more time was required for completion.

In an experiment designed to determine the importance of the overt response (16, 29) it was found that those subjects not required to write their answers did slightly better, though not significantly, than those subjects required to write their answers. This raises the question as to how important it is to actually have the student write his answers or

make some other form of overt response.

In comparing the performance of subjects receiving training using a multiple choice mode of response with the performance of subjects receiving training using a constructed mode of response it was found that no significant difference resulted on a criterion test consisting of both multiple choice and constructed type items (12). In another phase of this same study a comparison was made between branching and non-branching conditions. Under the branching conditions certain selected items were removed from the program providing certain other items were answered correctly the first time. Under non-branching conditions absolutely no alteration of the program was allowed. The results indicated that for the group using the multiple-choice approach the branching conditions required less training than nonbranching, with no significant difference in performance on the criterion test. For the group using the constructed answer mode of response, it was found that the performance of those receiving training under non-branching variables did significantly better than those receiving training under branching variables.

There have been a few studies done relating training methods with the criterion measures. Fry (21) found that those learning the material through a constructed answer approach did not perform significantly different on a multiple-choice post test from those using a multiple choice answer approach. He did find, however, that those learning the material through a constructed answer approach did perform significantly better on the constructed answer type items on a post test than did those using the multiple choice approach. From this it can be concluded that if the criterion of learning is to be recall, it is best that the constructed answer approach be used in the learning process. Holland (32) tends to support Fry. He used short essay questions in his study, and

observed that the students participating did very well in situations that required composition or the integration of many principles.

In a related study, Freeman (19) compared the performance of a control group, receiving no reinforcement, with the performance of an experimental group, having been reinforced on multiple choice items, on a test composed of both multiple choice and completion items. Freeman found that the multiple-choice reinforcement procedure caused the experimental group to perform significantly better on the objective items, but not significantly different on the items requiring constructed answers.

Use of the machine for special groups

There are several studies (7, 35, 46, 52) indicating that the machine may have application to certain special groups.

The purpose of a study done by Briggs (7) was to determine the merits of conducting special intensive seminar sessions for the superior student. The success of the study was dependent upon several factors, but one of the more significant is that the seminar groups used a "pocket tutor." The results of this study favored such seminars.

Jensen's study (35, p. 137) showed that "... superior, highly motivated students can satisfactorily handle college courses by guided independent study, if given materials and procedures for doing so." In this study, the students were provided with extensive instructional tests as well as a device for immediate self-scoring. Not only did the study indicate that such students achieve academically, but it showed that they saved time and increased their ability to do "independent and cooperative work."

Pressey (52) reports that the punchboard was found to work very well for superior students. The superior students did superior work, but in doing so saved about 60 percent in the number of class hours. The amount

of instruction needed was reduced, and the students found time to take additional work.

In studying the effectiveness of the teaching machine in spelling instruction, Porter (46) found that there was no relationship between intelligence and achievement in the experimental group, but that there was a significant positive relationship in the control group. The experimental group received special training using the machine, while the control group received more conventional training. This suggests that gains are independent of intelligence, and consequently special training on the machine is good for the lower I.Q. child.

Attitudes of students toward use of the machine

A review of the studies that have assessed the attitudes of students toward activity on the machine indicate that, for the most part, students are favorably impressed (2, 32, 41, 46, 52). One of the most extensive assessments of student's attitudes is Holland's (32). This study covered a period of two years with student attitudes being obtained at the end of each one year period. Between the first and second years the programs for the machines were extensively revised. Holland's (32) study provides the interested reader with some idea of the attitude change that may occur when certain variables are altered. Though the attitudes at the end of both years were favorable, those solicited at the end of the second year were somewhat more favorable than those at the end of the first year.

Program revision

One of the greatest advantages of the teaching machine is that it provides almost immediate feedback of teaching effectiveness to the instructor (5, 28, 32, 57)--a feedback that is not obtained with most other instructional devices. On the basis of this feedback it is possible

to revise and refine the program. Holland (32) reports a study that was conducted over a period of two years, with the program being revised between the first and second year. He reports that the revision eliminated about half of the errors previously made. Also the scoring errors that had been made by the students in evaluating their own responses were cut in half. After the revision, additional information was presented, but even with the added material, the average amount of time required to complete the program was decreased.

In concluding this review of the results of previous studies, there are one or two other important findings that do not fall into one of the preceding classifications. Holland (32) illustrates quite well the fact that one advantage of the machine is that it enables the student to move at his own rate of speed. He found that the fastest student required seven hours and forty-two minutes to finish a program and the slowest student required twenty-six hours and twenty minutes. The significant thing here is not the numbers themselves, but that this illustrates the capacity of the machine to adapt to the individual student.

In comparing the effects of massed practice on the machine with distributed practice, Porter (32) concluded that it makes little difference how practice is distributed.

Summary

On the basis of this review the following statements will serve to summarize the literature:

1. There are two major phases to the teaching machine method, the device itself, and the program that goes in the machine, of which the latter is most important.
2. Teaching machines are of two basic types, those presenting

multiple choice items requiring the subject to respond by selecting one of several alternatives, and those of a short answer type which require the subject to construct his response.

3. The problems in effective program preparation are more numerous and difficult than those relating to machine production, and consequently, programming is an area that is markedly deficient.

4. The teaching machine method appears beneficial because it embodies certain principles vital to learning.

5. For the most part, studies previously done indicate: that there are definite advantages in using the teaching machine; that there are many areas in program development needing further exploration, although studies have provided a more sound basis for finding solutions; that the teaching machine may be applicable to specific types of subjects, with the details of applicability not known; that those using the machine tend to be favorably impressed, and; that program revision, on the basis of previous teaching machine experiences, is highly desirable.

The purpose of this review has been to provide the reader with a frame of reference through which he can intelligently look at the teaching machine movement. It is hoped that the purpose has been accomplished. If it has not, or if the reader has a desire for additional information, this writer suggests that a consideration be given to the references provided in the Literature Cited Section. There have been other reviews written, most of them approaching the problem from a different perspective (9, 10, 11, 20, 28, 38). The interested reader will find these informative.

The emphasis upon self-instruction is fairly recent, and consequently, the explorations up to the present time have, for the most part, lacked the degree of research sophistication that can eventually be expected to come. The past teaching machine research, though plagued with the main

problem of "newness," can hardly be considered unproductive. The work that has been done has all been a necessary and essential step in providing the foundations upon which further research can be built.

The greater percentage of the literature available is devoted to verbal explorations into the implications of the teaching machine. Much of the information concerns theoretical approaches to advantages, disadvantages, problems, relationship of the teaching machine methods to the learning process, etc.

There have been relatively few studies done in this area, and those that have been done have lacked a high degree of research organization. That is, most of the studies have been done on just about as many different phases of either programming or achievement gains as there are studies. This makes it very difficult to arrive at any consistent conclusions regarding any one phase of teaching machine method implications. In addition to this, many of the studies have lacked the desired degree of scientific control of experimental variables.

In conclusion, it can be expected that interest and research will increase, for the potentiality of the teaching machine, though not completely understood, has been sufficiently explored to indicate that here is a fertile field for educational research.

HYPOTHESES

In view of the objectives of this study, page 3, and the Review of Literature, the following experimental hypotheses were proposed:

1. Subjects using the machine will make greater achievement gains than will subjects not using the machine.
2. The teaching machine will compensate for verbal ability.
3. The teaching machine will compensate for poor study habits and attitudes.
4. The teaching machine causes a decrease in the variability of achievement gains.

The first hypothesis relates to the objective of determining the effectiveness of the teaching machine as a study aid, and the remaining three relate to the objective of learning for whom the machine is best suited.

To test these four experimental hypotheses seventeen corollary hypotheses were statistically treated. These are presented as part of the Results Section.

METHODS AND MATERIALS

Subjects

The subjects consisted of 105 students taken from two sections of general psychology during Spring Quarter of 1959-60 academic school year. Most of the subjects were freshmen and sophomores, although there were a few juniors. Two of the subjects were dropped from the study in view of the fact that they were international students, and consequently had a different background and orientation from the rest of the subjects. The subjects were randomly split into a control and an experimental group within each section to insure that an equal number, from each section, were assigned to each group. Randomization was controlled only to the extent that an equal number of males and females from each section were in each group. The technique of randomization consisted of randomly drawing the names of first, the males, and second, the females in each section and alternately placing them in one of the two groups. After this had been done, the control subjects in each section were combined to make the final control group, and the experimental subjects in each section were combined to make the final experimental group. The experimental group consisted of fifty-one subjects, fifty males and eleven females. The control group consisted of fifty-two subjects, forty-one males and eleven females.

Participation in the study was a requirement of the course and a detailed record was kept of each subject's activity to insure that the participation met the requirements of the study. In no instance was it necessary to eliminate a subject from the study on the basis of inadequate

participation.

Apparatus

The teaching machine used is commercially manufactured by Foringer and Co., Inc., Rockville, Maryland. The model employed in the study was #2002 (see Figure 1). Ten machines were used in the study, each of which is approximately the size of a portable typewriter. The machine houses the program which is printed on a eight and one-half inch wide sheet of paper of any desired length folded in an accordian fold. Several sheets of paper may be attached, if necessary, to accommodate the desired program. Also within the machine is housed the response tape which is two and three-eights inches wide and, like the program, is in an accordian fold.

On the face of the machine are two windows, one large, and one small. The large window is completely covered by transparent plastic and it is in this window that the programmed items appear. The upper half of the smaller window is also covered with transparent plastic. The lower half is left uncovered thus exposing part of the response tape upon which the student will write his response to the question appearing in the larger window. This device is basically of Skinner design, in that it requires the student to respond with constructed answers.

Both the programmed tape and the response tape move through the machine with the aid of a friction roller which is manipulated by a lever on the outside of the machine. The friction roller allows the tape to move only one way. This prevents the subject from making any changes in his answer once the response has been made.

The exact way the machine is to be employed varies with the design and construction of the program. In order to describe the operation of

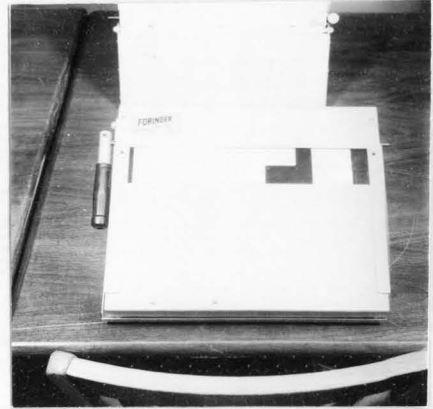


Figure 1. Model #2002 of the teaching machine manufactured by Foringer and Company, Inc.

the machine as it relates to this study, the instructions to the experimental subjects found on one of the programmed chapters are as follows:

INSTRUCTIONS: This tape is designed to serve as a study aid in understanding and mastering the information on "Maturation and Development" contained in Chapter 2. There are a total of 112 items on the chapter and they have been divided into two parts. The first part (Part 1) consists of 52 items and the second part (Part 2) consists of 60 items.

Each item consists of three parts: (1) the question, usually of a short answer type, (2) the answer to the question, and (3) a discussion of the question including a page reference.

Procedure: The handle must first be worked until Question number 1 appears in the lower half of the window. From this point on three steps are involved for each item: (1) You will read the question and will write your answer in the small window to the right of the machine, (2) You will then work the handle once and in so doing the question will move to the upper half of the window, as will also the answer. It will be observed that at this same time the correct answer will move from behind the black plastic shield in the lower right hand corner until it appears in the upper half of the window. Also, as the question moves into the upper half of the window a discussion of the question moves into the lower half. Thus you are able to see the question, your answer, the correct answer, and a discussion of the question. In some cases a discussion has not been given, but in every case there is a page reference. You will note that there is a small hole in the plastic shield covering your answer. This may be used in marking your answer. (3) You will then work the handle two times and the next question will appear in the lower half of the window.

The tape will move only one way while in the machine. Therefore, if you desire to do further study on any topic, it will be necessary for you to take any desired notes on the topic or page reference at the time the item appears in the window. The textbook may be used in connection with this tape.

Program

Seven chapters from Morgan's Introductory Psychology text (42) were programmed for use in the teaching machine and were covered at the rate of one each week. The chapters included: Chapter 2, "Maturation and Development"; Chapter 4, "Feeling and Emotion"; Chapter 6, "Imagination and Thinking"; Chapter 9, "Personality"; Chapter 11, "Mental Health and

Psychotherapy"; Chapter 14, "Prejudice and Social Conflict"; and Chapter 16, "Aptitudes and Vocational Adjustment." These chapters are referred to as the experimental chapters. The nine remaining chapters covered throughout the study are referred to as control chapters because they did not receive any special attention by either the control or experimental groups.

In programming each chapter little effort was made to arrange the items in order of difficulty, as the primary purpose of the study was to use the machine as an aid in reviewing material previously read, rather than a means of teaching new concepts. The items were presented in the same order as they appeared in the text book. The items were of a short answer nature requiring the subject to construct, in writing, his answer. In some cases one word was sufficient to answer the question, but in other instances, a short phrase was required.

Each program, on the average, consisted of about 109 items. The program for each chapter was divided into two logical parts, with each part containing about one-half of the items. This provided the program and the student with more flexibility than would be possible were the tape on each chapter to remain undivided.

Each item consisted of three basic parts:

1. The question
2. The answer to the question
3. A discussion of the question

The discussion included a review of the question and provided a text page number in order that the subject could, if desired, review further the concept involved in the question. In some cases it was not necessary to include a discussion, but in all cases a page reference was given. This program design has one advantage over many of the approaches previously

used in that it does not only provide the student with knowledge of results, but if the subject's response is incorrect it reviews the concept and tells the student why he was wrong. If the subject is correct in his response the machine will further elaborate on the question and in many cases clarify certain phases that were not entirely clear, but were sufficiently so to enable the subject to make a correct response. For a sample of the programs used, the reader is referred to Appendix A.

It was observed after the second week that some of the subjects were finishing the program well within the scheduled time, even with additional re-workings of the program. In order to provide additional information on each chapter for the student desiring it, a supplementary tape was prepared which consisted of definitions of the more important words found within the chapter. Each item consisted of only two parts, the statement of definition of a word which the subject was to identify by writing the appropriate word on the response tape, and the programmed answer which provided the subject with a knowledge of results. The subject would read the statement in the lower half of the large window on the face of the machine and would respond by placing the appropriate word in the lower half of the small window. Upon working the machine, the statement and the subject's response would move into the upper half of the window, with the subject's response being covered with transparent plastic. At the same time the correct answer would move from behind the black plastic shield located in the lower right hand corner of the large window. This enabled the student to see the statement and compare his response with the programmed answer. No discussion was provided. For a sample of the supplementary tape the reader is referred to Appendix B.

Study Conditions

Initial reading of the material

The initial reading of each experimental chapter by both groups was done the first day of each week during the regular class period. One exception was necessary, however, in that it was necessary to initially read one chapter on the preceeding Friday. The time limit allowed for the reading of the chapter for the first time was fifty minutes, which is the length of the regular class period. No one was excused from participation and if absent was required to make up the period the following day.

