A STUDY OF THE EFFICIENCY AND EFFECTIVENESS OF FOUR DIFFERENT MODES OF INSTRUCTION IN PROVIDING LEARNING EXPERIENCES FOR HIGH SCHOOL DRIVER EDUCATION STUDENTS

Thesis for the Degree of Ed. D.

MICHIGAN STATE UNIVERSITY

EDWARD ROY McINTOSH

1967

This is to certify that the

thesis entitled

A Study of the Efficiency and Effectiveness of Four Different Modes of Instruction In Providing Learning Experiences for High School Driver Education Students

presented by

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has been accepted towards fulfillment of the requirements for

Ed. D. degree in Education

Horace C. Harrell
Major professor

Date June 5, 1967

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ABSTRACT

A STUDY OF THE
EFFICIENCY AND EFFECTIVENESS
OF FOUR DIFFERENT
MODES OF INSTRUCTION
IN PROVIDING LEARNING EXPERIENCES FOR
HIGH SCHOOL
DRIVER EDUCATION STUDENTS

by Edward R. McIntosh

The purpose of this study was to secure evidence upon which to base the most efficient and effective design, production, and utilization of instructional materials. Although the literature leaves little or no doubt that people learn from films and other instructional materials, the problem confronting the instructional materials producer and user today is controlling learning so that the important concepts to be learned are not inhibited by non-essential information. The best use of instructional materials is accomplished by their design and use as individual or controlled combinations of materials called modes of instruction.

Little factual evidence exists upon which to base the most effective production of instructional materials. The problem of selection and use becomes one of logistics and strategy. Carefully stated learner-tasks in behavioral terms become essential to the process of selecting the best modes of instruction which permit the student to complete more

efficiently the prescribed task. At this time, there is little evidence to support specific environmental arrangements and materials combinations.

High school driver-education students were selected during the summer as the population for the study. All were novice drivers who had volunteered for the experiment. The area of driver-education was chosen because of the availability of a proven new, un-biased digital computer--the "Drivometer," which was mounted in the test vehicle that was used to collect and record the data.

Because novice drivers were used, basic driver-education instruction was necessary; but no projected instructional materials were used before the treatment. A paper-and-pencil test was then given to the students so that they might be grouped homogeneously in regard to their knowledge of driving, as shown by their paper-and-pencil test, their sex, and their instructor.

A three-by-three factorial analysis research design was used with four independent replications. Assignment was by random means, and subjects were treated using four different instructional materials. Two, called documentary materials, were not specifically designed to teach driving skills, whereas the other two, called non-documentary materials, were designed to teach freeway driving skills. The materials used were very different in their content treatment.

After the treatment, each subject drove on that part

of the freeway which had been selected as the test course for the study. The Drivometer recorded each student's performance on the four attributes of driving skill which it measured: (1) steering-wheel reversals, (2) speed changes, (3) accelerator-reversals, and (4) brake applications.

The research hypothesis was stated as follows:

> Students who have been exposed to one mode of instruction will make different mean scores on the Drivometer than will students who have been exposed to another mode of instruction.

Significant results were found at the .01 level for steering-wheel reversals, at the .04 level for speed-changes, and at the .001 level for accelerator reversals. The analysis, however, did not locate the specific cause of these significant differences. A further analysis was performed in order to identify the individual instructional material which was responsible for the significance found.

The analysis showed that the documentary materials were not nearly so effective in inducing student behavioral changes as were the non-documentary materials. In addition, the analysis showed that important differences existed between the non-documentary materials.

For high school driver-education students, it was found that instructional materials should present the concepts to be learned in a serious manner; should not introduce anything which inhibits or interferes with the attention to, and comprehension of, these concepts by the students; and should be concise and businesslike.

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By

Edward R. McIntosh

A THESIS

Submitted to
Michigan State University
In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF EDUCATION

College of Education

1967

ACKNOWLEDGMENTS

One person, more than any other, has made my doctoral study possible. Without the encouragement, guidance, critical questioning, and never-failing help given by my advisor--Dr. Horace C. Hartsell--the author's completion of the Educational Media Specialist program at Michigan State University would have been much more difficult. The author can never adequately express his thanks to Dr. Hartsell.

In addition, the author expresses sincere appreciation to the other members of his doctoral committee: Dr. Ted Ward, Dr. John Carson, and Dr. D. W. Olmstead.

Without the support of Dr. Charles F. Schuller, who helped the author secure a one-year National Defense Education Act Fellowship, the completion of this study would still be many months away.

Mr. Bob Shinn, of the Highway Traffic Safety Center at Michigan State University, gave unselfishly of his time and experience in making available his extensive knowledge of the Drivometer and in helping select the section of the freeway to be used. It was through his help that the Drivometer itself was made available for this study.

Sincere thanks are extended to Mr. Fletcher N. Platt, of the Ford Motor Company, for providing the vehicle, for

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making available the Ford sound-filmstrips, and for other aid. I also wish to thank Walt Disney Productions for providing a print of their film Freewayphobia.

Dr. Bruce D. Greenshields, of the University of Michigan, made available to the author his extensive engineering background and experience in both development work and research on the Drivometer.

The approval of the Lansing, Michigan, school system for the use of students at Sexton High School as the subjects for the study was greatly appreciated.

To Dr. Charles F. Martin, Jr., President of Radford College, Radford, Virginia, the author is especially indebted for Dr. Martin's help and understanding in arranging professional leave as well as for other considerations.

A special thank-you is extended to Dr. Edwin L. Stockton and to Dr. H. Dean Propst, professors of English at Radford College, for checking both the manuscript and the final copy of this thesis.

Others who have contributed to this research are Dr. Leslie Silvernale, Mr. G. V. Naidu, Mr. Lloyd A. Trinklein, and Mr. Bruce Rogers of Michigan State University; Mr. Dale France and Mr. Jim Bond of the Sexton High School, Lansing, Michigan; and Mrs. Patricia F. Krajci for her typing of this document.

Finally, my loving appreciation is given to my wife, Mary Frances, for her help, concern, encouragement, and never-wavering confidence in the ability of the author to complete his doctoral program.

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CHAPTER I

THE PROBLEM

The basic assumptions behind the production of instructional materials are that their use will cause change in the behavior of students who use the materials and that the change will be in a predetermined direction. Further stated, there are underlying principles with which to guide such production. Unfortunately, little research exists upon which to base most materials production; and what does exist is often not utilized. Hoban reinforced these assumptions by stating: "There is little evidence that film research findings have reached and influenced the producers or users of films for and in schools and colleges."[1] However, there is considerable supporting evidence that people do learn from films. Wittich and Schuller, for instance, reported on an early research study conducted by Yale University which tested the question: "Was the motion-picture film a serious and worthwhile means of contributing to classroom learning experiences?" They quoted the study by Yale University as

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[1]Charles F. Hoban, "The Usable Residue of Educational Film Research," New Teaching Aids for the American Classroom (Washington: U. S. Government Printing Office, 1962), p. 100.

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follows: "The result of this research established that the use of the 'Chronicles of America Photoplays' series increased pupils' knowledge of places, personages, and events from 19 to 35 percent. More important, it stimulated 40 percent more free reading by pupils who had seen and studied the silent film materials."[2] Arnspiger also pointed out the importance of films, for he believed that films

> (1) provide stimuli for reflective thinking, (2) provide for use of concepts mastered from film in new and different settings, (3) provide self measure of pupil's progress, (4) provide opportunity for creative and oral expression, (5) enable teachers and students cooperatively to build upon common experiences of film, and (6) build confidence for teachers.[3]

Additional studies up to the present time provide ample evidence that films do induce learning. Hoban made this fact clear:

> People learn from films. . . . A tremendous amount of research has been in the field of learning. As a result the evidence that factual, attitudinal, opinional, and preceptual-motor learning occurs when people are exposed to films is overwhelming.[4]

Hoban concluded: "It can safely be said that people learn from films."[5]

What does it mean to say that people learn from films? Facts may be remembered, associated, or recalled;

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[2]Walter Arno Wittich and Charles Francis Schuller, Audiovisual Materials: Their Nature and Use (4th ed. rev.; New York: Harper and Row, 1967), p. 401.

[3]When asked about his ideas concerning the unique contribution of films, Dr. Clyde Arnspiger made these statements to Dr. Horace C. Hartsell.

[4]Hoban, op.cit., p. 105.