Review study sessions

All subjects were required to attend study sessions sometime during the three day period of Wednesday, Thursday, or Friday of each week. During this time they would review the material read the previous Monday. Each subject, in both groups, was required to spend two fifty minute review sessions, or one 100 minute review session. Each subject was allowed to select from several hours available those which would best fit into his schedule. The subjects were then required to attend at the hours selected. In some cases, however, adjustments within the three day period were made to accommodate the individual student. No subject was excused from participation and if a review session was missed, it was necessary to make it up the following school day.

The machines were set up in a teaching machine room to which the experimental subjects reported at the times scheduled. Ten subjects could be accommodated during each study period. The machines were set on a large table in the center of the room around which the subjects seated themselves to work the machine. The subjects were instructed as

to how to load and unload their machines, thus making each subject relatively independent of assistance from the supervisor present. As the subjects reported for the study sessions they checked out a program on the material scheduled for the week, and proceeded immediately to an available machine where there would begin to work. At the end of the period, the subject would unload the machine, place the tape back in the folder, and return it to the central program file.

The control subjects would report at their scheduled times to a classroom adjacent to the teaching machine room. Upon reporting, the subject immediately would begin reviewing, in his own way, the material read the previous Monday. There were no assigned seats and, consequently, the subjects could seat themselves anywhere in the room they desired.

Conditions designed to approximate normal study situations

One of the principle objectives in designing the study was to provide study conditions that approximated--as nearly as was possible--a routine, unstructured study situation. The purpose of this being to determine the effectiveness of the machine when compared to the type of study that would be characteristic of the average college student.

Controlled, supervised study sessions were not characteristic of either the control or the experimental group. About the only supervision was that of keeping records of the subjects attendance and participation. Questions were answered only when asked. Care was taken, however, to see that control subjects were working on the subject matter assigned for the week. It was impossible, of course, to govern the amount and degree to which they studied the subject matter, but it was possible, for the most part, to insure that they were not working on inappropriate material. In the experimental situation care was taken to see that the subjects used the machine, and that they followed the basic procedure

suggested.

The experimental subjects were allowed to use their textbooks in connection with the machines, however, they were instructed to use the machine as the basis of their study and the textbook only in a supplementary role. The used response tapes were not gathered by the supervisor, but rather were kept by the student. The subjects were thus free to do as they wished with the response tapes. In some cases they were disposed of immediately, but in other instances, the subjects made additional comments on the tapes and used them in further review. The fact that textbooks were allowed, and the response tapes not gathered, served to emphasize the role of the machine as being one of an aid to review rather than a testing device.

Evaluation Measures

Non-standardized measures

Six non-standardized measures were used to evaluate student performance:

1. A psychology pre-test on the experimental chapters
2. A psychology pre-test on the control chapters
3. A psychology final test on the experimental chapters
4. A psychology final test on the control chapters
5. A summary of hours spent in outside study by each subject on each chapter
6. A complete record of student participation

The pre-tests were designed to determine the initial knowledge of each subject concerning psychology, and the final tests were to determine the knowledge of each subject at the end of the experiment. The score was the number of items answered correctly. The difference between the

final and the pre-test scores for each subject is the amount of achievement gain. The final tests on the experimental and control chapters were exactly the same as the pre-tests. The subjects did not know that the final examination they were to receive was the same as the pre-test given at the beginning of the experiment.

The initial and final tests on the experimental chapters consisted of seventy multiple choice items, ten from each of the seven chapters programmed for use in the machine. The initial and final test on the control chapters consisted of ninety multiple choice items, ten from each chapter. The items in both tests were selected randomly from several test items previously prepared for use in the general psychology course (43, 44). After the random selection had been made each item was evaluated by this writer and one other graduate student in psychology. On the basis of this evaluation several items were reconstructed or were discarded completely and replaced with comparable items. The items in question consisted of ambiguous items as well as those that did not discriminate between the student of psychology and the person having had no training in psychology. This is to say, that the test items were designed to measure knowledges acquired during the course.

In order to aid in the evaluation of achievement gains, each subject handed in weekly a detailed record of the number of hours spent in outside study (study other than that done under the controlled conditions of the experiment) on each chapter. For a sample of the form used to obtain this information, refer to Appendix C. The form was handed to each student at the beginning of each week with instructions to keep the hours spent in study on a daily basis. At the beginning of the next week the questionnaire on the previous week was gathered and a new questionnaire handed to the subjects. The questionnaire calls for a

chapter breakdown on the amount of time spent in study each day during the week. The reporting was to include time spent down to, and including, quarter hours.

One other device used to evaluate performance was the detailed record kept of each subjects participation. This report included the number of make-up sessions required for each subject, and the day the requirement was satisfied. It also includes the number of times each subject was absent from the course lectures.

Standardized measures

One of the two standardized measures used was the Brown-Holtzman Survey of Study Habits and Attitudes (SSHA) published by The Psychological Corporation, New York City, New York. This survey provides a quantitative measure of a student's study habits and related attitudes.

The other standardized measure used was the verbal score from the School and College Ability Test (SCAT) published by the Cooperative Test Division, Educational Testing Service, Princeton, New Jersey, and Los Angeles, California. The verbal scale provides a measure of the subjects ability to comprehend and use words and language meaningfully.

Procedure

At the beginning of spring quarter, before course work actually began, all subjects were given a pre-test to determine their initial knowledge of psychology. They were not aware that the test was to be administered. Two one hour class periods were required to administer the test. During the first hour the pre-test covering the experimental chapters was administered with the pre-test on the control chapters being administered the second hour.

The standardized tests, the Brown-Holtzman Survey of Study Habits

and Attitudes and the School and College Ability Test were given during the first and second weeks of the experiment, respectfully.

The experiment lasted a period of seven weeks and at the end of that time the final psychology criterion tests were given all subjects on the seven experimental and the nine control chapters.

The first class period of each of the seven weeks was devoted by all subjects to reading one experimental chapter. A different chapter was covered each week. To aid the subjects in gaining, more quickly, an understanding of the chapter content, an outline of each chapter was handed out. A sample of the handout on Chapter 9 is found in Appendix D. Also at this time the questionnaires containing the number of hours spent in outside study by each subject during the preceding week were gathered.

During the remaining class periods each week the instructor in each section lectured on the experimental chapter read the previous Monday as well as one control chapter. It was necessary during two weeks to consider two control chapters in order to cover the necessary course material. Approximately the same amount of time was spent on each chapter by each instructor. No control was placed on the two instructor's methods of subject matter presentation, but in this regard it should be kept in mind by the reader that 50 percent in each section belonged to the experimental group, and 50 percent in each section belonged to the control group.

At scheduled times during Wednesday, Thursday, or Friday of each week all subjects would report to an appropriate room for review study on the experimental chapter read in class the previous Monday. Each subject was required to spend a total of 100 minutes (in either one or two sessions). The experimental subjects would report to the teaching

machine room where they would use the machines in reviewing the chapter, and the control subjects would report to the adjacent study room where they would review the chapter using their own study techniques.

RESULTS

The presentation of the results will be considered in their relationship to the following three areas:

1. The comparability of the control and experimental groups
2. The teaching machine as study aid
3. The student receiving the most benefit from using the machine (student discrimination by the teaching machine).

After consideration has been given to the comparability of the control and experimental groups, however, an additional section presents the seventeen corollary hypotheses used to test the remaining two areas.

Comparability of Groups

The reader will recall that a random method of group selection was employed. The fact, however, that a pre-test was given invites the use of a covariance analysis, on the basis of which the final scores obtained under the different conditions can be adjusted to compensate for pre-test differences. Nevertheless, it is significant that the randomized selection equated the experimental and control groups very well.

Table 1 presents the pre-test means and standard deviations for the experimental and control groups on the experimental and control chapters. In testing the significance of the difference between the means and standard deviations of the control group and experimental group on, first, the experimental chapters, and then secondly on the control chapters, it was found that no significant difference occurred between the interaction of any of the variables.

Table 1. Pre-test means and standard deviations of the experimental and control groups on the experimental and control chapters

Group	Experimental Chapters		Control Chapters	
	Mean	SD	Mean	SD
Experimental	25.35	4.57	26.86	4.69
Control	25.06	5.17	25.25	4.30

Table 2 shows the performance of the two groups on the Brown-Holtzman Survey of Study Habits and Attitudes, and the Verbal scale of the School and College Ability Test. The reader will notice the similarity of mean scores.

Table 2. Means of the experimental and control groups in verbal ability and in study habits and attitudes

Group	SSHA	Verbal
Experimental	28.76	31.22
Control	28.73	30.85

The mean numbers of hours spent in outside study for the control and experimental groups on both sets of chapters are presented in Table 3, along with the critical ratio resulting from a test of significance between the means of both groups. It will be noted that the ratios do not approach significance, and therefore, the mean number of hours spent in outside study by each group on the experimental and control chapters are relatively comparable.

Table 3. Significance of the difference between means of hours spent in outside study by both groups on the experimental and control chapters (in hours)

Chapters	Experimental Group Mean	Control Group Mean	CR
Experimental	12.53	11.10	1.01
Control	14.75	16.13	.89

Throughout the experimental period, accurate records of attendance and participation were kept on both the experimental and control subjects. Table 4 summarizes, for each group, the total absences from class lectures, the initial chapter reading, and the review study sessions. It is noted that the attendance for both the experimental and control groups show relatively equal participation.

Table 4. Comparisons of the participation by the experimental and control groups on selected criterion measures

Criterion Measure	Experimental Group	Control Group
Total absences - class lectures	149	152
Total absences - initial chapter reading ^a	24	21
Total absences - review study sessions ^a	36	38

^a Subjects were required to make up the time they had missed on the following school day.

Corollary Hypotheses

In order to test the objectives of this study, page 3, and the experimental hypotheses, page 38, the following corollary hypotheses were tested. Their areas of applicability have been identified.

The teaching machine as a study aid

1. There is no significant difference between the mean achievement gain of the experimental group and the mean achievement gain of the control group on the experimental chapters.

2. There is no significant difference between the mean achievement gain of the experimental group and the mean achievement gain of the control group on the control chapters.

3. There is no significant difference between the mean achievement gain of the experimental group on the experimental chapters and the mean achievement gain of the experimental group on the control chapters.

4. There is no significant difference between the mean achievement gain of the control group on the experimental chapters and the mean achievement gain of the control group on the control chapters.

Student discrimination by the teaching machine

5. There is no significant difference between the mean achievement gain on the experimental chapters of experimental group subjects scoring in the top 50 percent in verbal ability and the mean achievement gain on the experimental chapters of experimental group subjects scoring in the bottom 50 percent in verbal ability.

6. There is no significant difference between the mean achievement gain on the experimental chapters of control group subjects scoring in the top 50 percent in verbal ability and the mean achievement gain on the experimental chapters of control group subjects scoring in the bottom 50 percent in verbal ability.

7. There is no significant difference between the mean achievement gain on the control chapters of experimental group subjects scoring in the top 50 percent in verbal ability and the mean achievement gain on the control chapters of experimental group subjects scoring in the bottom

50 percent in verbal ability.

8. There is no significant difference between the mean achievement gain on the control chapters of control group subjects scoring in the top 50 percent in verbal ability and the mean achievement gain on the control chapters of control group subjects scoring in the bottom 50 percent in verbal ability.

9. There is no significant difference between the mean achievement gain on the experimental chapters of control group subjects scoring in the top 50 percent in verbal ability and the mean achievement gain on the experimental chapters of experimental group subjects scoring in the bottom 50 percent in verbal ability.

10. There is no significant difference between the mean achievement gain on the experimental chapters of experimental group subjects scoring in the top 50 percent in study habits and attitudes, and the mean achievement gain on the experimental chapters of experimental group subjects scoring in the bottom 50 percent in study habits and attitudes.

11. There is no significant difference between the mean achievement gain on the experimental chapters of control group subjects scoring in the top 50 percent in study habits and attitudes, and the mean achievement gain on the experimental chapters of control group subjects scoring in the bottom 50 percent in study habits and attitudes.

12. There is no significant difference between the mean achievement gain on the control chapters of experimental group subjects scoring in the top 50 percent in study habits and attitudes, and the mean achievement gain on the control chapters of experimental group subjects scoring in the bottom 50 percent in study habits and attitudes.

13. There is no significant difference between the mean achievement gain on the control chapters of control group subjects scoring in the top

50 percent in study habits and attitudes, and the mean achievement gain on the control chapters of control group subjects scoring in the bottom 50 percent in study habits and attitudes.

14. There is no significant difference between the mean achievement gain on the experimental chapters of control group subjects scoring in the top 50 percent in study habits and attitudes, and the mean achievement gain on the experimental chapters of experimental group subjects scoring in bottom 50 percent in study habits and attitudes.

15. There is no significant difference between the correlation of achievement gains with verbal ability of the experimental group on the experimental chapters, and the correlation of achievement gains with verbal ability of the control group on the experimental chapters.

16. There is no significant difference between the variability of the achievement gains of the experimental group on the experimental chapters and the variability of the achievement gains of the experimental group on the control chapters.

17. There is no significant difference between the variability of achievement gains of the control group on the experimental chapters and the variability of the achievement gains of the control group on the control chapters.

The Teaching Machine as a Study Aid

The first four corollary hypotheses were used to determine the effectiveness of the teaching machine as an aid to study. Figure 2 has been prepared to aid the reader in more readily understanding the conditions tested. The conditions have been identified by hypotheses. The major results are also indicated to aid in interpretation. In addition, reference is made in the treatment of each hypothesis to tables where the

results are summarized.

First hypothesis, Figure 2

An analysis of variance (26, pp. 205-303) was employed to determine the significance of the difference between the mean achievement gains of the experimental group and the control group on the experimental chapters. The resulting variance ratio on the pre-test means was .09, indicating essentially no difference. The variance ratio on the final test, however, was 17.16, which is significant beyond the .01 level of probability (see Table 5). This means, then, that the experimental group performed significantly better than did the control group on the experimental chapters. On this basis, the null hypothesis is rejected.

Second hypothesis, Figure 2

An analysis of variance (26, pp. 295-303) was used to determine the significance of the difference between the mean achievement gains of the experimental and control groups on the control chapters. The variance ratios on the pre-test means and the final test means are .47 and 3.17 respectively. Neither of these approach significance (see Table 5). It can, therefore, be concluded that the experimental group and the control group did not perform significantly different on the final test on the control chapters. On this basis the null hypothesis is accepted.

Table 5. Significance of the difference between means made by the experimental and control groups on the experimental and control chapters

Chapters	Mean Scores				F_x^a	F_y^b
	Pre-test		Final Test			
	Exp. Gp.	Con. Gp.	Exp. Gp.	Con. Gp.		
Experimental	25.35	25.06	44.43	37.00	.09	17.16*
Control	26.86	26.25	39.65	36.31	.47	3.17

a Variance ratio of pre-test means.

b Variance ratio of final test means.

* Significant at .01 level of probability.

Third hypothesis, Figure 2

To test whether the experimental group made significantly greater gains on the experimental chapters than it did on the control chapters, a test for significance using the single group method (26, pp. 226-228) was used. The resulting critical ratio is 5.23 which is beyond the 2.68 required at the .01 level of probability with fifty degrees of freedom (see Table 6). Therefore, the experimental group made significantly greater gains on the experimental chapters than they did on the control chapters. On this basis the null hypothesis is rejected.

Fourth hypothesis, Figure 2

The same statistical procedure as was used to test the third hypothesis was used to determine if the control group made significantly greater gains on the experimental chapters than it did on the control chapters. The critical ratio of 1.68 is not significant at the .05 level of probability, 2.01 being required with fifty-one degrees of freedom (see Table 6). Therefore, on this basis the null hypothesis is accepted. The control group did not perform significantly different on the experimental and control chapters.

Table 6. Significance of the difference between means on the experimental and control chapters by the experimental and control groups

Group	Experimental Chapters		Control Chapters		C.R.
	Mean	50	Mean	50	
Experimental	19.06	8.178	12.49	8.705	5.23*
Control	11.96	7.58	10.12	8.45	1.68

* Significant at .01 level of probability.

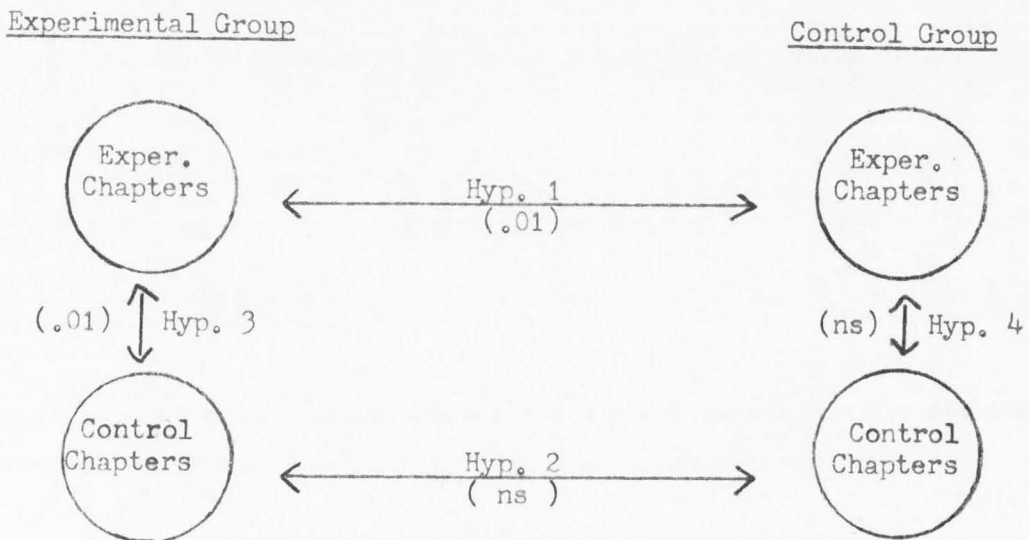


Figure 2. Graphic presentation of the conditions tested, identified by hypothesis and the resulting level of significance (significance of the difference between means)

Student Discrimination by the Teaching Machine

The remaining thirteen corollary hypotheses were tested to determine if, on the basis of the experimental measures employed in this experiment, the teaching machine distinguished between certain characteristics of students using the machine. Figures 3, 4, 5, and 6 have been prepared to aid the reader in more readily understanding the conditions tested. The conditions have been identified by hypothesis. The major findings are also indicated to aid in the interpretation. Again, with each hypothesis

tested, reference is made to tables where the results are summarized.

Three statistical devices are used in testing the different hypotheses:

1. An analysis of variance (26, pp. 295-303), with a covariance analysis used, when necessary, to adjust the final achievement means on the basis of pre-test differences.
2. Product moment correlation (26, pp. 134-139), with the appropriate test of significance between correlations (26, pp. 241-243).
3. The standard deviation (26, pp. 51-53), with the appropriate test of significance between standard deviations (26, pp. 232-235).

Fifth hypothesis, Figure 3

An analysis of variance was used to determine if the top 50 percent of the experimental subjects in verbal ability made significantly greater achievement gains on the experimental chapters than did the bottom 50 percent. Table 7 shows the variance ratios for the pre-test means and the final test means to be 8.79 and 13.02 respectively, both of which are significant beyond the .01 level of probability. The final means scores were then adjusted on the basis of pre-test means differences by a covariance analysis. The variance ratio of the final means, adjusted for pre-test differences, was 6.25 which is significant beyond the .05 level of probability. It can be concluded that the top 50 percent of experimental subjects in verbal ability showed significantly greater gains on the experimental chapters than did the bottom 50 percent. The null hypothesis is thus rejected.

Sixth hypothesis, Figure 3

An analysis of variance was used to determine whether the top 50 percent of the control subjects in verbal ability made significantly greater achievement gains on the experimental chapters than did the

bottom 50 percent. As shown in Table 7, the variance ratios for the pre-test means and final test means respectively were 7.72 and 31.77. These are both significant beyond the .01 level of probability. Using covariance analysis the variance ratio of the final test means, adjusted on the basis of pre-test differences, is 20.70. This final mean difference remains significant beyond the .01 level of probability, consequently, the null hypothesis is rejected. It can be concluded that the top 50 percent of the control subjects in verbal ability showed significantly greater achievement gains on the experimental chapters than did the bottom 50 percent.

Seventh hypothesis, Figure 3

An analysis of variance was employed to determine whether the top 50 percent of the experimental subjects in verbal ability showed significantly greater achievement gains on the control chapters than did the bottom 50 percent of the experimental subjects. The resulting variance ratio on the pre-test mean differences was 7.95 which is significant at the .01 level; and the variance ratio on the final test means was .84, which is not significant (see Table 7). Even though the variance ratio of the pre-test means was significant, it was not necessary to apply a covariance analysis to adjust the final mean differences in view of the fact that the final test variance ratio is so small and the pre-test means are such that any adjustment made by a covariance analysis would only tend to show the final means further equated. Therefore, the null hypothesis is accepted, and it can be concluded that the top 50 percent of the experimental subjects in verbal ability did not show significantly greater achievement gains on the control chapters than the bottom 50 percent.

Eighth hypothesis, Figure 3

An analysis of variance was used to determine whether the top 50 percent of control subjects in verbal ability made significantly greater achievement gains on the control chapters than did the bottom 50 percent. The variance ratios for the pre-test means and the final test means were 8.00 and 20.29 respectively, both significant at .01 level of probability (see Table 7). A covariance analysis was then employed to adjust the final mean scores. The resulting variance ratio of the final test means, adjusted on the basis of pre-test mean differences, was 14.60, which is significant at .01 level of probability. It can thus be concluded that the top 50 percent of the control subjects in verbal ability made significantly greater achievement gains on the control chapters than did the control subjects scoring in the bottom 50 percent in verbal ability. The null hypothesis is thus rejected.

Table 7. Significance of the difference between means resulting from various comparisons of the top and bottom 50 percent in verbal ability

Group	Chapters	Mean Scores				F _x	F _y	F _{y.x}
		Pre-test		Final test				
		Top 50%	Btm 50%	Top 50%	Btm 50%			
Experimental	Experimental	27.69	22.92	49.23	39.44	8.79**	13.02**	6.25*
Control	Experimental	26.96	23.15	42.46	31.54	7.72**	31.77**	20.70**
Experimental	Control	28.58	25.08	40.81	38.44	7.95**	.84	
Control	Control	27.85	24.65	41.15	31.46	8.00**	20.29**	14.60**
Top 50%-Con. Btm 50%-Exp.	Experimental	26.96	22.92	42.46	39.44	11.17**	1.23	

* Significant at .05 level of probability.

** Significant at .01 level of probability.

Ninth hypothesis, Figure 3

An analysis of variance was used to determine whether the experimental group subjects scoring in the bottom 50 percent in verbal ability performed significantly different from the control group subjects scoring in the top 50 percent in verbal ability on the experimental chapters. The variance ratio for the pre-test means was 11.17, which is significantly beyond the .01 level of probability. The final test mean variance ratio was 1.23, which is not significant (see Table 7). Covariance analysis was not employed due to the fact that the pre-test means are such that an adjustment would only serve to further equate the final means. The null hypothesis is accepted and it can be concluded that the experimental subjects scoring in the bottom 50 percent in verbal ability do not register achievement gains on the experimental chapters significantly different from the control subjects scoring in the top 50 percent in verbal ability.

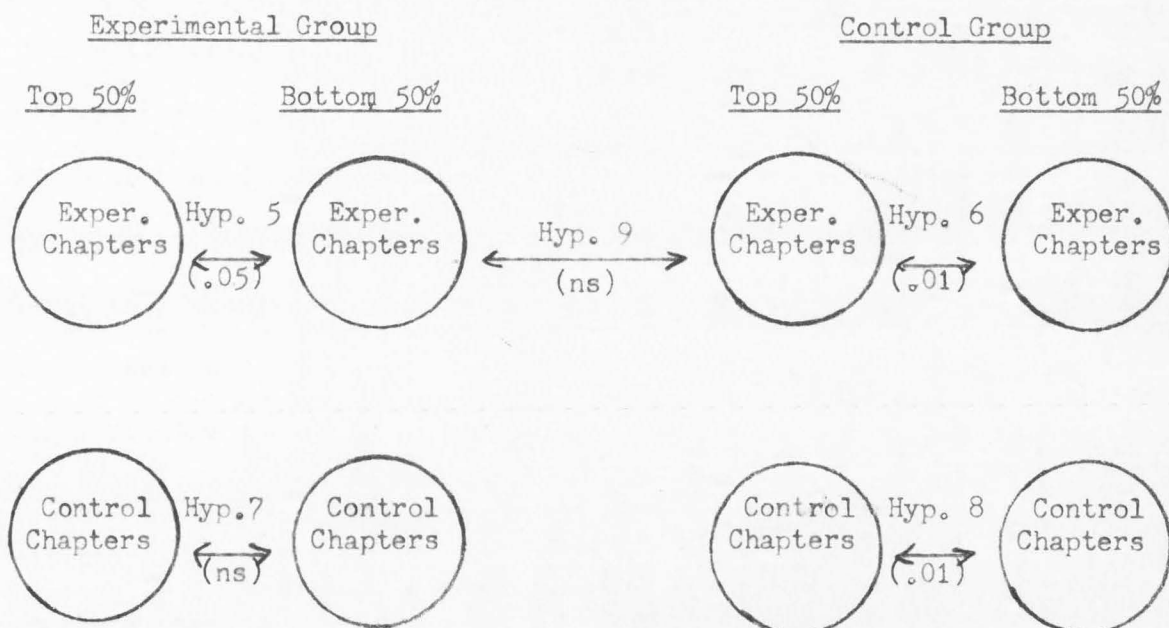


Figure 3. Graphic presentation of the conditions tested on the basis of differences in verbal ability, identified by hypothesis and the resulting level of significance (significance of the difference between means)

Tenth hypothesis, Figure 4

An analysis of variance was used to determine whether the top 50 percent of the experimental subjects in study habits and attitudes performed significantly different on the experimental chapters than did the bottom 50 percent. The resulting variance ratios for the pre-test means and the final test means are .31 and .40 respectively (see Table 8). Neither of these ratios is significant and on this basis the null hypothesis is accepted. It can be concluded that the top 50 percent of the experimental subjects in study habits and attitudes did not perform significantly different on the experimental chapters than did the bottom 50 percent.

Eleventh hypothesis, Figure 4

An analysis of variance was used to determine whether the control subjects scoring in the top 50 percent in study habits and attitudes register significantly different gains on the experimental chapters than did the control subjects scoring in the bottom 50 percent. The variance ratios for pre-test means is 4.67, which is significant at the .05 level of probability. The variance ratio for the final test means is 19.20, which is significant at the .01 level of probability (see Table 8). In applying an analysis of covariance the resulting variance ratio for the final test means, adjusted for pre-test mean differences, is 13.45. The final test variance ratio remains significant at the .01 level of probability. The null hypothesis is thus rejected and it can be concluded that control subjects scoring in the top 50 percent in study habits and attitudes registered significantly greater gains on the experimental chapters than did the control subjects scoring in the bottom 50 percent.

Twelfth hypothesis, Figure 4

An analysis of variance was used to determine whether the experimental subjects scoring in the top 50 percent in study habits and attitudes registered significantly greater gains on the control chapters than did the bottom 50 percent. The resulting variance ratios as reported in Table 8 are 2.33 for the pre-test means and 3.60 for the final test means. Neither are significant, though the variance ratio for the final test means appears to approach significance. It was not necessary to use a covariance analysis to determine the adjusted final means because the pre-test mean differences are such that they would only further equate the difference. It can therefore, be concluded that the experimental subjects scoring in the top 50 percent in study habits and attitudes did not perform significantly different on the control chapters from the bottom 50 percent. The null hypothesis is thus accepted.

Thirteenth hypothesis, Figure 4

An analysis of variance was used to determine whether the control subjects scoring in the top 50 percent in study habits and attitudes registered significantly different gains on the control chapters than did the control subjects scoring in the bottom 50 percent. The variance ratio of pre-test means is 2.11, which is not significant, but is sufficiently great to warrant the use of covariance analysis in view of the variance ratio of the final test means. The variance ratio for the final means is 11.95, which is significant at the .01 level. An analysis of covariance yields a variance ratio on the final test, adjusted for pre-test mean differences, of 9.45. This remains significant at the .01 level (see Table 8). The control subjects scoring in the top 50 percent in study habits and attitudes did register significantly greater achievement gains on the control chapters than did the control subjects scoring in

the bottom 50 percent. The null hypothesis is thus rejected.

Table 8. Significance of the difference between means resulting from various comparisons of the top and bottom 50 percent in study habits and attitudes

Group	Chapters	Mean Scores				F _x	F _y	F _{x.y}
		Pre-test		Final test				
		Top 50%	Btm 50%	Top 50%	Btm 50%			
Experimental	Experimental	25.72	25.00	45.28	43.62	.31	.40	
Control	Experimental	26.58	23.54	41.62	32.38	4.67*	19.20**	13.45**
Experimental	Control	27.88	25.88	42.08	37.31	2.33	3.60	
Control	Control	27.12	25.38	40.27	32.35	2.11	11.95**	9.56**
Top 50%-Con. Btm 50%-Exp.	Experimental	26.58	25.00	41.62	43.62	1.23	.69	

* Significant at .05 level of probability.

** Significant at .01 level of probability.

Fourteenth hypothesis, Figure 4

An analysis of variance was employed to determine whether the experimental subjects scoring in the bottom 50 percent in study habits and attitudes registered significantly different gains on the experimental chapters than did the control subjects scoring in the top 50 percent. The resulting variance ratios for the pre-test mean differences and the final test mean differences are 1.23 and .69 respectively, see Table 8. Neither are significant and the null hypothesis is accepted. It can be concluded that the control subjects scoring in the top 50 percent in study habits and attitudes did not perform significantly better on the experimental chapters than did the experimental subjects scoring in the bottom 50 percent.