[5]Ibid.

practice

processes may be explained; or aesthetic interests may be strengthened. To say that people learn from films tells little about the learning experience itself. Hoban emphasized the importance of analyzing the learning task when he identified the central problem of education as the control of learning:

> It is in the nature of man to learn. The central problem of education is not learning, but the control of learning. Once we have satisfied ourselves that people can and do learn from films, the problem becomes that of (a) controlling what is learned and (b) increasing the efficiency of learning.[6]

Ideally, teachers should select instructional materials to present information for a specific purpose and to present content so as to emphasize identified conceptual ideas. But few teachers are knowledgeable enough to select such instructional materials, and they are often not readily available since instructional materials' producers usually find a wider market for their product if it is general rather than specific in nature. Often the practice of presenting too much information on a given occasion tends to cause the specific concept being studied to become lost in a wealth of related information. Learning theory research has shown that this practice increases the probability of forgetting due to retroactive or proactive interference.[7] Yet the fault is often our own because, as Berlo put it, we fail to realize that we are in the "people

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[6] Ibid.

[7] Robert M. Gagne, The Conditions of Learning (New York: Holt Rinehart and Winston, 1965), p. 105.

business," that our "bucket" theory of communication places the meanings in symbols used rather than in the people who produce and receive these symbols. So we have only the lower meanings people have. Berlo stated:

> This viewpoint assumes that meanings are to be found in words or other symbols and that communication consists of the transmission of ideas from one individual to another through the use of symbols. This can be characterized as a process of dumping ideas from the source into a bucket--such as a film, a lecture, a book, television program or what have you--and shipping the bucket over to the receiver and dumping the contents into his head. Given the assumption that the meanings are contained in the bucket, it follows that if you fill the bucket with symbols that have the right meaning, the receiver will get the meaning out--if he is at all intelligent and interested in learning. Contemporary philosophical thinking suggests the fallaciousness of such a position, and communication research indicates clearly that "bucket" behavior provides severe and frequent communication breakdowns.[8]

This breakdown of communication often inhibits the transfer of conceptual information.

When a film is produced for a specific purpose, the objective for which it was produced is more effectively realized. One step in this direction is what is commonly referred to as the single concept film. A short length of film mounted in a repeating magazine can be replayed as often as needed. The single concept is strengthened because the instructional material used was produced and then presented as a bit of related perceptual information.

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[8]David K. Berlo, "You Are in the People Business," Audiovisual Instruction, XIII (June, 1968), 573-581.

Short films are one way in which emphasis can be given to specific concepts. Another way of treating content is to identify related concepts and to regard each as a module in a much longer film. The problem then becomes one of developing and using the proper combination of materials for teaching, for learning, and for developing modes of instruction which provide the best and most efficient learning environment.

Hartsell and Margoles pointed out an important aspect of the problem: "The difficulty most frequently occurs due to lack of a plan and because of ineffective communications among the researcher, the administrator, the teacher, and the educational specialists, i.e., media, learning, and evaluation." In addition, they operationalized problems involved in the selection of instructional materials by educators in terms of key curriculum issues:

> The key curriculum issues appear to be: (a) need for establishing priority, (b) importance of learning how to learn, (c) need to see the school program as a totality, and (d) caution in promotion of 'easy to adopt' packaged programs. A quantity of instructional materials is no assurance that the learner will reach his behavioral goals.[9]

The problem of selection and use becomes one of logistics and strategy. Carefully stated learner-tasks in behavioral terms become essential to the process of selecting the modes of

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[9]Horace C. Hartsell and Richard A. Margoles, "Guidelines for the Selection of Instructional Materials," Audio-visual Instruction, XII (January, 1967), 23-26.

instruction--modes which permit the student to more efficiently complete the prescribed task. At this time, there is little evidence to support specific environmental arrangements and media combinations.

Purpose of the Study

The purpose of this study is to gather empirical evidence relevant to the relationship between the use of different types of instructional media and their effectiveness in producing the best possible conditions for learning. Gagne has alluded to this problem:

> Still another implication that derives from a specification of the conditions of learning concerns the choice of media for instruction.
>
> The required conditions for learning can be put into effect in different ways and to differing degrees by each medium. . . . There are, then, some positive characteristics and some limitations of each instructional medium that become evident when they are examined in the light of their learning functions. . . . Instructional media constitute the valuable 'resources for learning' that an educational system has to draw on. When these resources are put to use, they are usually placed in some particular arrangement called a mode of instruction. . . . The various modes of instruction are employed for the purpose of getting the greatest instructional usefulness from media and combinations of media. Thus the choice of modes is also a matter of aiming for optimal functioning in generating the proper conditions for learning.[10]

Gagne realized that "it is these conditions that provide the immediate instructional purposes on the basis of which

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[10]Gagne, op.cit., pp. 28-29.

correct decisions can be made about media and modes of instruction."[11]

In this study, an attempt was made to provide answers to the problem of which mode of instruction or controlled combinations of various modes of instruction produce the best possible conditions for learning.

Need for the Study

The works of Hoban and Gagne seem to support the position that instructional materials do stimulate and increase learning. This concern for the quality of the learning experience and the implications of controlling the learning environment was especially emphasized. There is a need to know whether instructional materials and modes of instruction being used provide the best possible learning experience or whether some other combination of materials would produce a better and more meaningful learning experience. Prior research concerned with this problem consisted mainly of comparative studies in which one type of material was tested against another type. A film has been compared to a filmstrip in a specific situation. Newer instructional media have been compared with older types of media or with non-media instruction. For example, Hoban stated:

> Media research in education frequently deals with comparative learning, i.e., with the problem of whether the learning increment from the newer

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[11] Ibid.

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> media and methods is equal to, less than, or greater than that from older and/or more conventional methods.[12]

The use of instructional media increases learning, but not all types of media used in the same learning experience produce similar behavioral changes or provide equal conditions for learning. It is possible that one combination of media would provide a far better learning experience than would be afforded by another combination. The problem of films versus filmstrips is not the issue. The effectiveness and efficiency of various types of media or modes of instruction necessary to reach learning goals is the real issue. Emphasis must be placed upon the learning task and on producing the instructional materials which best help the learner most effectively achieve desired objectives. Evidence based upon empirical research should help provide these needed answers; should be of value in the design, production, and utilization of future instructional media; and should provide a base for better use of existing media.

Scope of the Study

The major limitation for examining media effectiveness has been the lack of reliable instrumentation with which to measure the efficiency and effectiveness of one mode of instruction when compared with another. Most studies have relied upon paper and pencil tests for factual information.

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[12]Hoban, op.cit., p. 105.

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Now a new instrument, referred to as the "Drivometer,"[13] may make it possible to measure the effectiveness of modes of instruction on covert behavior.

It is apparent that a study of this nature must have pre-stated limitations and that recognition and control must be given to certain variables. Those limitations and controls so identified are as follows:

(1) The variables will be limited to those derived from the instrumentation used to measure and record differences in the effectiveness of one mode of instruction when compared with another.

(2) The statistical analysis performed will be limited to comparing the efficiency of four modes of instruction when they are used as instructional media in the same learning experience, to collating one type or combination of media with the other types and combinations, and to locating possible interaction effects between all combinations of media tested.

(3) The modes of instruction to be used in driver education training will be limited to four types of media--namely, (a) a standard film, The Case of Officer Hallibrand, (b) a horror film, Signal 30, (c) a teaching film, Freeway-phobia, and (d) a set of teaching filmstrips, Ford Time-lapse filmstrips--Freeway series.

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[13]The "Drivometer" is explained later in this chapter.

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(4) High school driver education students will be used, subject to the following limitations: (a) selection for assignment to treatment groups will be by a table of random numbers, (b) a three by three factorial analysis will be used with four replications. Each nine subjects required per replication will be as homogeneous as possible, (c) no subject will be selected who has had any driving experience before the driver education course, (d) no subject will be selected who is or has been a frequent passenger in a car driven on a freeway.

(5) A standard driving course on a freeway will be established, which each student will drive.

(6) Approximately a thirty-minute driving experience will be given each student for the collection of the data.

(7) No driving will be done on days when the pavement is wet or when there are high winds.

In this study, an attempt will be made to determine the degree of significance of each mode as it relates to the learner's achievement. The first mode of instruction consists of the teaching film, Freewayphobia, and the second consists of the teaching filmstrips, Ford Time-lapse filmstrips--Freeway series. They are combined into what is called teaching media. The third mode consists of the horror film, Signal 30, and the fourth consists of the standard film, The Case of Officer Hallibrand. They are combined into what is called documentary media. Whereas all four modes of instruction used in this

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study were designed to be used in the area of driver education, their content treatment was quite different.

The horror film, Signal 30, was designed to emphasize the personal danger involved in driving an automobile. Consisting of various color segments taken at the scene of actual highway accidents, the film shows in very graphic form what can happen to anyone who is involved in an accident. Very gory and gruesome, the scenes show smashed and burned victims.

The standard film, The Case of Officer Hallibrand, is a screenplay which portrays the last twenty-four hours in the life of a traffic policeman. Several characters commit various traffic violations in a typical middle-sized city. Finally, Officer Hallibrand is killed while chasing a speeding car. The film stresses the importance of safe driving, but does so without any of the shocking scenes or treatment of Signal 30. Although both of these films were designed to influence and promote safe driving, they were not produced to teach specific driver education skills. Therefore, they are documentary in nature.