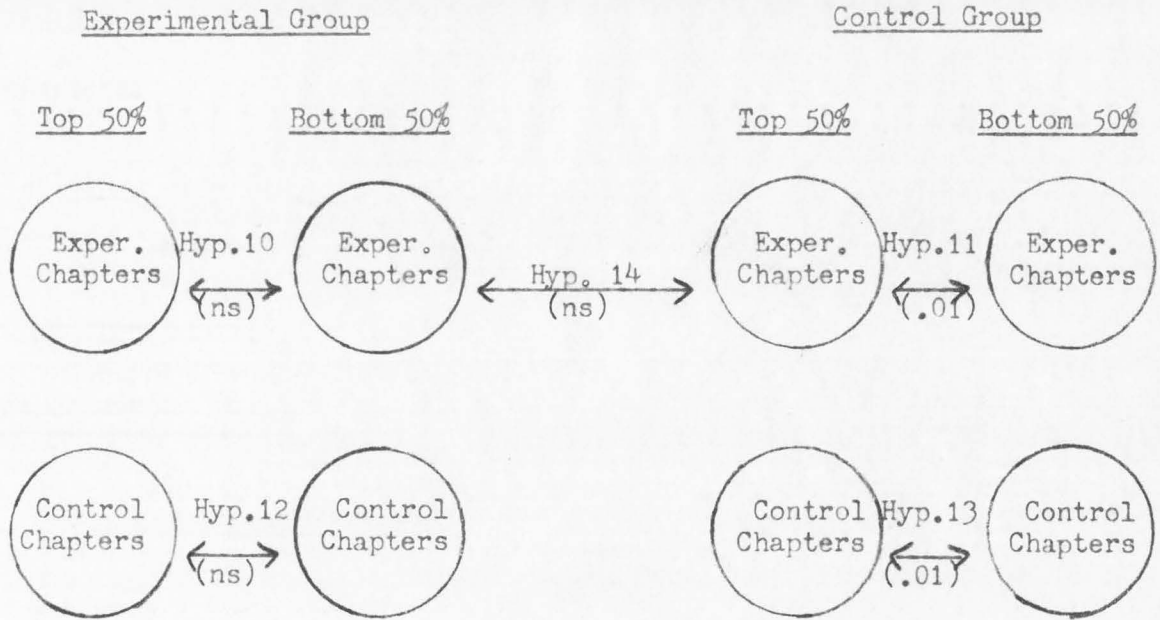


Figure 4. Graphic presentation of the conditions tested on the basis of differences in study habits and attitudes, identified by hypothesis and the resulting level of significance (significance of the difference between means)

Fifteenth hypothesis, Figure 5

In order to determine whether there is a significant difference between the correlation of achievement gains with verbal ability of the experimental group on the experimental chapters, and the correlation of achievement gains with verbal ability of the control group on the experimental chapters, two basic steps were followed. Correlations were determined between achievement gains and verbal ability for both groups. Then a test of significance was applied to these correlations. The correlation for the control group was .38 and the correlation for the experimental group was .49 (see Table 9). The resulting critical ratio of .69 is not significant, and on this basis the null hypothesis is accepted. It can, therefore, be concluded that there is no significant difference between the correlation of achievement gains with verbal ability of the experimental group on the experimental chapters, and the correlation of

achievement gains with verbal ability of the control group on the same chapters.

Table 9. Significance of the difference between the correlations of achievement gains with verbal ability for the experimental and control groups on the experimental chapters

Control Group Experimental Chapters	Experimental Groups Experimental Chapters	CR
.38	.49	.69

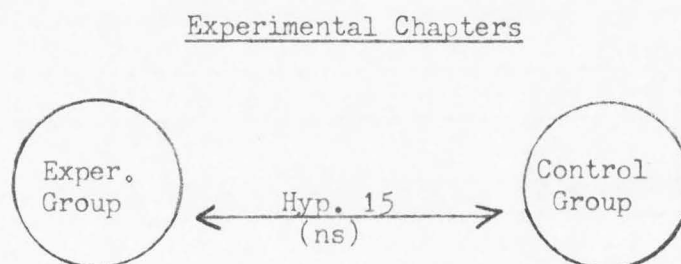


Figure 5. Graphic presentation of conditions tested relating to correlation of achievement gains with verbal ability, identified by hypothesis and the resulting level of significance (significance of the difference between correlations)

Sixteenth hypothesis, Figure 6

A test for standard deviations was used to determine whether there was any significant difference between the variability of the achievement gains of experimental subjects on the experimental chapters, and the variability of the achievement gains of same subjects on the control chapters. The standard deviations of the gains on the experimental and control chapters were 8.178 and 8.705 respectively. The correlation between the gains of the two sets of chapters was .44 (see Table 10). The resulting critical ratio of .49 is not significant and, therefore, the null hypothesis is accepted. On this basis, there is no significant

difference between the variability of the experimental group's achievement gains on the experimental and control chapters.

Table 10. Significance of the difference between the standard deviations of achievement gains for the experimental and control groups on the experimental and control chapters

Group	Exper. Chpts.	Cont. Chpts.	CR
Experimental	8.178	8.705	.49
Control	7.58	8.45	.91

Seventeenth hypothesis, Figure 6

A test for standard deviations was used to determine whether there was any significant difference between the variability of achievement gains of control subjects on the experimental chapters and the variability of achievement gains of the same group on the control chapters. The standard deviations on the experimental and control chapters were 7.58 and 8.45 respectively. The correlation between the gains of the two sets of chapters was .52 (see Table 10). The resulting critical ratio of .91 is not significant and, therefore, the null hypothesis is accepted. It can be concluded that there is no significant difference between the variability of the control group's achievement gains on either the experimental or control chapters.

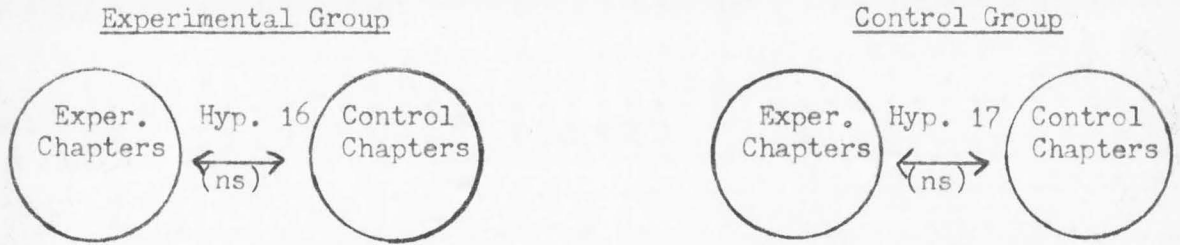


Figure 6. Graphic presentation of the conditions tested relating to variability of achievement gains, identified by hypothesis and resulting level of significance (significance of the difference between standard deviations)

DISCUSSION

The reader will recall that the two major objectives of this study were to determine the effectiveness of the machine as a study aid, and to determine for whom the machine is best suited, that is, who is the student that makes the greatest achievement gains. The discussion of the results will be considered as they relate to these two objectives.

The Teaching Machine as a Study Aid

To this writer's knowledge, none of the studies previously done on the effectiveness of the teaching machine have been specifically designed to determine its applicability in a study situation, though several have approached this area. Therefore, in this respect, this particular investigation is unique, although it is a legitimate question to inquire as to the factors involved that really set it apart from the other studies. Indeed, in many aspects the lines of distinction may be very thin and undefined, but three critical differences seem to be evident. First, all subjects were initially exposed to the subject matter in a supervised study situation. This study situation, though supervised, was uncontrolled in that the subjects were allowed to use their own approach to studying the material. A second difference, closely related to the first, is that the subjects used the machine after they had been exposed to the material, as opposed to being exposed to the material at the same time they worked with the machine. A third, and final critical difference, is that in the program development no special effort was made to arrange the items in order of difficulty, leading from the most elementary concepts to the high level of competence desired. Rather, the material was

prepared in a logical sequence, primarily as it appeared in the text, and consisted not only of questions and answers, but also of discussions on each item. In the discussion, the concept involved in the item, and/or related information was reviewed. At this point, one of the most obvious questions that remains unanswered as it relates to this investigation is what the effects might have been were the program to have been modified or changed in any way. Perhaps even when using the machine as a review device it is necessary to program the material in a series of small steps.

All studies previously done have their unique characteristics, with varying amounts of control over the experimental design. The major similarity, however, between all of these studies, including this one, is that the teaching machine acts as the independent variable with achievement gains being the dependent variable.

Most of the studies to this point, though in many cases quite different in design, have found that the subjects using the teaching machine make greater achievement gains than those not using the machine. Granting that this design is sufficiently similar to those previously followed, it can be expected that the findings will support the majority of the available literature. An analysis of the results in the previous section indicates that this study does support those previously done.

The experimental group, using the machines, made significantly greater gains on the experimental chapters than did the control group, not using machines. To further add to the consistency of this finding, the experimental group made significantly greater gains on those chapters reviewed using the machine than they did on the chapters not involving the machine. In addition, the control and experimental groups showed no significant difference between their performance on the control chapters, in which neither group used the machine. It was also found that the

control group did not register significantly different gains on the experimental chapters than they did on the control chapters. On this basis, the evidence appears definite that those using the machine did make significantly greater gains.

The next question that presents itself, and one which is perhaps the most critical, is just why such results were obtained. Does the machine itself really facilitate performance to this degree, and if it does, what factors are inherent within the process which contribute to this? Perhaps the machine in and of itself is not entirely responsible for the results; but if not, what other factors are interacting with such a high degree of effectiveness? It was the intent of this experimental design to control as many of the variables as possible, leaving the machine process itself as the only major uncontrolled variable. If we grant that our design has accomplished this objective, then we look to factors within the machine. In doing this we find that the majority of these have previously been discussed in the literature and include such significant factors as reinforcement, immediate feedback, active student participation, student paced learning, and applicability to special groups. An additional factor, not commonly mentioned, is that the machine may function as a device forcing some students to study that otherwise might not. It seems to this writer that when the machine is used as a study aid there is not nearly as much effort required on the part of the student. In other words, the machine is less demanding. If the student is left to use his own approach, he is required to exercise a certain amount of independence and originality in developing new and effective ways of mastering the subject material. Since this is hard for certain people, they become very stereotyped and perhaps eventually non-effective in their study approaches. The machine, however, alleviates

this problem to a certain degree, in that it incorporates certain basic desirable learning principles.

There are one or two other factors which may have had some effect upon the performance of the subjects in this study, the study environment being one. In the experimental group the subjects were all seated around a large table upon which the machines were placed, and everyone was active in working the machine. A subject would be less apt to sit and do nothing in such a situation, where it would be obvious to everyone else that he was not utilizing his time, than it would be in a situation where it was difficult to tell how involved a person has become in the study situation. In the control group study sessions, it was possible to control the material the student was working with, but it was impossible to control the degree to which he studied the material. It is quite possible that some of the control subjects did absolutely nothing, or very little, during some of the review sessions. In the experimental group, on the other hand, while it was still impossible to control the degree of concentration and effort, yet the subjects did work the machines and in so doing were more apt to receive gains than were their counterparts in the control group.

One other factor, by way of speculation, that may have had some influence on motivation and effort, is the way in which each group perceived its role in the experiment. Care was taken by the experimenter not to give one of the groups more attention or personal consideration than the other. However, the nature of the experimental design itself may have served to cause one group to feel they were somewhat more special than the other group. This is something that was not measured, and perhaps is not significant, but nevertheless remains as a factor to consider.

In summary, it is the opinion of this writer that the gains are no

doubt a product of several factors, some identifiable, and some unidentifiable. Some, of course, are more influential than others. But even granting that many factors are functioning, it is felt that by far the most significant factors are those that relate to the machine process itself, and if it were possible to control these other factors it is doubtful that the overall results would be substantially affected.

Student Discrimination by the Teaching Machine

Since the results of this study show the experimental group making significantly greater gains, a next logical question might very well be concerned with the characteristics of the student making the greatest achievement gains, that is, for whom is the machine best suited. There has been relatively little done in this area, other than a few studies which hint at the problem (see Review of Literature). Briefly, these studies indicate the following:

1. That bright students do well on the machine.
2. Conversely, that performance seems to be independent of intelligence and aptitude.
3. The variability of achievement scores for those using the machine is smaller than for those not using the machine.

A smaller variability of scores would indicate that the machine has a tendency to equate the performance of the bright and dull students. The fact that variability is decreased, however, is not substantiated by all investigators, for some have found just the opposite. In short, it can be said that a great deal of further investigation is necessary in all areas that relate to the machine and its applicability to special groups in given situations.

This study used four techniques in approaching some of these problems:

1. Comparisons between the top and bottom 50 percent of each group in verbal ability
2. Comparisons between the top and bottom 50 percent of each group in study habits and attitudes
3. Correlations of the gains of each group on the experimental chapters with verbal ability
4. Measures of variability of the gains for each group on each set of chapters.

Performance of the top and bottom 50 percent in verbal ability

Mastery of psychology, to a great extent, is dependent on verbal ability. Therefore, it would be expected that those subjects more capable in verbal ability would do better than those not so capable. This is supported by the fact that the top 50 percent of the control group did significantly better (.01 level) than the bottom 50 percent on both sets of chapters. The variance ratio on the experimental chapters was 20.70 as compared to 14.60 on the control chapters. This suggests that not only does study of psychology favor the student with higher verbal ability, but a required study situation tends to accentuate these differences. This would be expected in view of the fact that the content is largely verbal in nature and the required study periods would tend to place the student with high verbal ability at a distinct advantage.

In comparing the performance of the top 50 percent of the experimental group with bottom 50 percent on the experimental group, it was found that the top 50 percent made significantly greater gains, but only at the .05 level as compared to the top 50 percent of the control group that made significantly greater gains (.01 level) than did the bottom 50 percent of the control group. Though this is not conclusive by any means, the smaller mean difference suggests the use of the machine may

tend to compensate somewhat for verbal ability, The picture is not entirely clear, however, for in comparing the top 50 percent of the experimental group with the bottom 50 percent, on the control chapters, it was found that no significant difference existed. This writer can not present any justification for this in view of the other findings, other than to suggest the possibility of transfer effects which are very unlikely to have affected the results to a significant degree.

An additional important comparison was made between the performance of the bottom 50 percent of the experimental group in verbal ability and the top 50 percent of the control group, on the experimental chapters. The results showed no significant difference in their achievement gains. This again suggests a beneficial influence of the machine on performance. From previous results it can be concluded that the machine will benefit all students, but from this latter comparison it is interesting to note that those in the lower 50 percent in verbal ability do as well when using the machine as the top 50 percent in verbal ability when not using the machine. Again this suggests that the use of the machine tends to compensate for verbal ability, but it does not infer that this compensation is such that it would enable the student scoring in the bottom 50 percent to equal or exceed a student scoring in the top 50 percent who also used the machine.