The teaching film, Freewayphobia, was produced by the Walt Disney Studios to teach three main skills of freeway driving. These are (1) entering the freeway, (2) proper positioning of the vehicle in relation to traffic flow, and (3) leaving the freeway. The medium used to teach these skills was the Disney character "Goofy." The film was in bright

color, had an excellent sound-track, good narration, and presented the concepts to be learned in a very entertaining manner.

The teaching filmstrips, Ford Time-lapse filmstrips--Freeway series, were produced by the Ford Motor Company to teach four specific skills: (1) entering the freeway, (2) driving on the freeway, (3) passing on the freeway, and (4) leaving the freeway. One of these topics was assigned to each filmstrip. A series of rapid scenes keyed to the narration showed all of the steps necessary in order to learn the skill treated under each topic. Then every step was presented in detail. Finally, each step was again shown in a rapid sequence in order to reinforce upon the viewers' consciousness the continuity of the sequence of steps necessary to achieve safely the skill being presented. In these black-and-white filmstrips, nothing has been included which does not relate directly to the skill being presented. Whereas both Freeway-phobia and Ford Time-lapse filmstrips--Freeway series were designed for much the same purpose, the treatment of their content was quite different. Both however, were designed and produced specifically as teaching materials.

The area of driver-education was selected for the following reasons: (1) it was believed that any information which would improve the design of instructional materials in the area of driver-education would be of vital importance, and (2) it was believed that the use of a new and proven instrument, the "Drivometer," could record the covert, psychomotor

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behavior of the learner, thus providing the researcher with a more reliable measure of the effectiveness of a given mode of instruction.

Citizens of the United States are killing and injuring one another on the nation's highways at an appalling rate. One important way to begin reducing this slaughter is to change driver-behavior through the use of the best driver-education materials available and to produce better materials. It is imperative that program developers examine the prescriptive aspects of the problem as a follow-up to the descriptive approach. To prescribe, one must know materials effectiveness as well as the effectiveness of materials combinations. It was expected that the Drivometer would help identify such materials.

The Drivometer was developed as a joint effort by Mr. Fletcher N. Platt, Manager of the Traffic Safety and Highway Improvement Department at the Ford Motor Company in Dearborn, Michigan, and by Dr. Bruce Greenshields, who was formerly the acting director of the Transportation Institute and a lecturer in transportation engineering in the Department of Civil Engineering at the University of Michigan. He now maintains a research office in the Civil Engineering Department at the University of Michigan. The Drivometer can measure the three variables of driver performance, which are (1) tracking the vehicle, (2) measuring the speed control of the vehicle, and (3) positioning the vehicle in relation to the other elements within the driving environment. Completed research by

Greenshields, Platt, and others[14] has shown that the Drivometer does measure such variables and that these measurements can be analyzed by statistical techniques.

The Drivometer records the following information in digital form: (1) steering wheel reversals, (2) acceleration reversals, (3) brake applications, (4) vehicle driving time, and (5) total trip time. Steering wheel reversals measure and count each 3/8 inch turn of the steering wheel in either direction. The steering wheel reversal rate is a highly sensitive measure of driving skill, attitude, and emotional reactions. Acceleration reversals include acceleration rates and deceleration rates measured by the up-and-down motion of the foot-throttle feed. The other attributes measured are self-explanatory. In addition to the measures computed by the Drivometer, an observer in the car kept a record of road conditions and traffic flow as they occurred each minute.

The Drivometer is a mechanical computing and recording device that measures in a factual, unbiased manner the psychomotor changes occurring in driver performance. The research by Greenshields, Platt and others[15] has established both the validity and the reliability of the Drivometer as an effective and accurate instrument with which to measure changes in driver behavior.

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[14] Others listed in the Bibliography are Shinn, Reel, Burti, Gervais, and Fedderson.

[15] Supra, footnote 14, chapter i, p. 14.

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Major emphasis in the research was placed upon either the individual mode of instruction or the controlled combinations of modes of instruction. It was not placed upon the area of driver education as such. The researcher was concerned with testing a generality within a specific setting.

Definition of Terms

The terms defined in the section below are either those used to form the operational hypothesis, or those that do not bear a common referent to the literature of the educational field, or those which are used in a particular and limited sense in this study.

"Mode of instruction:" Any instructional materials or specific combination or arrangement of instructional materials or media used as a means for presenting ideas or concepts in a given learning situation.

"Instructional media, or media:" A term having the same meaning as instructional materials or materials. Filmstrips and motion pictures were used in this study.

"Drivometer:" An electrical multiple counting and recording digital computer used to measure the three main variables of driving performance.

"Horror film:" A documentary motion picture which stressed the dangers of driving by showing color scenes of gory accidents and accident victims. In this study, Signal 30 was used.

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"Standard film:" A documentary motion picture which stressed the importance of safe driving and the dangers of violating traffic laws. It did not show the gory scenes as mentioned above. In this study, The Case of Officer Hallibrand was the medium.

"Teaching filmstrips:" These were four black and white, sound filmstrips designed to teach specific freeway driving skills. In this study, the Ford Time-Lapse filmstrips--Freeway series were used.

"Teaching film:" This was a Walt Disney color motion picture film designed to teach specific freeway driving skills. In this study, Freewayphobia was used.

"Freeway driving:" All aspects of entering, driving, and leaving the freeway were included.

"Basic instruction:" The required non-media instruction each student received in freeway driving before any treatment.

"Paper-and-pencil test:" A test given to all subjects after basic instruction, but before the treatment called for by the research design.

"Non-documentary materials:" These consist of the Ford filmstrips and the Disney film.

"Documentary materials:" These consist of both the horror film and the standard film.

"Steering wheel reversals:" Any movement of more than 3/8 inch by the steering wheel in either direction as measured

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and recorded by the Drivometer. This is the most sensitive measure of driving skill, emotion, and attitude.

"Acceleration reversals:" All up and down motions of the accelerator of more than 1/8 inch.

"Brake applications:" The total number of times the brakes were applied during the trip.

"Vehicle driving time:" The actual time the vehicle was in motion.

"Speed change:" The minute-by-minute change in the speed of the vehicle. Each two and one-half miles-per-hour change in either direction was recorded as a half count by the Drivometer. At the end of the trip, this was shown as a total count.

"Total trip-time:" The total time required to return to the starting point.

"Tracking the vehicle:" The amount of deviation from a hypothetical straight line down the highway as measured by the Drivometer.

"Positioning the vehicle in relation to the other elements within the driving environment:" This is self-defined, but positioning is measured mainly by steering wheel reversals.

Hypothesis

The hypothesis presented here is in the general research form. In Chapter III, it is operationalized and presented in testable form.

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H_1: Students who have been exposed to one mode of instruction will make different mean scores on the Drivometer than will students who have been exposed to another mode of instruction.

Although this is a non-directional hypothesis, it was expected that the non-documentary materials would be more efficient and effective in providing the best control for learning.

Research Design

The design of this research is to measure the effectiveness of four modes of instruction as applied to driver education. The specific area of instruction used in the research was freeway driving. A three-by-three factorial analysis was used. Each mode of instruction was compared with the mode of instruction in a control group; and each treatment condition was compared with every other treatment condition for main effects, possible interaction, and significance.

Instructional materials dealt with were: (1) Ford Time-lapse filmstrips--Freeway series, (2) the Disney film--Freewayphobia, (3) Signal 30, and (4) The Case of Officer Hallibrand.

In figure one, the basic three-by-three factorial research design of the study is shown. In order to satisfy the assumption of independence of treatments, four independent replications were used.

Experimental Design

Figure 1.

		Columns	Non-documentary Materials	
		No Proj. Materials	Filmstrips (Ford)	Film (Disney)
Rows	No Proj. Mat.	Control group	Ford Timelapse filmstrips--Freeway series	Freewayphobia
Documentary Materials	Horror Film	Signal 30	Signal 30 and Ford Timelapse filmstrips--Freeway series	Signal 30 and Freewayphobia
	Standard Film	The Case of Officer Hallibrand	The Case of Officer Hallibrand and Ford Timelapse filmstrips--Freeway series	The Case of Officer Hallibrand and Freewayphobia

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The two types of instructional media used in the four modes of instruction were the educational motion picture and the filmstrip. Emphases were given to the modes of instruction reflecting the instructor's use of and the student's reactions to the instructional material. Greater emphasis was thereby given to the resulting behavior, and less emphasis was given to instructional media by type.

Summary

Although instructional media should be produced and selected in order to cause pre-determined changes in behavior, little research evidence exists upon which to base such production and selection. There is no doubt that people learn from films, but this statement tells little about the value of the learning experience. The central problem of education is that of controlling and increasing the efficiency of learning. Improved production, selection, and utilization of educational media is one way in which learning can be controlled.

Most teachers are not knowledgeable enough to make intelligent selection and use of instructional media; and, unfortunately, little media of a specific nature has been produced, except as short, single-concept films. The use of instructional media which present too much information on a given occasion often promotes the forgetting of important concepts due to retroactive interference. Today, little empirical

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evidence exists to support specific environmental arrangements and media combinations.

The purpose of this study was to gather empirical evidence relevant to the relationship between the use of different types of instructional media and their effectiveness in producing the best possible conditions for learning. Instructional media seem to be most effective when placed in a particular arrangement known as a mode of instruction. In this study, an attempt will be made to provide answers to the problem of determining which mode of instruction or controlled combinations of various modes of instruction produce the best possible conditions for learning. Research which helps provide some of the answers should be of value in the design, production, and utilization of future instructional media as well as in the establishment of a base for better use of existing media.

Four modes of instruction were used, consisting of two teaching media and two documentary media. A three-by-three factorial analysis was employed as the research design with which to compare the efficiency and effectiveness of individual and various controlled combinations of instructional media as modes of instruction. The various necessary controls and limitations required by the nature of the research design and the study have been provided.

A new, bias-free, automobile-mounted-digital computer, the Drivometer, should make it possible to measure the effectiveness of various modes of instruction on the covert,

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psychomotor skills of freeway driving. Research subjects were high school driver-education students assigned to treatment groups by random means.

Major emphasis in this research was placed on individual mode of instruction or the controlled combinations of modes of instruction. It was not placed upon the area of driver education as such. The researcher was concerned with testing a generality within a specific setting. The availability of the Drivometer dictated the area of specific instruction and the types of instructional media used.

The research hypothesis is as follows: Students who have been exposed to one mode of instruction will make different mean scores on the Drivometer than will students who have been exposed to another mode of instruction. Although not stated in the hypothesis, the non-documentary modes of instruction were expected to be more efficient and effective in the control of learning.

Information relating to this study and the data collected will be presented in the following sequence:

Chapter One: "The Problem."

Chapter Two: "Review of Related Literature."

Chapter Three: "Design of the Study."

Chapter Four: "Analysis of the Data."

In the final chapter, Chapter Five: "Summary and Conclusions," the researcher proposes to synthesize his work by presenting the summary; conclusions; implications; and recommendations for further research, if warranted.

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CHAPTER II

REVIEW OF RELATED LITERATURE

Instructional media are positively effective only when the induced behavioral changes occur in the desired direction. There has been little previous research concerned with the criteria upon which to base instructional media, yet there can be little doubt that the use of most instructional media does cause behavioral change. Instructional media does teach, but little has been written on the direction or consequence of the learning which occurs. Therefore, a brief summary of previous research which seems to be closely related to the problem will be given in this chapter.

Literature on Behavioral Change

The use of all instructional media involves the communication of ideas. The presentation of these ideas determines their effectiveness in producing behavioral changes in the desired direction. Hoban has stated: "It can safely be said that people learn from films."[1] But he also noted:

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[1]Charles F. Hoban, "The Usable Residue of Educational Film Research," New Teaching Aids for the American Classroom (Washington: U. S. Government Printing Office, 1962), p. 105.

> Instead of disposing of the problem, this statement of a policy of knowledge opens up the question of the determinants. It is in the nature of man to learn. The central problem of education is not learning but the control of learning. Once we have satisfied ourselves that people can and do learn from films, the problem becomes that of (a) controlling what is learned and (b) increasing the efficiency of learning.[2]

In a detailed technical report, Wulan and van Cronenburg traced the development of instructional film research from 1918 to 1950. Under the heading, "VALUES OF INSTRUCTIONAL FILMS," they reported upon five identified values:

> Value 1: People learn from films.
>
> They can learn factual knowledge, concepts, motor skills, attitudes, and opinions.
>
> Value 2: When effectively used, carefully planned films are regarded, by people who learn from films and are familiar with them, as helpful in learning.
>
> Value 3: Instructional films may stimulate other learning activities.
>
> Value 4: Certain films may facilitate thinking and problem solving.
>
> Value 5: Some pilot films are equivalent to actual experiences, and can be used to substitute for them when the film's function is to unify the facts or demonstrate the procedures presented in the film.[3]

They further observed that when "films are used and integrated with other instructional procedures and materials, more learning

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[2] Ibid.

[3] U.S. Army and U.S. Navy, Instructional Film Research (Rapid Mass Learning) 1918-1950 (Navexos P-977; Port Washington, L.I., New York: Special Devices Center, 1951), pp. 9-1; 9-2.

results from the combination than from either medium alone."[4] However, they concluded:

> There is nothing in a motion picture presentation, per se, that guarantees better learning. . . . Some films have turned out to be no better than other methods . . . and some films may even promote less learning than usual methods.[5]

World War II saw the first mass use of audiovisual instructional media. Faced with the almost impossible task of training a huge influx of manpower, the military services turned to audiovisual instructional media.

The Research Branch of the Army's Information and Education Division conducted a number of research studies concerning the use of films as aids to teaching. Hovland, Lumsdaine, and Sheffield have compiled much of this research in book form. This compilation covered such areas as attitude changes caused by orientation films. The teaching effectiveness of filmstrips and sound motion pictures, the difference in opinion formation when "one-sided" versus "two-sided" presentations were given, and the effect on learning of student participation were additional topics of research. In all of these studies, the major concern was "on the measurement of changes in knowledge produced by a film or other communication device."[6] This research has also been summarized by a joint Army and Navy report: "Few, if any, specific attitude changes

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[4] Ibid.

[5] Ibid.

[6] C.I. Hovland, A.A. Lumsdaine, and F.T. Sheffield, Experiments On Mass Communications (Princeton: Princeton University Press, 1949), p. 5.

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will result when the film bias is strongly contradictory to the social norms. In the case of contradictory influence, film bias may actually reinforce the existing attitude, rather than modify it."[7] This is confirmation of the "boomerang effect" found by Hovland, Lumsdaine, and Sheffield.[8]

In discussing research findings on the motion picture versus the filmstrip and other communication media, this same Army-Navy report stated: "There is, however, no direct evidence that motion pictures are reliably superior to other media of communication in their influence on general attitudes."[9]

Hovland and others discussed an early study by Peterson and Thurstone which showed that exposure to silent motion pictures did result in changes in attitude measured by verbal scales and that these changes had some permanence.[10] However, they reported that films which are not properly designed to produce attitude change do not produce well-defined attitude change. If no important attitude change occurs, the "boomerang effect" may result.

Thorndike's work, entitled, The Psychology of Wants, Interests, and Attitudes, demonstrated that reward is an

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[7]U.S. Army and U.S. Navy, Instructional Film Research Reports (Navexos P-1543; Port Washington, L.I., New York: U.S. Naval Training Device Center, 1956), II, 5-1; 5-18.

[8]Hovland, Lumsdaine, and Sheffield, Communication and Persuasion (New Haven: Yale University Press, 1953), pp. 36, 63, 141-143, 164, 286.

[9]U.S. Army and U.S. Navy, op.cit., II, 5-18.

[10]Hovland, Lumsdaine, and Sheffield, op.cit., pp. 241-265.

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important factor in attitude formation and change. More recent studies by reinforcement-learning theorists support these conclusions. Skinner defines "reinforcement theory" in these simple terms:

> . . . . If it's in our power to create any of the situations which a person likes or to remove any situation he doesn't like, we can control his behavior. When he behaves as we want him to behave, we simply create a situation he likes, or remove one he doesn't like. As a result, the probability that he will behave that way again goes up, which is what we want. Technically it's called 'positive reinforcement'. The old school made the amazing mistake of supposing the reverse was true, that by removing a situation a person likes or setting up one he doesn't like--in other words by punishing him--it was possible to reduce the probability that he would behave in a given way again. That simply doesn't hold. It has been established beyond question. What is emerging at this critical stage in the evolution of society is a behavioral and cultural technology based on positive reinforcement alone. We are gradually discovering--at an untold cost in human suffering--that in the long run punishment doesn't reduce the probability that an act will occur. . . . Now that we know how positive reinforcement works and why negative doesn't, . . . we can be more deliberate, and hence more successful, in our cultural design.[11]

In addition, Bruner stated his viewpoint:

> Virtually all of the evidence of the last two decades on the nature of learning and transfer had indicated that, while the original theory of formal discipline was poorly stated in terms of the training of faculties, it is indeed a fact that massive general transfer can be achieved by appropriate learning, even to the

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[11]B.F. Skinner, Walden Two (New York: Macmillan, 1948), pp. 259-262.

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> degree that learning properly under optimum conditions leads one to 'learn how to learn'.[12]

But the discussion of "positive reinforcement" and "optimum conditions for learning" provides little concrete evidence on providing learning experiences which are really positive in nature and are conducted under optimum conditions.