In summary, it can again be emphasized that all students benefit by the use of the machine, and that students below the fiftieth percentile do as well, if the machine is used, as students above the fiftieth percentile that do not use the machine. In addition, there is a slight indication that the machine may favor the student scoring in the lower 50 percent in verbal ability, by virtue of the fact that the final mean differences between top and bottom 50 percent were not as great for the

experimental group as they were for the control group.

The reasons why the machine facilitates learning have been presented before and will not be repeated, however, there is one additional factor which may be appropriate in this regard. The program was designed to consider the more significant points throughout the chapter, and as a result, much of the unnecessary and irrelevant material was not included. This made it unnecessary for the student lacking in verbal ability to select and learn these significant points--it had already been done for him. Consequently he was able to function at a much higher level of efficiency than he otherwise would. As far as the student with greater ability is concerned, it would make little difference for he would be apt to more readily make the distinction without the aid of the program. It is also possible that the discussion part of the items further aided the student of lesser verbal ability in that it added further organization and understanding to his study approach.

Correlation of gains with verbal ability

Another approach to the problem of the relationship of verbal ability with performance was the correlating of the achievement gains on the experimental chapters, for each group, with their respective scores in verbal ability. The reader will recall that Porter (46) found after using the machine in the teaching of spelling, the relationship between achievement gains and intelligence was not significant. However, he found that a positive relationship existed between the achievement gains and intelligence of those subjects not using the machine. Porter thus suggests that learning by the machine is independent to a degree from intelligence. Carr (9) reports that others have apparently found the same thing and also indicates that the same holds true for aptitude in a given subject.

The purpose of this phase of the study is to determine what effects teaching machine instruction has upon the correlation between achievement gains and verbal ability. In correlating the achievement gains with verbal ability for those not using the machine the result was a correlation of .38. The comparable r of those using the machine was .49. These were not significantly different. In addition it will be noted that the correlation for the group using the machine was higher, though not significantly so, than the correlation for the group not using the machine. Such a result certainly does not support previous findings.

In this regard, however, it should be noted that the comparisons in this case are not exactly comparable with those made by Porter. Porter's achievement gains were in spelling and the comparison was with intelligence, while the comparison in this case was between achievement gains in psychology and verbal ability. In addition to this, the age range was entirely different. Porter used second and sixth grade elementary school children, while this study employed college students.

Therefore, while Porter suggests that achievement is independent of intelligence, it certainly cannot be said that achievement in psychology is independent of verbal ability. Mastery of psychology requires a certain amount of verbal proficiency and whether the machine is used or not, achievement gains are partially dependent upon this verbal ability. Such a conclusion supports what was previously found, in that the machine compensates very little, if any, for verbal ability. In the former analysis, however, the results suggested a slight possibility; such is not the case here.

In discussing what is indicated by these results, this writer suggests that one of the most significant conclusions is that this area needs a great deal more research. It is quite feasible that it will be

impossible to find common rules which apply in all cases. What really may be indicated here is that there is a different and distinct relationship between the conditions of each experiment. That is, the relationship is dependent upon the subject matter, its presentation, and the criterion measures involved.

Performance of the top and bottom 50 percent in study habits and attitudes

The purpose of this phase of the study was to determine the relationship of study habits and related attitudes with teaching machine use. To this writer's knowledge, there have been no experiments done in this area.

On both the experimental and control chapters, the control subjects in the top 50 percent made significantly greater achievement gains than did the lower 50 percent (.01 level). This finding is not unusual, for it would be expected that the subjects with better study habits would make greater achievement gains, all other things being equal. However, it is important to note that the top 50 percent of the experimental group, though they made greater gains, did not make significantly greater gains than did the bottom 50 percent when using the machines. This indicates that while the machine helps everyone make greater gains generally, the machine compensates for poor study habits. The result being that the student with poor study habits, when using the machine, makes a comparable achievement gain with the student with better study habits. This is not the case with students not using the machine, where significant differences emerged.

A further comparison was made which further illustrates the value of the machine in causing greater achievement gains. It was found that subjects in the bottom 50 percent on study habits and attitudes, when using the machine, made greater achievement gains (though not significantly)

than did the top 50 percent not using the machine.

In addition to the factors incorporated in the teaching machine process that have previously been referred to, there are some additional reasons which might be suggested as contributing to the compensating role of the machine as it relates to study habits. The machine has a tendency to "force" some subjects to study that otherwise would not make a consistent effort. In the teaching machine we have a device that more readily commands the subject's attention, and also provides a unique and a much more effortless approach to study. The subject is not required, for the most part, to use any originality in study approach, or to worry about sound learning principles because these have all been taken into consideration in connection with the teaching machine process and the preparation of the program. These factors seem, to this writer, to be significant contributions in causing the student with the poorer study habits and attitudes to make achievement gains relatively comparable to those students with the better study habits.

Though the evidence is in favor of this conclusion, there is one further comparison that presents results somewhat more difficult to explain, and which would certainly identify the need for additional investigation. On the control chapters, the top 50 percent of the experimental group did not make significantly greater gains than did the bottom 50 percent, as would be expected in view of the control group findings, and the fact that on the control chapters, the experimental group did not use the machine. This is difficult to understand why such would occur, however, one explanation which surely deserves consideration is in regards to the amount of transfer that might have been experienced by the experimental group as a result of their participation on the machine. The reader will recall from the review of literature that one of the

questions posed by investigators is in regards to the degree and nature of transfer that may occur as a result of variable interaction. In this case, one plausible explanation is that the students with the poorer study habits learned effective study approaches and techniques, by using the machine, which were readily transferable to their more conventional study methods. While this is a very real possibility there is a question as to how much transfer would be functional under such conditions and is it such that it results in no significant differences. Indeed, this is not an easy question to answer.

Variability of achievement gains

One final approach to the problem of teaching machine effects upon achievement gains was to compare, for both groups, the variability of the achievement gains on the experimental chapters with the variability of the achievement gains on the control chapters. There does not appear to have been any intensive study into this problem, but several have reported giving it limited consideration. The reports are by no means conclusive, with there being quite a divergence in findings with some indicating greater variability as a result of teaching machine instruction, and some indicating less variability, with a tendency towards the latter (see Review of Literature). The problem of score variability has definite implications as to the nature of the student making the greatest gains. Decreased variability, as a result of using the machine, would indicate a more homogeneous grouping of scores, which in turn would indicate that the machine has a tendency to equalize the performance of the good and the poor student. A greater variability would indicate an accentuation of the already existing differences.

In this study the standard deviation was the measure of variability used. In comparing the variability of the achievement gains on the

experimental chapters with the variability of achievement gains on the control chapters, for the experimental group, it was found that there was no significant difference. The standard deviation on the experimental chapters was actually slightly smaller, however, not sufficiently so to suggest the trend toward a lower variability resulting from teaching machine training. The importance of the slightly smaller standard deviation in favor of the experimental chapters is further minimized in view of the fact that the standard deviation of the control group performance on the experimental chapters was also smaller, though not significantly so, than the standard deviation on the control chapters.

A consideration of these two findings would lend doubt as to whether the machine actually does cause a decrease in variability, at least under the conditions of this study. It therefore, follows that the generally poor student does not benefit any more from using the teaching machine than does the better student. In considering why the standard deviations for both groups would be somewhat smaller on the experimental chapters, one possibility is suggested. The experimental design called for regularly scheduled study periods for both the control and experimental groups, during which the experimental chapters were to be studied. The fact that these study sessions were in a sense "forced," it is very likely that the decrease in variability was not a result of any method of study, but rather resulted because some of the students studied that otherwise wouldn't have. The fact that some students would not put forth as much effort on the control chapters (as is likely because no special consideration was given them) would cause these measures of variability to be somewhat higher.

The results of this phase of study are certainly not conclusive. The differences in variability are not significant and consequently on

this basis it cannot be determined whether the machine favors any "type" of student.

CONCLUSIONS

On the basis of the results obtained in this study, the following major conclusions are presented:

1. Subjects using the teaching machine made significantly greater achievement gains than did subjects not using the machine.
2. The achievement gains of subjects scoring below the fiftieth percentile in verbal ability were as great, when using the teaching machine, as the achievement gains of subjects scoring above the fiftieth percentile in verbal ability, not using the machine.
3. The achievement gains of subjects scoring below the fiftieth percentile in study habits and attitudes were as great, when using the machine, as were the achievement gains of subjects scoring above the fiftieth percentile in study habits and attitudes, not using the machine.
4. There is only a very slight indication that the machine compensates for verbal ability. The greater part of the evidence indicates that the machine makes no compensation for poor verbal ability.
5. Correlations between achievement gains and verbal ability indicate that achievement gains are not independent of verbal ability.
6. The achievement gains of subjects scoring in below the fiftieth percentile in study habits and attitudes, when using the machine, were not significantly different from the achievement gains of subjects scoring above the fiftieth percentile when using the machine. This indicates that the machine compensates for poor study habits to a large degree.
7. A comparison of the variability of achievement gains does not indicate that the machine is favorable to either the poor or the better student.

SUMMARY

Objectives

The two major objectives of this study were:

1. To determine the effectiveness of the teaching machine as a study aid at the college level.
2. To learn something of the student making the greatest achievement gains.

Methods and Materials

The subjects consisted of 103 general psychology students. These were divided randomly into two groups, an experimental and a control group. The experimental period lasted for seven weeks during which time sixteen chapters from a general psychology text were covered. Seven of these chapters received special consideration and consequently were referred to as experimental chapters. The remaining nine chapters were referred to as control chapters inasmuch as they did not receive any special consideration. One experimental chapter was covered during each of the seven weeks. In addition at least one, and sometimes two, control chapters were covered each week.

At the beginning of the experiment a pre-test covering course content was given all subjects in order to determine the initial knowledge of general psychology. Also given, during the experimental period, were measures of verbal ability, and study habits and attitudes.

During the first class period of each week all subjects studied an assigned experimental chapter utilizing their own study methods. During

scheduled periods during the last three days of each week all subjects spent two fifty minute periods in review of the chapter studied the first of the week. The experimental group reviewed the material using the teaching machine, for which a review program had been prepared. The control group reviewed the material utilizing their own study methods. At the end of the seven week experimental period a final test was given to determine the amount of achievement gain registered by each S.

During the experimental period accurate records were kept of student participation, and the number of hours spent in outside study. In order to control as many variables as possible, and leave the teaching machine as the only major uncontrolled variable, all subjects received exactly the same procedures with the one exception being that the experimental group used the machine in review and the control group did not.

Seventeen corollary hypotheses were used to test the objectives and experimental hypotheses previously outlined. The basic statistical device was a test of significance of the differences between means using an analysis of variance. When necessary, however, an analysis of covariance was employed to adjust the final mean differences on the basis of the initial test differences. Also used were tests of significance of differences between correlations and standard deviations.

Results

An analysis of the results showed:

1. That the experimental and control groups were closely comparable on initial testing.
2. That those using the machine made significantly greater achievement gains than did those not using the machine.
3. That subjects in the bottom 50 percent in verbal ability and

study habits and attitudes did not perform significantly different, when using the machine, from subjects in the top 50 percent in verbal ability and study habits and attitudes not using the machine.

4. That the machine compensates only slightly, if at all, for verbal ability.

5. That achievement gains made by subjects using the machine are not independent of verbal ability.

6. That the machine is very effective in compensating for poor study habits and attitudes.

7. That the machine does not serve to reduce the variability of achievement gains.

Also considered was a review of the literature that relates to the teaching machine movement, a discussion of the results, and also implications and suggestions for additional research.

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APPENDIX

APPENDIX A

CHAPTER 4

FEELING AND EMOTION

taken from

Morgan, Clifford T., Introduction to Psychology,
New York: McGraw-Hill Book Company, Inc., 1956

INSTRUCTIONS: This tape is designed to serve as a study aid in understanding and mastering the information on "Feeling and Emotion" contained in Chapter 4. There are a total of 100 items on the chapter and they have been divided into two parts. The first part (Part 1) consists of 60 items and the second part (Part 2) consists of 40 items. About 100 minutes will be required to complete the 100 items.

Each item consists of three parts: (1) the question, usually of a short answer type, (2) the answer to the question, and (3) a discussion of the question including a page reference.

Procedure: The handle must first be worked until Question number 1 appears in the lower half of the window. From this point on three steps are involved for each item: (1) You will read the question and will write your answer in the small open window to the right of the machine, (2) You will then work the handle once and in so doing the question will move to the upper half of the window as will also the answer. It will be observed that at this same time the correct answer will move from behind the black plastic shield in the lower right hand corner until it appears in the upper half of the window. Also, as the question moves into the upper half of the window a discussion of the question moves into the lower half. Thus you are able to see the question, your answer, the correct answer, and a discussion of the question. In some cases a discussion has not been given, but in every case there is a page reference. You will note that there is a small hole in the plastic shield covering your answer. This may be used in marking your answer. (3) You will then work the handle two times and the next question will appear in the lower half of the window.

The tape will move only one way while in the machine. Therefore, if you desire to do further study on any topic, it will be necessary for you to take any desired notes on the topic or page reference at the time the item appears in the window. The textbook may be used in connection with this tape.

PART I

1. About the only emotion that can be distinguished in the first few weeks after birth is _____.

diffuse general
excitement

This general excitement is about the same from one occasion to the next; it is not a specific response to any particular stimulus; it shows itself whenever the environment suddenly changes. p. 87.

2. What is the earliest age at which a child generally can respond differently to pleasant and unpleasant experiences?

three months

At three months he responds to unpleasant situations with general signs of distress, but he responds to nursing, fondling, tickling, and rocking with smiling and general signs of delight. p. 87.

3. Once a child begins to make a distinction between pleasant and unpleasant experiences the emotions begin rapidly to differentiate, and by _____ (give age) he has a repertory of specific reactions to different situations.

two years

See page 87

4. Before any diversity of emotional reactions can be fully developed it is necessary that there must be control of muscles of the face, the vocal apparatus, and the body. All this then, it would seem, would depend upon the maturation of the _____.

nervous
system

The control of the facial muscles, the body, and the vocal apparatus are dependent upon the nervous system. This is one reason why it is felt that maturation plays an important part in emotional development. p. 88.

5. It is probably true that patterns of emotion are dependent upon the (1) _____ of certain centers in the (2) _____.

1. maturation
2. brain

This is one reason why maturation undoubtedly plays an important role in emotional growth. p. 88.

6. Emotional development does not depend entirely upon maturation, for it undoubtedly also depends upon _____.

learning

You will recall the classic experiment of an eleven-month old boy named Albert. For detailed explanation of the experiment refer to page 88 in the text.

7. The case of eleven-month old Albert illustrates that _____
(name the emotion involved) can be learned.

fear

See page 88.

8. In the case of Albert, he learned to fear a _____.

white rat

Initially when Albert was shown the white rat he had no unfavorable reactions, in fact he was quite interested in it and tried to play with it. p. 88.

9. In the case of Albert, what two objects or experiences were paired to produce this fear?

A white rat
and a loud
noise

Every time Albert was shown the rat, the experimenter sounded a loud noise to which Albert initially had shown definite fear reactions. p. 88.

10. After Albert had been exposed to the rat and the loud noise several times, what was the result?

Albert showed definite fear reactions to the rat.

Albert showed these fear reactions to the rat even though after a time the loud noise was not presented along with the rat. p. 88.

11. What happened when Albert was shown a rabbit and other white or furry objects.

Albert became fearful

This illustrates that through learning, white furry objects had become emotionally charged stimuli for Albert. This same concept is applicable in everyday experience. p. 88.

12. In looking at the whole picture of emotional development it is rather likely that it is a product of _____ and _____.

maturation
and
learning

A further illustration of this is: The baby has many opportunities to learn in the first few months, yet he is slow in acquiring an emotional repertory as he is in walking and talking. p. 88.

13. It is difficult to say precisely what emotion is because it has many different aspects. Four aspects that the text lists are:

1. stirred-up bodily state.
2. something we do.
3. something we feel.
4. it is a motive.

It is a stirred-up bodily state because changes occur in our breathing, heart rate, circulation, and other physiological functions. It is something we do (a pattern of expression) because we smile, laugh, cry, cringe, etc. It is something we feel--happiness, disappointment, unpleasantness, elation, etc. It is a motive because it keeps us working toward some goals and avoiding others. p. 89.

14. The stirred-up or upset state that characterizes the more extreme emotions is (1) _____ (easy, hard) to detect in the (2) _____ organs of the body.

1. easy
2. internal

You will recall the survey made of more than 4,000 airmen who flew in combat during the Second World War. They experienced a wide variety of bodily changes and were able to indicate many of the symptoms when asked. For detailed breakdown on these symptoms refer to page 89.

15. The survey of 4,000 airmen who flew in combat during World War II indicated that the most common symptom experienced was _____.

Pounding heart
and rapid pulse

86% of the airmen responded in the affirmative that they had experienced this. The next most frequently experienced symptom was the muscles being very tense to which 83% replied in the affirmative. p. 89.

16. The part of the nervous system that initiates many of the bodily changes that occur in emotion is the _____.

Autonomic
system

Because many of the bodily changes that occur in emotion are initiated by the autonomic system these changes are called autonomic changes. p. 89.

17. The autonomic system consists of many _____ leading from the brain and spinal column out of the various organs of the body, including particularly the blood vessels serving both the interior and exterior muscles.

nerves

See page 89.

18. The autonomic system has two parts which usually work in opposition to each other. Name these two systems.

Sympathetic
Parasympathetic

These may not always be in opposition to each other but this statement can be made as a generality. pp. 89-90.

19. (A) Which part of the autonomic system swings into play when we become emotional, or at least fearful or angry? (b) Which part of the autonomic system tends to be more active when we are calm and relaxed. (though sometimes it may be active in emotion)

- (a) sympathetic
- (b) parasympathetic.

The sympathetic system increases the heart rate and blood pressure and distributes blood to the exterior muscles rather than to the digestive system. The parasympathetic system does many things that taken together, build up and conserve the body's store of energy. Among them is the slowing of the heart, reduction of blood pressure, and diversion of blood to the digestive tract. p. 90.

APPENDIX B

SUPPLEMENTARY TAPE

CHAPTER 9

PERSONALITY

taken from

Morgan, Clifford T., Introduction to Psychology,
New York: McGraw-Hill Book Co., Inc. 1956

INSTRUCTIONS: This tape consists of several items designed to help you master some of the more significant terms used in the chapter. When you finish the two parts of the basic tape on the chapter you are encouraged to make use of this supplementary tape. It should prove valuable in helping you master the information contained within the chapter.

Each item consists of two parts: (1) a statement, or statements, which is the definition for a specific term, and (2) the correct word, or term, the statement is describing.

Procedure: The handle must be worked until statement number 1 appears in the lower half of the window. You will read the statement and will then write the word you think it describes in the small open window to the right of the machine. Upon working the handle again the statement will move to the upper half of the window as will also your response. It will be observed that at this same time the correct answer will move from behind the plastic shield in the lower right hand corner until it appears in the upper half of the window. At this point you are able to see the question, your response, and the correct answer. You will note that there is a small hole in the plastic shield covering your answer. This may be used to mark your answer. You will then work the handle one time and the next statement will appear in the lower half of the window.

1. The extent to which a method of measurement measures what it is supposed to measure. Is expressed in terms of a coefficient of correlation representing the relationship of a set of measurements to some criterion.

Validity
(page 647)

2. A general term referring to any knowledge, skill, or capacity that can be demonstrated by appropriate measurements.

Ability
(page 624)

3. A tendency to respond either positively (favorably) or negatively (unfavorably) toward certain persons, objects, or situations.

Attitude
(page 626)

4. The traits, modes of adjustment, and ways of behaving that characterize the individual and his relation to others in his environment.

Personality
(page 638)

5. One of the psychoses, characterized by fantasy, regression, hallucinations, delusions, and general withdrawal from contact with the person's environment.

Schizophrenia
(page 643)

6. A class of individuals alleged to have a particular trait; but a concept not accepted as valid by psychologists because individuals cannot be grouped together into a few discrete classes.

Type
(page 647)

7. A pencil and paper test designed to measure different types of disturbances of personality. This is an example of a test so constructed that faking is difficult and that if faked it can be detected.

Minnesota Multi-
phasic Personal-
ity Inventory
(page 222)

8. The customs, habits, and traditions that characterize a people or a social group. It includes the attitudes and beliefs that the group has about important aspects of its life.

Culture
(page 628)

9. A device which makes a record of movement. It may be used to measure heartbeat, body sway, breathing, finger tremor, etc.

Kymograph
(page 635)

10. In general, the unique organization of traits, motives, and ways of behaving that characterizes a particular person; in psychoanalysis, the conception of the personality in terms of ie, ego, and superego.

Personality
structure
(page 639)

11. In psychoanalytic theory, that which restrains the activity of the ego and the id. This corresponds closely to what is commonly called conscience, it keeps a person working toward ideals acquired in childhood.

Superge
(page 645)

12. A pencil and paper test that measures six major areas of a person's interest: theoretical, economic, aesthetic, social, political, and religious.

Allport-Vernon
Study of Values
(page 223)

13. In psychoanalytic theory, the aspect of personality concerned with instinctual reactions for satisfying motives. This seeks immediate gratification of motives with little regard for the consequences or for the realities of life.

Id
(page 633)

14. Ability to profit by training.

Aptitude
(page 625)

15. In psychoanalysis, a term referring to the self and to ways of behaving and thinking realistically. It delays the satisfaction of motives, when necessary, and directs motives into socially acceptable channels.

Ego
(page 629)

16. The characteristic way in which an individual attempts to satisfy his motives.

Mode of adjustment.
(page 636)

17. In the study of personal adjustment, a tendency that is inherited or has a biological basis to develop certain personality disorders. Some individuals, for example, seem to have a biological predisposition for schizophrenia.

Predisposition
(page 639)

18. A paper and pencil test measures "sense of humor" as a characteristic of personality.

Cattell-Luborsky
Test
(page 224)

19. An aspect of personality that is reasonably characteristic of a person and distinguishes him from many other people.

Trait
(page 646)

20. Method used in the study of personality, in which a subject is presented with a relatively ambiguous stimulus and asked to describe it in a meaningful way or to tell a story about it.

Projective
method
(page 640)

APPENDIX D

Chapter 9

PERSONALITY

- I. Personality Characteristics
 - A. Traits
 - B. Types
 - C. Abilities, attitudes, and interests
 - D. Motives
 - 1. Basic Motives
 - 2. Conflict of motives
 - E. Modes of adjustment
- II. Methods of Measuring Personality
 - A. Pencil-and-paper tests
 - 1. Questionnaires
 - 2. Disadvantages
 - 3. Minnesota Multiphasic Personality Inventory
 - 4. Allport-Vernon Scale
 - 5. Cattell-Luborsky Test
 - B. Situational tests
 - C. Experimental measurements
 - D. Personal interview
 - E. Rating scales
 - F. Projective methods
 - 1. The Torschach Test
 - 2. Thematic Apperception Test
- III. How Personality Develops
 - A. Predispositions
 - B. Endocrine glands
 - C. Physique and temperament
 - D. Abilities
 - E. Culture
 - F. Family
- IV. The Individual and the Self
 - A. Individuality
 - 1. Uniqueness of personality
 - 2. Continuity of Personality
 - 3. Personality changes
 - B. Personality syndromes
 - C. Personality structure
 - D. The self
 - 1. Origin of the self
 - 2. Self-perception
 - 3. The self and emotional adjustment
- V. Summary

THE INFORMATION GIVEN BELOW WILL HAVE ABSOLUTELY NO EFFECT UPON YOUR FINAL GRADE IN THE COURSE; THEREFORE, PLEASE GIVE US THE BENEFIT OF YOUR HONEST REACTIONS TO THE STATEMENTS BELOW.

DIRECTIONS: For each statement below indicate whether you STRONGLY AGREE, AGREE, DISAGREE, or STRONGLY DISAGREE BY placing a check mark in the appropriate box to the right of the statement. RESPOND TO ALL OF THE STATEMENTS --- LEAVE NONE OF THEM BLANK. If you have a difficult time making up your mind just do the best you can and go on to the next item.

SA -- STRONGLY AGREE
 A -- AGREE
 D -- DISAGREE
 SD -- STRONGLY DISAGREE

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2
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| | | 4 | 3 | 2 | 1 |
| 1. I have found that the study sessions have helped me to develop more consistent study approaches. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | |
| 2. I appreciate the study sessions because I was made to study the material more comprehensively and effectively than I otherwise would. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | |
| 3. Participation in the study sessions each week has stimulated my interest in Psychology | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | ✓ |
| 4. At first the study sessions were quite beneficial but after a while they became boring and unproductive. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | |
| 5. It would have been a great help to have been required to review all of the chapters in similar study sessions. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | |
| 6. I feel I would have gotten much more out of the time required were I allowed to study on my own and had not been required to attend the established study periods. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | |
| 7. Any objection or feelings I have against the study is really a feeling against the time required outside of class and not against the study itself. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | |
| 8. The hour that was spent in class reading the chapter for the first time was worthwhile. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | |
| 9. It is not fair to require a General Psychology class to participate in a research project that requires additional time to be spent outside of class. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD | |

SA -- STRONGLY AGREE
 A -- AGREE
 D -- DISAGREE
 SD -- STRONGLY DISAGREE

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| 10. | The fact that I was asked to hand in a report on hours spent in study served to motivate me in studying all of the chapters. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 11. | I would have enjoyed participating in the study and would have learned more if the study environment had been improved. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 12. | I feel that I would have enjoyed the experience and gained more from the study if I had not felt this was something I had to do to get credit. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 13. | These types of study sessions help the poor student but not the good student. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 14. | While the study sessions are probably good for some people I feel that in my case I gained very little from them. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 15. | I would have participated in this study even if it was not compulsory. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 16. | Now, after participation in this study, I would participate voluntarily in a program requiring special study sessions. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 17. | If the study period approach to review were used in connection with another course it would be best to make participation a requirement of the course. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 18. | Lecture on a chapter after once reviewing it in a study session does not contribute anything, but is unnecessary repetition. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 19. | After finishing my review of each chapter covered during the study sessions I felt as though I knew the material more thoroughly than if I had spent an equal amount of time reviewing under circumstances of my own choice. | <input checked="" type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |

SA --- STRONGLY AGREE
 A --- AGREE
 D --- DISAGREE
 SD --- STRONGLY DISAGREE

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| 20. | I would have learned more if there had been more supervision and direction during the study sessions. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 21. | There is a distinct advantage in coming to a designated place at a specific time even tho sometimes it seems like a bother. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 22. | Before starting the final test I felt more confident about the chapters studied during the study periods than those that were not. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 23. | After the final examination I felt that the study sessions had been a definite aid in answering many of the test questions that came from the chapters studied during the study periods. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 24. | I wish that I had been a member of the other group rather than the group I was in. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 25. | At the beginning of the study I felt that the group I was in was at a distinct disadvantage, but at the end of the study I had changed my mind. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 26. | If special study sessions were required for all freshmen there would be fewer drop-outs and first year failures. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 27. | It would be a great help to college students if teaching machines were placed in the library and material were available for all courses | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 28. | I feel a little sorry now that I didn't use my time to greater advantage during the review sessions because I can now see that it would have been to my benefit. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 29. | I really did not put forth as much effort as I should have. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |

SA --- STRONGLY AGREE
A --- AGREE
D --- DISAGREE
SD --- STRONGLY DISAGREE

30. It would have been a great help to have had access to all of the tapes and a machine in order to review for the tests. SA A D SD
31. I could easily have used more than the two hours in the study sessions reviewing each chapter. SA A D SD
32. I have really enjoyed participating in the study. SA A D SD
33. COMMENTS: (in the space below please feel free to make any comments concerning the study or any of its implications. We would welcome your suggestions and criticisms.)

THE INFORMATION GIVEN BELOW WILL HAVE ABSOLUTELY NO EFFECT UPON YOUR FINAL GRADE IN THE COURSE; THEREFORE, PLEASE GIVE US THE BENEFIT OF YOUR HONEST REACTIONS TO THE STATEMENTS BELOW.

DIRECTIONS: For each statement below indicate whether you STRONGLY AGREE, AGREE, DISAGREE, or STRONGLY DISAGREE by placing a check mark in the appropriate box to the right of the statement. RESPOND TO ALL OF THE STATEMENTS -- LEAVE NONE OF THEM BLANK. If you have a difficult time making up your mind just do the best you can and go on to the next item.