In discussing this matter of experience and its importance in inducing behavioral change, Dewey also said:

> The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative. Experience and education cannot be directly equated to each other. For some experiences are mis-educative. Any experience is mis-educative that has the effect of arresting or distorting the growth of further experience. An experience may be such as to engender callousness; it may produce lack of sensitivity and of responsiveness. Then the possibilities of having richer experience in the future are restricted. . . . The trouble is not the absence of experiences, but their defective and wrong character--wrong and defective from the standpoint of connection with further experience.[13]

Mis-directed experience will often come about as the result of social pressures directed against individuals to conform to group norms, even if such norms are not in harmony with society in general. According to Travers, "Some of the early research on social psychology demonstrated that the opinion of an individual might be modified by knowledge of the opinion of the group to which he is assigned."[14] In alluding

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[12]Jerome S. Bruner, The Process of Education (New York: Vintage-Random House, 1960), p. 6.

[13]John Dewey, Experience and Education (New York: Collier-MacMillan, 1963), pp. 25-27.

[14]Robert M.W. Travers, Essentials of Learning (New York: MacMillan, 1963), p. 381.

to this same problem, Newcomb said: "Attitudes will be affected by external influences to the extent that previous attitudes are not strongly held, to the extent that such influence is not neutralized by contrary influences, and to the extent that influences are vivid, first-hand ones."[15]

Literature on Fear-Arousing Appeals

Of major concern has been the use of some form of anxiety-producing instructional media in order to arouse interest, to focus attention, and to induce desired behavioral change. Anxiety, of course, appeals to emotional rather than rational thought. Hovland, Janis, and Kelley,[16] in Chapter Three: "Fear-Arousing Appeals," cite three early studies in this area. Two of these studies by Hartmen and by Menefee and Granneberg report emotional appeals as being more effective than rational appeals, but neither of these studies used true anxiety-producing appeals. Hartmen distributed two leaflets preceding an election. One was highly emotional, whereas the other was rational. The emotional appeal was reported by Hartmen as being more effective; but the "%" difference was only ten, and the results were at the .50 level of significance. Although Hartmen concluded that "there seems to be no escape from the decision that the

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[15]Theodore M. Newcomb, Social Psychology (New York: The Dryden Press, 1950), p. 209.

[16]Carl I. Hovland, Irving L. Janis, and Harold H. Kelley, Communication and Persuasion (New Haven: Yale University Press, 1953), pp. 56-61.

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emotional political appeal is a better vote-getting instrument than the rational approach, . . ."[17] it seems obvious that with a fifty percent probability, no valid conclusions can be based upon his research.

Menefee and Granneberg, having United States foreign policy as their subject matter, used printed materials which advocated isolationism as the best foreign policy.[18] One set used an emotional appeal, whereas the other employed a rational one. The authors of the study concluded: ". . . Emotional propaganda was much more effective in changing student opinion regarding our foreign policy than was logical argumentation."[19] But nowhere in their study do they report a level of significance greater than .20, with various parts of the study yielding results of .40, .52, and .98 in support of the emotional appeal. Such results hardly justify their positive statement of superiority for the emotional appeal.

Knower utilized two speech presentations advocating prohibition.[20] One used the emotional appeal, but the other had a rational appeal. He reported results favorable to the

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[17]George W. Hartmen, "A field experiment on the comparative effectiveness of 'emotional' and 'rational' political leaflets in determining election results," Journal of Abnormal and Social Psychology, XXXI, No. 1 (1936), 99-114.

[18]Selden C. Menefee and Audrey G. Granneberg, "Propaganda and Opinions on Foreign Policy," Journal of Social Psychology, XI, No. 2 (1940), 393-404.

[19]Ibid.

[20]Franklin H. Knower, "Experimental Studies of Changes in Attitudes: A Study of the Effect of Oral Argument on Changes of Attitude," Journal of Social Psycholcgy, VI, No. 3 (1935), 315-347.

rational appeal, yet only at a significance level of .20.

In none of these three studies was achieved a level of significance of .05 or better. The reported results were within chance expectations and showed the bias of the researchers. In total, they threw no real light on the problem of emotional versus rational appeals.

Janis and Feshbach, in 1953, undertook research based upon three versions of a fifteen-minute slide-tape presentation on dental hygiene which were shown to three groups of high school students, each group having fifty persons.[21] Presentation was designed to arouse strong anxiety by showing the painful consequences of tooth decay, diseased gums, and other serious conditions which can result from poor dental hygiene. The second presentation used a milder fear-arousing approach. Finally, the minimal fear-arousing presentation mentioned only briefly the consequences of poor dental hygiene. All presentations contained the same factual information and vital recommendations concerning oral hygiene. The authors concluded: "The evidence strongly suggests that as the amount of fear-arousing material is increased, conformity to recommended (protective) actions tends to decrease."[22] They also stated the results ". . . demonstrate that the strong appeal was markedly less effective than the minimal

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[21] Irving L. Janis and Seymour Feshbach, "Effects of Fear-Arousing Communications," Journal of Abnormal and Social Psychology, XLVIII, No. 3 (1953), 78-92.

[22] Ibid.

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appeal. . . ."[23] In their study, the term "strong" referred to the anxiety-producing appeal.

Levonian cited additional research involving more dental hygiene, the use of automobile safety belts, and smoking and lung cancer. But the results reported were not conclusively in favor of any position. In the same report, Levonian presented the results of a study which he performed, in 1965, at the University of California at Los Angeles.[24] While connected to a Galvanic Skin Response recorder, four groups of high school students were exposed to the traffic-safety film. Immediately after the film, a thirty-item questionnaire was given. Fifteen of the thirty items on the questionnaire pertained to the film. A week later, the students were again asked to fill out the same questionnaire. The three variables of interest in the study were forgetting, retention, and reminiscence. He reported significant results in the direction of the retention of anxiety-producing sections of the film at the .01 level. But no attempt was made to test for actual induced changes in behavior, resulting from exposure to the film.

Beach conducted a pilot study to test the conclusions of Janis and Feshbach that fear-arousing communications fail, not because they fail to arouse fear, but because they evoke

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[23] Ibid.

[24] Edward Levonian, Effectiveness of Traffic Safety Films in Relation to Emotional Involvement (Los Angeles: Institute of Transportation and Traffic Engineering, University of California, 1965), pp. 111; 116.

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anxieties which motivate the audience to avoid the communication and its recommendation.[25] Her study was an attempt to "explore this defensive-avoidance hypothesis."[26]

She showed two modified prints of the film Safety Through Seat Belts to forty-eight adult drivers. In each instance, footage from the film Signal 30 was inserted. But gory accident scenes were used in one print of Safety Through Seat Belts, whereas footage showing state police training procedures and a state police officer interviewing an accident victim's wife was inserted in the other print of the basic film. Twenty-three subjects were shown the anxiety-producing film, but twenty-five subjects were shown the low-threat or low-anxiety producing film. The data was collected by using "(a) skin resistance changes during the test inserts, (b) heart rate changes during the test inserts, (c) attitude changes towards concepts rated on the semantic differential, (d) changes in self-rated intention to install seat belts, and (e) frequency of installation of seat belts."[27] She found that "the inclusion of high-threat material in one print of this film did not render it either more or less effective than the control print containing low-threat material"[28] and that ". . . the failure to obtain significant differences in

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[25]Ruth I. Beach, "The Effect of a 'Fear-Arousing Safety Film' on Physiological, Attitudinal and Behavioral Measures: A Pilot Study," Traffic Safety Research Review (1966), p. 53.

[26]Ibid.

[27]Ibid., p. 54.

[28]Ibid., p. 56.

arousal in response to the two inserts is particularly striking in view of their considerable differences in content."[29]

Her results tended to show the inclusion or use of anxiety-producing films or film-segments did not produce any significant differences when compared with low-threat film segments. Although anxiety-producing film segments served no positive purpose in the study, a slight, though non-significant, "boomerang effect" was reported. Somewhat fewer subjects who saw the high-threat film segment indicated their intention to install seat belts.

Literature on the Drivometer

As Hoban has said, the literature leaves little doubt that people do learn from films and other instructional devices. The important problem is not learning itself, but controlling the direction of the learning which occurs. The "boomerang effect" is an ever-present possibility. Previous research has usually been forced to attempt to measure learning and its direction through the use of paper and pencil tests, but all paper and pencil tests contain error and bias. Furthermore, the required use and understanding of language introduces even greater chance for error.

The development of the Drivometer, by Dr. Bruce D. Greenshields of the University of Michigan and Mr. Fletcher N. Platt of the Ford Motor Company, has produced an

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[29]Beach, op.cit.

automobile-mounted computer which measures and records in digital form the responses made by subjects to the driving tasks as well as the subjects' emotional involvement in the driving situation.

Mr. Bob Shinn and Mr. Tom Reel, of the Highway Traffic Safety Center at Michigan State University, have made an in-depth analysis of the functioning of the Drivometer:

> Throughout the driving task, the driver is constantly confronted by a wide variety of events - events involving the roadway, signs, signals, traffic in the form of other vehicles and pedestrians, and other elements that influence or conflict with his intended path of travel.
>
> On the basis of the observations that the driver must make of these events and how he perceives them, he arrives at decisions regarding his intended course of action. These decisions are directly expressed in the manner in which the driver controls his vehicle and communicates with other drivers.
>
> Operations research concerning the driving task has established 3 basic control actions available to the driver. These are:
>
> 1. Tracking the vehicle
> 2. Speed control of the vehicle
> 3. Positioning the vehicle in relation to the other elements within the environment
>
> It should appear, then, that if precise measurements of DRIVER ACTIONS can be made and if relationships of inputs and responses (driver actions) can be established, a new means of evaluating a driver's approach to, and ability to, handle the driving situation is possible.
>
> The Drivometer has been developed to measure these basic driver actions of tracking, speed control, and positioning. . . .
>
> 1. The Drivometer directly measures the control actions of tracking and speed control and indirectly measures the element of positioning.

> 2. Because of the fact that driver actions reflect the operator's mental attitude (alertness, perception, emotions, etc.) the Drivometer ratings, along with the observer's written and/or oral comments, will also indicate the mental approach of the driver to the driving task.[30]

In describing the functioning of the Drivometer, they further stated:

> The Drivometer is an electro-mechanical instrument which was develcped by Dr. Bruce Greenshields of the University of Michigan's Transportation Institute, and Fletcher N. Platt Manager of Ford's Traffic Safety and Highway Improvement Department. Briefly, it provides a visual, objective record of driving performance by measuring four important actions:
>
> 1. Steering wheel reversals (per minute and total) (tracking and positioning)
> 2. Speed changes (per minute and total) (speed control and positioning)
> 3. Accelerator reversals (total only) (speed control and positioning)
> 4. Brake applications (total only) (speed control and positioning)
>
> . . . Two significant performance checks are (1) the number of steering wheel reversals per minute and (2) the number of speed changes per minute made by the driver.[31]

The appendix of their paper is especially valuable since it provides an interpretation of variable Drivometer readings.

Platt and Greenshields found that data supplied by the Drivometer can be used to differentiate between different

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[30]Bob Shinn and Tom Reel, Untitled memorandum, dated October 6th, 1965, whose subject was "Research Vehicle and Drivometer" (East Lansing: Highway Traffic Safety Center, Michigan State University), pp. 1-2.

[31]Ibid., p. 4.

classes of drivers because such drivers exhibit different driving patterns:

> In order to gain a better understanding of the highway transportation system consisting of the driver, the vehicle, the highway and the environment, it has seemed logical to first examine objectively the behavior of the individual driver and his traffic environment.
>
> Attempting to preselect the driver for this type of examination is admittedly optimistic, but by following the proven validity of the systems approach to a complex problem, it has been possible to identify and measure elements which relate to the driver and his environment. Perhaps a logical progression of this type of investigation will lead to a better method of predicting accident potential. The paper here presented indicates that certain measured driver controls and related vehicle dynamics are meaningful and that a group and individual classification of drivers may be obtained by discriminant computer analysis of these measurements.[32]

Their study was based upon the hypothesis that "drivers with different accident experience and driving records exhibit different driving profiles in ordinary driving."[33] The Drivometer was used to measure and record these "different driving profiles." Platt and Greenshields first cited evidence to show that it is very difficult to predict with any accuracy the accident rate for any given individual or homogeneous group of individuals. In their study, the subjects consisted of:

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[32] Bruce D. Greenshields and Fletcher N. Platt, "The Development of a Method of Predicting High Accident and High Violation Drivers," Unpublished research study, Transportation Institute, Department of Civil Engineering, University of Michigan, Ann Arbor, Michigan.

[33] Ibid.

(1) a control group of forty better-than-average drivers, selected from lists supplied by an insurance agent. In addition, highly-qualified driver education instructors were included in this control group.

(2) a high accident group of forty drivers who were in jeopardy of losing their insurance because of too many accidents. However, those selected were not high violators.

(3) a high violation group of twenty drivers who had excessive violations, but those selected had accident records not above average.

(4) a beginning driver group of forty drivers who had passed high school driver education and had secured their driver's license not more than three months prior to the study.

As each subject drove a standard course, the Drivometer was used to collect and record the data. The multivariate analysis used, the discriminatory analysis, provided a highly accurate method for categorizing the different groups of drivers. Each group had its own particular combination of Drivometer variable read-outs. The analysis further determined which type of Drivometer data was most accurate in the discrimination of a driver's characteristics. The two important variables in driver control were found to be steering wheel reversal-rate and accelerator reversal-rate. Of these two, steering wheel reversal rate was shown to be the most closely related to the emotional state of the subject.

Greenshields and Platt were further able, by using the Drivometer, to select a driver at random, test his driving

over the prescribed test course, and determine whether his driving ability and emotional temperament placed him in the beginning (poor) group, or in the control (good) group. They were able to do this correctly more than two-thirds of the time.

Surti and Gervais used the Drivometer as a means to study seven variables resulting from driver reactions measured through the Galvanic Skin Response instrument and from the response each driver made to his vehicle as measured and recorded by the Drivometer.[34] They compared both the galvanic skin response data and the Drivometer responses in determining a comfort index, or the index of the driver's tension response to driving on the freeway versus normal surface routes. The results showed the Drivometer to be a sensitive and valid instrument for this purpose since much valuable and unique data, collected through its use, could not have been secured otherwise.

Platt conducted a study in which the Drivometer was used to evaluate the effect of driver fatigue and stress during an extended cross-country trip, as reflected in the factors of tracking and speed control.[35] He concluded:

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[34]Vasant H. Surti and Edward F. Gervais, "Peak Period Comfort and Service Evaluation of an Urban Freeway and an Alternate Surface Street" (Detroit: The National Proving Ground for Freeway Surveillance, Control and Electronic Traffic Aids, 1966), pp. 1-63.

[35]Fletcher N. Platt, "A New Method of Measuring the Effect of Continued Driving Performance," Highway Research Record, XXV (1963), 33-57.

"Driver stress and the effects of fatigue can be measured effectively by the Drivometer . . . (and) quantitatively rating a driver's performance compared to his norm provides a starting point for providing a specific measure of fatigue."[36] Greenshields reported on the summary table and graphic charts presented in his study of the same topic.

> An examination of the graphic charts of the individual "fatigue" runs and of the summary table showing the changes in driving patterns at half hour intervals plus other findings from Drivometer tests leads to several conclusions.
>
> The Drivometer is sensitive enough to monitor the changes in driving behavior that occur with time behind-the-wheel. The most pronounced measurement is the frequency of the steering wheel reversals. The amount of speed change is less pronounced than the steering wheel reversal rate. The accelerator reversals seem to mean little as a measure of driving change and the number of brake applications are even less significant.[37]

In an article reprinted from Traffic Engineering, Greenshields demonstrated the validity of the Drivometer as a research tool to determine the quality of traffic flow for safety engineers: "The attitude of the driver toward the driving task is a most important factor in highway travel."[38] He further stated:

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[36] Ibid.

[37] Bruce D. Greenshields, "Changes in Driver Performance with Time in Driving" (Ann Arbor: Transportation Engineering, Dept. of Civil Engineering, Univ. of Michigan, n.d., p. 17.

[38] Bruce Greenshields, "Drivometer Determines Quality of Traffic Flow for Engineers," Traffic Engineering (1965), reprint-unpaged.

> A main purpose . . . has been to demonstrate that driver effort reflects driver attitudes-what he likes and dislikes about driving.
>
> All recordings are digital which means that computer cards can be punched directly from the field data recordings. This is not a tedious task for only four variables are involved: (1) time, (2) distance, (3) speed change, and (4) direction change.
>
> With this new measuring and recording device, it should be possible to set up standards of performance for evaluating traffic operations.[39]

Fedderson reported on two different uses of the Drivometer in measuring a driver's ability. The first report discussed its use by the Kentucky Department of Public Safety, whose primary concern was to "explore new methods of on-the-road testing that would give a greater degree of objectivity than has been available with present simulated and subjective procedures."[40] State police cadets were tested by the use of the Drivometer and, at a different time, by the use of subjective evaluation. Those cadets who scored highest in the subjective ratings were also "best" in Drivometer ratings.[41] This high correlation between subjective and Drivometer ratings is further evidence of the validity and reliability of the Drivometer.

In the second study, Fedderson reported the results of using the Drivometer as the final rating instrument in the

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[39] Ibid.

[40] Gerald J. Fedderson, "A New Method of Rating Drivers," The Highway User (1965), pp. 24-25.

[41] Ibid.