SA -- STRONGLY AGREE
A -- AGREE
D -- DISAGREE
SD -- STRONGLY DISAGREE

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| 1. I have found that the machine has helped me to develop more consistent study approaches. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 2. I appreciate the machine because it made me study the material more comprehensively and effectively than I otherwise would. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 3. Using the machine has stimulated my interest in Psychology | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> S | <input type="checkbox"/> SD |
| 4. Using the machine to review certain chapters aided in studying other chapters. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 5. One may learn quite a bit at first, but after a few weeks of using the machine it becomes boring. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 6. It would have been a great help to have been able to review the rest of the chapters on the machine. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 7. I feel I would have gotten much more out of the time required were I allowed to study on my own and had not been restricted by the machine. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 8. Any objection or feelings I have against the study is really a feeling against the time required outside of class and not against the study itself. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |
| 9. The hour that was spent in class reading the chapter for the first time was worthwhile. | <input type="checkbox"/> SA | <input type="checkbox"/> A | <input type="checkbox"/> D | <input type="checkbox"/> SD |

SA -- STRONGLY AGREE
 A -- AGREE
 D -- DISAGREE
 SD -- STRONGLY DISAGREE

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| 21. | Lecture on a chapter after once reviewing it on the machine would not contribute anything, but would be unnecessary repetition. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 22. | After finishing the tapes on each chapter I felt as though I knew the material more thoroughly than if I had spent an equal amount of time reviewing any way I would like. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 23. | The tapes generally were in too much detail and consequently much time was wasted. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 24. | I would have learned more if there had been more supervision and direction during the study sessions on the machine. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 25. | Before starting the final examination I felt more confident about the chapters studied on the machine than those that were not programmed for use on the machine. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 26. | After the final examination I felt that the machines were a definite aid in answering many of the test questions that had, at one time, been covered on the machine. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 27. | I would have been more interested in the study if the program that was prepared for the machine had been more interesting. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 28. | I wish that I had been a member of the other group rather than the group I was in. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 29. | At the beginning of the study I felt that the group I was in was at a distinct advantage, but at the end of the study I had changed my mind. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |
| 30. | The teaching machine helps in memorizing facts, but it is of little use in learning principles. | <input checked="" type="checkbox"/> SA | <input checked="" type="checkbox"/> A | <input checked="" type="checkbox"/> D | <input checked="" type="checkbox"/> SD |

SA --- STRONGLY AGREE
 A --- AGREE
 D --- DISAGREE
 SD --- STRONGLY DISAGREE


- | | | | | | |
|-----|--|--------------------------------|-------------------------------|-------------------------------|--------------------------------|
| 31. | If special study sessions were required for all freshmen there would be fewer drop-outs and first year failures. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 32. | The teaching machine would not be practical for extensive use because it is too boring. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 33. | It would be a great help to college students if teaching machines were placed in the library and material were available for all courses. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 34. | I feel a little sorry now that I didn't use my time to greater advantage during the review sessions because I can now see that it would have been to my benefit. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 35. | I really did not put forth as much effort as I should have. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 36. | Use of the machine tends to leave a person with a false sense of security about his knowledge of the material. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 37. | I could easily have used more than the 2 hours on the machine in reviewing each chapter. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 38. | It would have been a great help to have had access to all of the tapes and a machine in order to review for the tests. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 39. | I have really enjoyed participation in the study and my work on the machines. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |
| 40. | I found that the supplementary tape on word definitions was a worthwhile addition to the basic tape because it provided working material for the more rapid student. | SA
<input type="checkbox"/> | A
<input type="checkbox"/> | D
<input type="checkbox"/> | SD
<input type="checkbox"/> |

41. COMMENTS: (in the space below please feel free to make any comments concerning the study or any of its implications. We would welcome your suggestions and criticisms.)

FORM: FC-1

NUMBER 10

INSTRUCTIONS

On the pages following you will find 90 multiple choice items. There is only one acceptable answer to each item, although in some cases it appears that there is more than one correct answer. In such cases select the most appropriate answer. After you have selected, from the alternatives given the answer you think is best then indicate your choice by making a heavy dark mark in the appropriate blank on the answer sheet. Example . Do not make any marks in this booklet. Make only one mark for each item and if you change your mind be sure to erase your first mark completely.

You have until the bell rings to finish. This means that you will have to work as rapidly as possible. When you come across a question you have difficulty with do not spend too much time on it, but rather, do the best you can and move on to the next item. When you finish the 90 items then go back and spend additional time on those items you had difficulty with. Your score will be the number of items marked correctly.

While working through the test items keep in mind that each item should be answered in terms of the psychological principles and concepts presented during the quarter.

G O O D L U C K

1. Hunger seems to result from chemical conditions in the blood because (1) hunger pangs and reports of hunger are associated (2) people without stomachs feel hunger (3) chemical changes associated with hunger are easily identified and demonstrated (4) all of these.
2. The maturation of the sex glands (1) occurs at puberty (2) is correlated with the appearance of sexual interest (3) determines the appearance of secondary sex characteristics (4) all of these.
3. Social techniques are (1) acquired through instrumental learning (2) innate (3) learned through classical conditioning (4) used only by human beings.
4. Repression (1) is quite distinct from forgetting (2) refers to the acquisition of unpleasant motives (3) causes motives to be unconscious (4) keeps us from fooling ourselves about our real motives.
5. Warmth, cold, and pain differ from other basic factors which serve to motivate behavior in (1) the kinds of receptors involved (2) the distribution of the receptors involved (3) the types of instrumental behavior they initiate (4) all of these.
6. Behavior may be classified as instinctive if it (1) occurs in the presence of a physiological drive (2) is unlearned (3) is complex (4) all of these.
7. Primary goals are similar to secondary goals in that (1) they are both learned (2) they both cause an animal to work. (3) they both satisfy a basic physiological need (4) they are both innate.
8. The motivational cycle usually starts with (1) consummatory behavior (2) a lack or deficit within the individual (3) goal-directed activity (4) random activity (5) instrumental behavior.
9. The need for security is best classified as a (1) primary need (2) affiliative need (3) status need (4) innate need (5) none of these.
10. Social values (1) are consistent from one society to another (2) vary from culture to culture (3) do not necessarily involve other people (4) are always enforced by law (5) are not influenced by words.
11. Instrumental behavior (1) accomplishes some result (2) is a reflex response (3) is an autonomic response (4) all of these.
12. College students learn mazes at what rate when compared to rats? (1) much more rapidly than (2) somewhat more rapidly than (3) at about the same rate as (4) more slowly than.
13. When school subjects aid in the solution of everyday problems, present day psychologists consider this a case of (1) retroactive facilitation (2) formal discipline (3) negative transfer (4) proactive facilitation (5) positive transfer.
14. Geometry would be most effective in providing for transfer of training if (1) the theorems and solutions of Euclid were carefully memorized (2) learning were massed rather than distributed (3) general principles and steps of reasoning were emphasized (4) the teacher pointed out its applications.

15. In memorizing lists of nonsense syllables, there is a maximum retroinhibition if (1) the responses on both lists are the same (2) both the responses and the stimuli on the two lists are different (3) the stimuli are the same, but the responses are different (4) there is a long rest in between learning the lists.
16. The common property of all the types of learning mentioned in your textbook is that (1) they all depend on reinforcement (2) they are all conscious (3) there is a change in behavior that results *from learning* (4) they all involve punishment (5) none of these.
17. If you often eat at the same restaurant and want the best service for the least money (1) never tip (2) tip only every so often (3) always tip, but in conservative amounts (4) give an enormous tip once, and never tip again.
18. The results of the Bryan and Harter studies on learning plateaus are applicable to the learning of (1) typing (2) piano playing (3) ping-pong playing (4) all of these.
19. The simplest example of learning is (1) the unconditioned response (2) the instrumental response (3) the conditioned response (4) the primary response (5) none of these.
20. Differential reinforcement refers to (1) reinforcing the correct response part of the time (2) secondary reinforcement without primary reinforcement (3) providing different reinforcements from trial to trial (4) reinforcing one stimulus and extinguishing another.
21. The artists of the Renaissance discovered that they could give depth to their paintings by employing certain principles, one of which is known today as (1) retinal disparity (2) kinesthetic cues (3) linear perspective (4) binocular cues.
22. "I couldn't concentrate on the dialogue for the crunching of popcorn all around me." For the person who made this statement, the dialogue was probably mostly (1) in the focus of attention (2) the margin of attention (3) outside the field of attention (4) below the threshold of attention.
23. Of the following cues for depth perception, the one that has not yet been clearly demonstrated to be important is (1) movement (2) shadows (3) convergence (4) interposition.
24. A 6-foot man looks to be 6 feet even when he is in the distance and is producing a small retinal image. This is due to perceptual (1) illusion (2) constancy (3) distortion (4) optical principle.
25. The meaning attached to objects aids us in (1) discriminating them (2) identifying them (3) remembering them (4) all of these.
26. Which of the following is an example of figure-ground? (1) boogie-woogie (2) profiles (3) person's movements (4) all of these.
27. A monocular cue for depth perception is (1) fusion (2) disparate images (3) convergence (4) linear perspective.
28. Our own internal needs and biases, which are both factors in motivation, affect mostly our perception of (1) inanimate objects such as tables and chairs (2) economic factors of value such as coins or money (3) environmental factors such as nature, plants, animals, etc. (4) complex things such as social and interpersonal relationships.

29. The world does not appear to ^{when we move} move our heads because of the influence of
(1) binocular cues (2) the static sense (3) set and expectancy (4) principle
of consistency (5) none of these.
30. The most important of all factors determining attention and perception are
(1) size and movement (2) intensity and contrast (3) sets and expectancies
(4) none of these.
31. The number assigned to horses at the race track best exemplify which of the
following scales? (1) nominal (2) to rate and to compare (3) ordinal
(4) ratio.
32. You can add and subtract the numbers on (1) a nominal scale (2) an ordinal
scale (3) an interval scale (4) all of these.
33. The first thing a statistician does in order to construct a frequency
distribution is to (1) count the cases (2) group the measurements into classes
(3) count of the mean (4) make a histogram.
34. The normal probability curve describes fairly accurately the distribution of
(1) intelligence (2) reaction time (3) height and weight (4) all of these.
35. If a distribution is of an undesirable shape, the best measure of central
tendency to use is the (1) mean (2) median (3) mode (4) none of these.
36. The size of the standard deviation varies with (1) the number of cases
(2) the location of the mean (3) the robustness ~~of~~ the nature of the distribution
(4) the standard used in computing it. *or*
37. Inferences of causation are made from (1) correlations (2) centiles
(3) standard scores (4) deviation scores.
38. The objection to grading essay examinations by counting number of words is
that it is not (1) valid (2) reliable (3) representative (4) none of these.
39. Standard scores are (1) always positive (2) never more than +1 or less than
-1 (3) either positive or negative (4) large when the mean is large and
small when the mean is small.
40. The correlation coefficient between the two forms of the Stanford-Binet test
is approximately (1) 1.00 (2) -1.00 (3) .90 (4) .50.
41. The list of psychosomatic disorders includes (1) influenza (2) cancer
(3) hives (4) all of these.
42. Repression (1) alters conscious goals (2) strengthens conscious motives
(3) strengthens conscious goals (4) intensifies conscious conflicts.
43. Suppose that after a mother scolds her son he proceeds to "take it out"
on his younger brother. In doing this he is making use of the defense
mechanism referred to as (1) projection (2) displacement (3) compensation
(4) reaction formation.
44. Yesterday a patient thought she was Martha Washington. Today she says she
is Madame Curie. The patient's illness is probably (1) paranoia (2) hebephrenic
schizophrenia (3) involuntional melancholia (4) paranoid schizophrenia.

45. The incidence of general paresis has been greatly lessened by (1) the discovery of psychotherapeutic techniques (2) new methods of brain surgery (3) the use of tranquilizing drugs (4) the discovery of penicillin.
46. Hostility and aggression (1) cannot be considered motivating forces (2) often conflict with the need for social approval (3) usually solve the problem of motivational conflict (4) are two quite different things.
47. Compensation is a method of adjustment in which (1) one motive is substituted for another (2) one goal is substituted for another (3) one activity is substituted for another (4) none of these.
48. Defense mechanisms are usually directed toward (1) the motivational conflict causing anxiety (2) the sources of frustration (3) the personality weakness which caused the conflict (4) the anxiety resulting from conflict.
49. The neurosis characterized by obsessions is classified as one of the (1) hysterias (2) psychasthenias (3) anxiety reactions (4) none of these.
50. Most generally the easiest conflict to resolve is the (1) avoidance-avoidance (2) approach-approach (3) approach-avoidance (4) double approach-avoidance.
51. The persons who have given us the most information concerning cultures are the (1) social psychologists (2) anthropologists (3) historians (4) naturalists (5) none of these.
52. The concentric organization chart shows well (1) minor organizational relationships (2) multiple roles (3) horizontal relations among workers of equal rank (4) informal relationships.
53. Of all the ways in which services to a society may be unequal, the most common differences arise from (1) sex (2) wealth (3) education (4) ability.
54. Multiple roles (1) always conflict (2) usually produce motivational conflicts (3) always complement each other (4) may help in the relief of conflicts.
55. The class that refers to itself as the working class is the (1) upper class (2) lower class (3) middle class (4) none of these.
56. In a nationwide sample of 1,100 adults, 51 per cent identified themselves with the (1) working class (2) lower class (3) middle class (4) upper class.
57. In the democratic group, the leader may be regarded as (1) the director (2) the traffic center (3) "the power behind the throne" (4) none of these.
58. Group learning can be described as (1) classical conditioning (2) mass trial and error (3) reeducation (4) desensitization.
59. All cultures develop social structures chiefly because (1) their members are born into different roles (2) some sub-groups naturally dominate others (3) people have innate needs for status (4) people depend on each other to an unequal extent for satisfaction of their needs (5) none of these.
60. Sociometric tests (1) are considered a valid and useful test for leadership (2) were proven ineffective during World War II years because officer's ratings of men were much better. (3) are being used less and less because of the difficulty in analyzing the data (4) define the desirable traits of leadership.

61. The best IQ test to use with mentally ill persons is the (1) Stanford-Binet (2) Wechsler-Bellevue (3) Otis (4) Army Beta
62. The most extensive factor-analytic studies of intelligence carried out in the United States were done by (1) Thurstone (2) Terman (3) Wechsler (4) Otis.
63. Most intelligence tests are not suitable instruments for comparing abilities between (1) different races (2) different cultural groups (3) individuals of different educational background (4) all of these.
64. The Vineland Social Maturity Scale weights (1) social intelligence (2) vocational intelligence (3) both of these (4) neither of these.
65. Test norms are obtained by giving a test to a (1) normative group (2) reference group (3) standardization group (4) validation group.
66. The first scientific test of intelligence was devised by (1) Kellogg (2) Binet (3) Otis (4) Terman
67. The IQ is primarily a measure of (1) mental age (2) chronological age (3) rate of mental development (4) nonverbal intelligence (5) ultimate potential.
68. Women excel men in (1) numerical ability (2) quick and precise movements (3) spatial comprehension (4) perception of spatial relationships.
69. In his follow-up study of children with an IQ above 140, Terman found that (1) about as many gifted children came from underprivileged homes as from privileged homes (2) all the gifted children became superior adults (3) those who became failures usually had emotional problems (4) in the long run gifted children were no more successful than average children.
70. Rural children do not score as well on intelligence tests as urban children because (1) brighter families migrate to the city (2) intelligence tests are not culture free (3) the stimulating environment of the city raises substandard intelligence (4) all of these.
71. The typical work curve was obtained on a job involving (1) clerical work (2) heavy handwork (3) heavy physical labor (4) fine work
72. Which one of the following types of activities does not involve a warm-up is (1) intellectual activity (2) clerical work (3) heavy hand work (4) none of these.
73. Recovery from fatigue (1) begins very slowly at first and gradually speeds up (2) is fairly rapid at first and then slows down (3) proceeds at an even pace (4) may be either (1) or (2) depending upon amount of fatigue.
74. The feature of work curves which can most often be considered psychological is (1) the warm-up effect (2) the error effect (3) the fatigue effect (4) the beginning spurt.
75. Excessive fatigue is least likely to cause a decrease in work performance when the subject (1) knows he is being tested (2) is working unsupervised (3) has shown a beginning spurt (4) is working under normal conditions.
76. Maximum total production from an individual can be gotten by having him work about (1) 25 to 33 hours per week (2) 36 to 44 hours per week (3) 48 to 54 hours per week (4) 54 to 60 hours.