1963 Detroit Traffic Safety Association's "Good Driver Recognition" contest:

> In many respects, the contest provided a valid testing ground for the "Drivometer" as well as the contestants. The group had been previously screened and were already in the "good" driver group by competent judges. Thus, the "Drivometer" was required objectively to rate drivers who in a sense were already winners in their class.
>
> . . . The observer scores of traffic violations also bore out the competency of the group. . . . The driver who had the best score on the "Drivometer" also was the only driver without a traffic violation, as scored by one observer.
>
> A significant observation is that observer opinions and "Drivometer" scores closely paralleled each other. The value of the "Drivometer" scores became apparent, however, when subjective ratings were indecisive. "Drivometer" scores differentiate at one-tenth of a percentage point, not possible with subjective methods. Thus, it was possible to rate contestants on a far more precise scale with the "Drivometer."
>
> All judges, officials, observers and contestants connected with the contest agreed on the "Drivometer's" validity in judging the contestants accurately, and voiced enthusiasm as to its potential in the fields of driver education, licensing and performance rating.[42]

From the research on the Drivometer, there can be no doubt of the validity of its use in measuring the variables of driver performance. It has been proven to be reliable, accurate, and bias-free.

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[42]Gerald J. Fedderson, "The 'Drivometer': An Objective Driver Performance Rating Instrument" (Traffic Safety and Highway Improvement Department, Ford Motor Company, 1963), unpaged.

Literature on Modes of Instruction

Gagne said that ". . . learning is inferred from a difference in a human being's performance as exhibited before and after being placed in a 'learning situation.'"[43] He also stressed: "It is necessary to show that there has been a change in performance."[44] For learning to have occurred, Gagne believes that a measurable change in performance as a direct result of the learning experience must take place. Moreover, he pointed out that although each learner brings a unique "internal capability" to the learning situation, he may also be strongly influenced by learning conditions which are "external to the learning." Gagne believed that it is essential to plan carefully these external stimuli. He explained: "One important implication of the identification of learning conditions is that these conditions must be carefully planned before the learning situation itself is entered into by the student."[45] He continued:

> The required conditions for learning can be put into effect in different ways and to differing degrees by each (instructional) medium. . . . There are, then, some positive characteristics and some limitations of each instructional medium that become evident when they are examined in the light of their learning function.[46]

Gagne realized that no type of instructional media can provide the best possible learning experience by itself:

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[43] Robert M. Gagne, The Conditions of Learning (New York: Holt Rinehart and Winston, 1965), p. 20.

[44] Ibid.

[45] Ibid., p. 24.

[46] Ibid., p. 28.

> . . . instructional media constitute the valuable 'resources for learning' that an educational system has to draw on. When these resources are put to use, they are usually placed in some particular arrangement called a mode of instruction. Some of these, like the lecture, are very widely and frequently used, but others, like the tutoring session, are employed rather infrequently. . . . The various modes of instruction are employed for the purpose of getting the greatest instructional usefulness from media and combinations of media. Thus the choice of modes is also a matter of aiming for optimal functioning in generating the proper conditions for learning. . . . It is these conditions that provide the immediate instructional purposes on the basis of which correct decisions can be made about media and modes of instruction.[47]

Gagne stressed the importance of selecting instructional media, not as a means in itself, but as materials used together with other instructional media in response to a specific need dictated by the unique conditions of the specific learning situation encountered.

In summary, he said: "Environments for learning consist of the various communication media arranged so as to perform their several functions by interaction with the student. The particular arrangements these media may have in relation to the student are usually called the modes of instruction."[48] In Experience and Education, Dewey alluded to this same problem: "I take it that the fundamental unity of the newer philosophy is found in the idea that there is an intimate and necessary relation between the processes of actual experience and education."[49]

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[47] Ibid., pp. 28-29.
[48] Ibid., p. 295.
[49] Dewey, op. cit., p. 20.

Although Dewey never used the concept "modes of instruction," he made much the same point concerning the need to fit the correct mode to a specific learning situation: "The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative. . . Some experiences are mis-educative. Any experience is mis-educative that has the effect of arresting or distorting the growth of further experience."[50] Gagne referred to this problem by using the term,"interference," to refer to experiences or modes which interfered with either new learning or the blocked retention of old. He called this either "pro-active inhibition," or "retroactive inhibition."[51]

Dewey expressed his philosophy concerning the need for positive learning experiences, represented many times by the proper learning environment as provided by the correct mode of instruction: "It is not enough to insist upon the necessity of experience. . . . Everything depends upon the quality of the experience which is had. . . . Hence the central problem of an education based on experience is to select the kind of present experiences that live fruitfully and creatively in subsequent experiences."[52] In support of this position, he further stated: "Unless experience is so conceived that the result is a plan for deciding upon subject-matter, upon methods in instruction . . . and upon material equipment . . .

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[50]Ibid., p. 25.
[51]Gagne, op. cit., p. 105.
[52]Dewey, op. cit., p. 90.

it is wholly in the air."[53]

Baldwin also referred to the importance of modes of instruction:

> . . . the purpose of instructional material is to change the individual's cognitive structure from one that is inadequate, incomplete, or incorrect into one that is improved. This requires an empirically founded set of hypotheses about the consequence of presenting instructional material with one sort of structure to an individual with a different cognitive structure. Presumably, the relevant variables are the discrepancies between the existing and presented structure.[54]

The best mode of instruction in one case may not be suitable in another.

Bruner described positive steps which have been taken toward developing the best possible modes of instruction to accomplish specific learning goals:

> There has been an unprecedented participation in curriculum development by university scholars and scientists, men distinguished for their work at the frontiers of their respective disciplines. They have been preparing courses of study for elementary and secondary schools not only reflecting recent advances in science and scholarship but also embodying bold ideas about the nature of school experience. Perhaps the most highly developed curriculum of this kind is the physics course for high schools prepared by the Physical Science Study Committee, a course for which textbooks, laboratory exercises, films, and special teaching manuals have been prepared. . . .[55]

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[53] Ibid.

[54] Alfred L. Baldwin, "Informational Structures," Learning About Learning (Washington: U.S. Government Printing Office, 1966), p. 167.

[55] Bruner, op.cit., p. 2.

Bruner did not use the concept "modes of instruction," but this integrated use of the most effective type of instructional media is the practical application of what Gagne had in mind. In the Physical Science Study Committee's new concept of physics, and in the Biological Sciences Curriculum Study Committee's report on their new biology, as well as in the new math and in chemistry, the concept of modes of instruction has been shown to be a valid one when wisely and correctly used. To strengthen further his position, he listed four different types of instructional materials: "Devices for vicarious experience, model devices, dramatizing devices, and automatizing devices."[56] In discussing these four types, he said: ". . . there exist devices to aid the teacher in extending the student's range of experience, in helping him to understand the underlying structure of the material he is learning, and in dramatizing the significance of what he is learning."[57]

The term, "integration," is used by Bruner in the same context that Gagne uses "modes of instruction." Bruner illustrated the importance of the "integration" of the Physical Science Study Committee's teaching films which were produced with two major objectives in mind: ". . . (1) further the presentation of the PSSC course as a whole, and (2) set the tone and level of the course. For the PSSC film is a part of

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[56] Ibid., pp. 82-83.
[57] Ibid., p. 84.

a complex that includes also the text, the laboratory, the classroom, the student, and the teacher."[58] And concerning teaching aids and their utilization, he felt:

> The devices themselves cannot dictate their purpose. Unbridled enthusiasm for audio-visual aids or for teaching machines as panaceas overlooks the paramount importance of what one is trying to accomplish. . . . The objectives of a curriculum and the balanced means for attaining it should be the guide.[59]

In his explanation of simulators and trainers, Travers discussed them as instructional devices and media working together as modes of instruction to provide the necessary learning experiences planned by their designers. Trainers and simulators vary in sophistication, but both are based upon the mode of instruction concept.

Referring to one example of a trainer, Travers cited the mechanized language learning laboratory:

> Language installations . . . reflect well the main principles that should guide the mechanization of the classroom. The student plays an active part in the learning process. He sets the pace of learning. . . . Within such a setting, the teacher is a very busy person, but the tasks undertaken are very different from those undertaken in the traditional classroom. The teacher spends very little time going over material found in textbooks, but spends a much larger amount of the time planning the learning experiences. . . .[60]

Travers continued:

> The design of human learning conditions is generally considered to be a two-stage

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[58] Ibid., p. 85.
[59] Ibid., pp. 87-88.
[60] Travers, op.cit., pp. 481-483.

> operation. First, the goals of learning must be specified, and second, procedures, materials, and equipment related to the achievement of these goals must be specified. . . The systematic design of learning conditions involves the planning of the child's environment in such a way that the impact of stimuli has the maximum effect in promoting learning in the directions that are specified by the objectives.[61]

Although these different authorities employed different terms in their statements, the fact remains that all have stressed the need for the cooperative, controlled, and integrated use of the best and widest media of instruction in the accomplishment of specific learning goals. Gagne referred to this unified, cooperative, controlled use as "modes of instruction." Whatever the name, the concept together with its application appears to be valid in light of the available literature.