77. In studies of industrial illumination it has been learned that (1) it is better to err on the side of too much illumination (2) reducing illumination can make production go up (3) indirect illumination is best (4) all of these.
78. The temperatures considered comfortable (1) are higher in winter than summer (2) become lower as the humidity rises (3) are lower in summer than in winter (4) become higher as the humidity rises.
79. Experiments show that the major effect of going without sleep for 4 days as measured by systematic tests was a change in (1) intelligence test performance (2) scores on special psychological tests (3) motivation and personality (4) general efficiency.
80. In some work situations where a change in a person's behavior cannot be observed, fatigue effects can be shown through (1) piloerection (2) pupil dialation (3) oxygen consumption (4) cannot be shown any other way except as it shows up in a persons observable behavior (lowering of output, errors, etc.)
81. A person who thinks he has good evidence for the way he thinks has an (1) attitude (2) belief (3) opinion (4) prejudice.
82. The person who associates only with "his own kind" is preserving his attitude by means of (1) withdrawal (2) social support (3) both of these (4) neither of these.
83. In constructing a scale, Likert uses (1) members of the target group (2) experts (3) psychologists (4) a panel of judges.
84. Open-end poll questions are usually scored (1) according to a designated code (2) according to the length and intelligence of the answer (3) by neutral observers with tabulating machines (4) by the person giving the answer.
85. Most large scale public-opinion polls now use (1) questionnaires sent by mail (2) the paired comparison method (3) quota sampling (4) random sampling.
86. A characteristic of propaganda is that it is (1) good (2) bad (3) not necessarily good or bad (4) usually both good and bad simultaneously.
87. To assess the influence of various cultural differences on attitudes we would most likely use (1) folk tales and proverbs (2) a factor analysis (3) correlational methods (4) sociological methods.
88. The typical individual (1) has enough facts to form his own opinions (2) must rely on authority for his facts (3) is seldom misled by the facts (4) usually has had enough contact with the object of his prejudice to justify it.
89. Prestige suggestion (1) is merely an instance of our reliance on authorities (2) alters a person's perception (3) involves identification with a leader or idol (4) all of these.
90. The "stock in trade" of the propagandist is (1) distorted facts (2) social suggestion (3) loaded words (4) appeal to needs.

FORM: FE-I

NUMBER 8

INSTRUCTIONS

On the pages following you will find 70 multiple choice items. There is only one acceptable answer to each item, although in some cases it appears that there is more than one correct answer. In such cases select the most appropriate answer. After you have selected, from the alternatives given, the answer you think is best then indicate your choice by making a heavy dark mark in the appropriate blank on the answer sheet. Example . Do not make any marks in this booklet. Make only one mark for each item and if you change your mind be sure to erase your first mark completely.

You have until the bell rings to finish. This means that you will have to work as rapidly as possible. When you come across a question you have difficulty with do not spend too much time on it, but rather, do the best you can and move on to the next item. When you finish the 70 items then go back and spend additional time on those items you had difficulty with. Your score will be the number of items marked correctly.

While working through the test items keep in mind that each item should be answered in terms of the psychological principles and concepts presented during the quarter.

G O O D L U C K

1. The mating of siblings is biologically poor practice because (1) all the children would be of the same sex (2) defective recessive genes would tend to be paired (3) recessive traits would tend to become dominant (4) it is against the law of nature.
2. Nature provides a "margin of safety" in the maturation process by (1) maturing organs well in advance of the time they are needed (2) making basic reflexes possible before they are needed (3) readying elementary forms of behavior 2 to 4 months ahead of time (4) all of these.
3. In one study on maturation it was observed that chicks who were kept in the dark for 5 days after hatching and then tested on their accuracy ^{at} pecking (1) failed to peck accurately about 25 per cent of the time (2) were practically perfect (3) made more errors than newly hatched chicks (4) needed a little practice to become perfect.
- F 4. The median age of children developing a certain skill refers to the (1) age at which all normal children have developed the skill (2) age at which half the children have developed the skill (3) age beyond which it is difficult for the child to develop the skill (4) age by which 75% of the children have developed the skill.
- F 5. Heredity is determined by the part of the chromosome called the (1) cytoplasm (2) gene (3) nucleus (4) enzyme.
- F 6. To be color-blind, a man must receive a gene for color blindness (1) from his mother (2) from his father (3) from both his mother and father (4) from his grandfather.
7. The first stage in the development of the sensory-motor arc is one in which (1) sense organs connect with the nervous system (2) the nervous system sends down nerves to the muscles (3) the sense organs, nervous system, and muscles develop separately with no connection between them (4) none of these.
8. We may conclude from studies of maturation and learning that (1) maturation determines the rate and limit of mental development (2) it is useless to "push" a child faster than his schedule of maturation permits (3) the fullest development of an individual depends upon learning (4) all of these.
9. In co-twin control studies, (1) experience is held constant (2) heredity is held constant (3) fraternal twins are separated to investigate environmental differences (4) identical twins are given exactly the same training opportunities.
10. The first type of sentence to be used by children consists of (1) only a noun and a verb (2) two or three unrelated words (3) a single word (4) a sentence repeated from an adult.
11. Children from 2-12 years of age tend to show the most fear when exposed to (1) strange things (2) animals (3) noises (4) threats.
12. Phobias and anxiety are similar in that (1) they both are based on fear (2) they are both based on generalization (3) they are both specific (4) they are both easily overcome.
13. Probably the most important source of frustration is (are) (1) environmental obstacles (2) unattainable goals (3) motivational conflict (4) personal failure.
14. The single emotion which is present in an infant for the first few weeks is (1) anger (2) fear (3) excitement (4) pleasure.

15. The most common symptom in fear, as observed in combat flying, is (1) a pounding heart and rapid pulse (2) feeling weak or faint (3) feeling sick to the stomach (4) trembling.
16. Adrenalin (1) has an effect similar to the sympathetic system (2) increases heart rate and blood pressure (3) aids in making more energy available to muscles (4) all of these.
17. Bodily changes are only easily distinguished between (1) mild and severe emotional states (2) fear and anger (3) fear and anxiety (4) any intense emotional states.
18. Judges looking only at facial expressions of emotion can best distinguish (1) surprise from fear (2) anger from fear (3) pleasant from unpleasant emotions (4) sorrow from anger.
19. The element in laughter-provoking situations that is most clearly recognized as important is (1) incongruity (2) pathos (3) novelty (4) aggression.
20. When a person indicates a preference between two things, it is an example of the method of (1) rating (2) order of merit (3) paired comparisons (4) none of these.
21. Learning and thinking are closely related because (1) many learning problems permit thinking (2) many thought problems permit learning (3) thinking usually results in learning (4) all of these.
22. The imageless-thought hypothesis led to two important ideas about thinking. They are: (1) eidetic imagery and set (2) set and unconscious processes in thinking (3) functional imagery and central processes (4) set and mental maps.
23. For Watson, the important aspect of thinking was (1) the set (2) association (3) muscle responses (4) images.
24. The purpose of the delayed-reaction technique is to (1) see how long an animal can withhold its response (2) force the animal to use symbolic processes (3) study the effects of delaying reward (4) eliminate problem solving on the part of the animal.
25. Five-year-old children can indefinitely extend sequences in the double-alternation problem because (1) they count and use language (2) they have accumulated experience with double alternation (3) they have developed the same symbolic processes as animals (4) they have learned to think in opposites.
26. Problem solving by insight may be distinguished from problem solving by rote in that (1) solution by insight requires past experience (2) solution by insight is more mechanical (3) solution by insight may be more novel (4) solution by rote always precedes solution by insight.
27. Reasoning differs from thinking in that (1) reasoning is problem solving (2) reasoning is a strictly human ability (3) reasoning involves putting two or more elements of past experience together to make something new (4) they do not differ.
28. Of the following, the one which is learned earliest in life is (are) (1) the rules of logic (2) simple association (3) reasoning (4) prejudice.

29. Cooperative problem solving by groups of people often has an advantage over individual problem solving because (1) it provides more incentive to succeed (2) it saves man-hours (3) two people can utilize language (4) two different people may not possess the same hindering set.
30. Factor analysis involving a large number of traits serves to (1) define additional traits (2) sort out useless traits (3) find a few basic traits that will describe behavior adequately (4) all of these.
31. According to the trait approach to personality, the behavior of an individual (1) can be predicted from a single act (2) is determined by his type (3) can be considered to fall along a continuum (4) none of these.
32. The test which assesses such traits as depression and paranoia on the basis of how normal and mentally ill people answered the questions is the (1) Allport-Vernon Scale (2) Minnesota Multiphasic Personality Inventory (3) Cattell-Luborsky Test (4) the Situational Test.
33. The effects of glands on personality (1) are commonly observed (2) are on the whole quite negligible (3) are seen only in dramatic cases of over or underdevelopment of glands (4) are seen most dramatically in the case of the thymus gland.
34. Personality is relatively continuous and unchanging because of (1) learning (2) endowment (3) social roles (4) all of the above three (5) personality is not relatively continuous and unchangeable.
35. Embedded patterns in designs cannot be seen easily by individuals who are (1) highly suggestible (2) inclined to be practical (3) very dominant (4) situation-bound.
36. An example of a determinant on the Rorschach test is (1) seeing animals (2) using shading (3) responding to a part of the blot (4) all of these.
37. The fact that your personality appears different to different people means (1) that personality is not really continuous (2) that your personality changes as you associate with different persons (3) that each judge of your personality observes you in a different context (4) all of these.
38. To be meaningful, personality characteristics must be (1) factorial and characteristic (2) distinctive and comprehensive (3) comprehensive and factorial (4) characteristic and distinctive.
39. To study leadership during the Second World War, the Office of Strategic Services used (1) pencil-and-paper tests (2) situation tests (3) projective tests (4) written personality inventories (5) none of these.
40. The type of therapy to which free association is most essential is (1) psychoanalysis (2) directive reeducation (3) distributive analysis and synthesis (4) client-centered.
41. The tendency of the patient to express toward the therapist those emotions formerly associated with others is known as (1) rapport (2) catharsis (3) transference (4) resistance.
42. A good general principle to follow in daily living is (1) "be realistic" (2) "never compromise your ideals" (3) "don't get mad" (4) "analyze yourself".

43. Society as a whole would benefit most from (1) psychotherapy for the chronically ill (2) psychotherapy for the severely disturbed (3) psychotherapy for the mild psychoneurotic (4) psychological support for the very young and very old.
44. Suggestion and hypnosis can be used effectively only (1) if the patient is easily hypnotized (2) if temporary relief is needed (3) in conjunction with other psychotherapy (4) all of the above.
45. Psychodrama is used as a technique (1) without an audience (2) with an audience that participates in the drama (3) with an audience of patients themselves the objects of therapy (4) all of these.
46. The greatest success with play and release therapy has been achieved by (1) emphasizing reeducation (2) avoiding much direction (3) emphasizing direction (4) avoiding all direction.
47. Useful work reduces conflict and frustration by (1) satisfying some goals (2) weakening some goals (3) both of these (4) neither of these.
48. The main aim of the client-centered therapist is (1) to help the person express his feelings freely (2) to interpret past experiences (3) to focus on what the therapist sees as the client's problem (4) to provide a dependent relationship.
49. The current trend in psychotherapy is toward (1) treatment of those having mild neuroses (2) treatment of those having severe psychotic disorders (3) the use of drugs and surgery in treatment (4) recommending hospitalization as a treatment for those having mild neuroses.
50. Beliefs are often stronger than logic because of (1) the weakness of the basic laws of logic (2) the conditioning history of the individual (3) the fact that beliefs are usually more correct than logic (4) all of these.
51. Probably the need best served by prejudice is the need for (1) affiliation (2) independence or dependancy according to how you look at it (3) status (4) companionship (5) attention
52. Most social institutions develop because people (1) need companionship (2) must defend themselves (3) have common interest (5) want to follow a leader.
53. In present-day industrial conflicts the power motive is (1) no longer of importance (2) Openly acknowledged (3) under cover but still operates (4) none of these.
54. A reasonable goal for dealing with social conflicts is (1) to eliminate them completely (2) to channel them into productive paths (3) to reduce their destructive consequences (4) all of these.
55. Mixing of white and Negro soldiers in Army units during the Second World War resulted (1) a reduction of prejudice (2) an increase in prejudice (3) ineffective units (4) intermarriages.
56. An attitude can be said to be stereotyped only if it is (1) unfavorable to one particular group (2) held generally by members of a group (3) based on a score of facts (4) all of these.

57. The extent to which prejudice will result in the segregation of a minority depends most on the (1) strength of the prejudice (2) true characteristics of the minority (3) identifiability of the minority (4) economic differences between the majority and the minority.
58. The goals or objectives upon which the members of a political party can agree are largely dependent upon the (1) party platform (2) size of the party (3) party candidate (4) strength of the party.
59. Anti-Semitic students were found to have (1) more than average aggressive needs (2) more than average sexual needs (3) both of these (4) none of these.
60. In prejudice, which of the following defense mechanisms is particularly prominent? (1) reaction formation (2) projection (3) displacement (4) regression (5) none of these.
61. Two general approaches to developing tests of interests are (1) empirical and theoretical (2) practical and rational (3) scholastic and vocational (4) personal and social
62. Moving pictures are best used in analyzing jobs that are (1) highly complex (2) impossible for expert job analysis to perform (3) highly repetitive (4) all of these.
63. The supervisor should communicate with his employees by (1) giving information in a few large doses (2) using technically correct language (3) telling them what they should know when they should know it (4) leaving problems of communication to professional writers.
64. Supervisors do not know how their ratings will turn out when they use (1) efficiency reports (2) man-to-man rating (3) forced-choice techniques (4) rating reports.
65. When workers rank pay as important to them, they want (1) high rate of pay (2) high total pay (3) fair pay in comparison with other people (4) none of these.
66. The widest range of ACCT scores occurs among (1) electricians (2) teachers (3) farmers (4) miners.
67. Construction of a new test differs from the validation of an existing test in that (1) no criterion group is used with new tests (2) new tests require an analysis for individual items (3) no criterion group is required for an existing test (4) existing tests require an analysis for each item.
68. A grade of C on the Strong test indicates that an individual's interests agree with those of how many members of a professional group? (1) an average (2) most (3) few (4) virtually all.
69. The information on an application blank can be considered to be (1) quantitative (2) qualitative (3) completely relevant (4) always necessary (5) none of these.
70. The most specific kind of achievement test is (1) a psychomotor test (2) a trade test (3) an intelligence test (4) a clerical-aptitude test (5) none of these.