Summary

Literature offering information, data, or provided results relevant to this study has been reviewed. The literature indicated that there can be little or no doubt that people learn from films. The issue, however, was not learning, per se; but the control of learning. Several studies provided insight and guidance into some of the factors relating to this problem.

Studies were also reviewed which had as their topic the subject of fear-arousing appeals. Although no definitive results were found, such literature had a direct relationship

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[61] Ibid., pp. 508-509.

to this study. Furthermore, literature on the Drivometer pertaining to data-collecting was reviewed. These studies showed that the Drivometer is a valid device with which to measure a driver's psychomotor performance.

Finally, the literature on "Modes of Instruction" was reviewed. Even though the phrase is used only by Gagne, the concept of the value of using instructional materials of all types in providing learning experiences was supported by the writings of Dewey, Bruner, and Travers.

The review of related literature has helped the researcher formulate the research design and disciplinary outline of this study.

CHAPTER III

DESIGN OF THE STUDY

Population

In order to test the effectiveness and efficiency of four different modes of instruction by means of the Drivometer, it has been assumed in this study that the best possible population would consist of novice drivers.

The experiment was designed to use subjects who were taking High School Driver Education for the first time, who had little or no previous driving experience, and who had not been exposed to vicarious learning due to their having been a frequent or daily passenger in an automobile driven on the freeway. In this manner, all subjects would enter the study with little or no previous experience in driving; but more important, they would have had no previous experience of any kind in freeway driving. Only through the use of novice drivers was it considered possible to fulfill the assumptions of the research design.

The subjects were volunteers from the driver education classes held during the summer of 1966, at Sexton High School, Lansing, Michigan. After answering a simple questionnaire to assure that they met the requirements of the research

design, they were ultimately selected by both random and purposive methods.

The sample used consisted of thirty-six high school students, divided into four groups which were as nearly homogeneous as possible. The following attributes were considered during the process of selection:

(1) Scores on a paper-and-pencil, non-media test on freeway driving.

(2) Sex: two groups of nine girls and two groups of nine boys were used.

(3) Instructor: each instructor had one group of nine girls and one group of nine boys.

The nine subjects for each group were assigned to one of the nine treatment cells by using four sets of random permutations of nine numbers chosen at random from table 15.6, starting at the 26th column, as listed by Cochran and Cox.[1]

The purposive selection of subjects was to insure homogeneous groups as nearly as possible. Random assignment to treatments satisfied the requirement of equal probability that any subject would be placed in any of the nine cells for his group. There were four separate and distinct groups of nine subjects each, one subject per cell per group.

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[1]William G. Cochran and Gertrude M. Cox, Experimental Designs (2d ed.; New York: John Wiley and Sons, 1957), p. 577.

Materials Used

Materials used in this study were as follows:

A. Testing.

Due to the nature of the research design and of the Drivometer, which was used as the main measuring device in this study, the actual analysis was based upon data gathered and recorded by this electro-mechanical digital computer.[2]

In addition, a paper-and-pencil test was given all subjects who volunteered. It was used as an aid in selecting the most homogeneous groups possible on the attribute of knowledge of freeway driving after the non-media classroom instruction, but before any projected media treatment. This test was prepared by Dale France and Jim Bond, the driver-education instructors at Sexton High School. The paper-and-pencil test followed by the Drivometer constituted the only testing devices used.

B. Treatment.

Four different instructional media were used in the treatment of subjects:

(1) Non-documentary materials designed specifically to teach: (a) the Ford Motor Company's four sound-filmstrips, Ford Time-lapse Filmstrips--Freeway series, and (b) the Walt Disney film--Freewayphobia.

(2) Documentary materials which were not designed specifically to teach: (a) the horror film--Signal 30, and

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[2]The Drivometer is fully explained in Chapter I and in Chapter II.

(b) the standard film--*The Case of Officer Hallibrand*.

C. Test vehicle.

The Drivometer was mounted in a new 1966 Ford station wagon, which was equipped with power steering and power brakes.

D. Test course.

A standard driving course was selected on which each student started from the front driveway of O'Rafferity High School, drove west on Saginaw Street, and entered the freeway, heading north toward Grand Rapids, Michigan. The Eagle exit and entrance provided additional Drivometer readings on exit and entrance performance and also reversed the course in the direction of Lansing. The rest area on the return trip to Lansing gave still more chance for testing exit and entrance behavior. The final exit was west on Saginaw Street. Each subject was scored on entrance and exit behavior at three different times. In addition, merging with the traffic flow as well as leaving the traffic flow, at three separate times, provided a better overall view of the total freeway driving performance of each subject.

E. Literature.

All previous research which used the Drivometer was reviewed, as was pertinent literature on behavioral and attitudinal changes due to exposure to instructional media which included fear-arousing media. Finally, the literature on "modes of instruction" was reviewed.

F. Data.

The minute by minute readout of the Drivometer data was recorded on the special form developed for that purpose.

G. Analysis.

The Control-Data-Corporation 3600 computer of Michigan State University was used for the data analysis. All processing of data and punch-card preparation related to the computer analysis was done by professional staff members of the Computer Center.

H. Other materials.

Other materials included a 16mm sound-motion-picture projector, a sound-filmstrip projector, a screen, various office supplies, a desk calculator, and other miscellaneous physical facilities belonging to Michigan State University and the Lansing, Michigan public school system.

Statistical Hypotheses

Based upon the operational definitions, the following hypotheses were formulated for testing purposes.

H_{0_1}: No differences exist between the mean Drivometer scores of students who have been exposed to one mode of instruction and the mean Drivometer scores of students who have been exposed to another mode of instruction.

H_1: Students who have been exposed to one mode of instruction will make different mean scores on the Drivometer than will students who have been exposed to another mode of instruction.

Experimental Procedures and Design

In order to secure information relative to effectiveness and the efficiency of four different modes of instruction, there were selected for the experiment two instructional media designed to teach specific freeway driving skills and two instructional media which stressed the importance of safe driving. A three-by-three factorial analysis of variance design was employed, using four independent and mutually exclusive replications. This design was carefully prepared in order to eliminate bias in its results and confusion in the analysis and interpretation. It was designed by the statistics expert, who was available himself to graduate students in the Michigan State University College of Education. The design, before being accepted, was further checked by several Michigan State University faculty members.

Previous researchers dealing with behavioral and attitudinal changes resulting from the use of media have turned to the use of some type of paper-and-pencil testing procedure. It is likely that whatever significant differences may have actually been present between treatment conditions were often masked by the bias factor inherent in such tests. Therefore, the researcher was often forced to accept the null hypothesis.[3]

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[3]Hildreth Hoke McAshan, "An Experimental Study of Traffic Safety Films, the Factors Involved in Determining Driver Behavior, and the Predictive Effects of Driver Behavior Change Analysis" (Unpublished Ed.D. Thesis, Dept. of Administrative and Educational Services, Michigan State University).

The research literature concerning the use of the Drivometer as the testing device indicated a bias-free situation. A computer can only report what has happened. In addition, the literature showed the Drivometer to be a valid device for use in measuring differences in driver performance. For these reasons, the Drivometer was selected as the measuring device to be used in this research.

The Drivometer has gone through several stages in its development. At one time, motion pictures were used in addition to the instrument itself. The use of film as a recording device, however, did not prove to be needed. In the study, this particular model of the Drivometer tested the four basic driver skills: (1) Steering wheel reversals per minute, coded SR in the analysis, (2) Speed changes per minute, coded SC in the analysis, (3) Accelerator reversals per minute, coded AR in the analysis, and (4) Brake applications per minute, coded BA in the analysis.

No attempt was made to identify specific areas of increased awareness or learning as a result of the treatments. Due to the various treatments given, the Drivometer measured either the emotional, attitudinal, and behavioral changes or the lack of them.

A complete analysis of the validity and effectiveness of this research will be given in the following chapter.

Experimental Design

Figure 1.

Rows		Columns: No Proj. Materials	Non-documentary Materials: Filmstrips (Ford)	Non-documentary Materials: Film (Disney)
No Proj. Mat.		Control group	Ford Timelapse filmstrips--Freeway series	Freewayphobia
Documentary Materials	Horror Film	Signal 30	Signal 30 and Ford Timelapse filmstrips--Freeway series	Signal 30 and Freewayphobia
Documentary Materials	Standard Film	The Case of Officer Hallibrand	The Case of Officer Hallibrand and Ford Timelapse filmstrips--Freeway series	The Case of Officer Hallibrand and Freewayphobia

This experimental design was administered using the following procedure:

(1) The sample population was divided into one control and eight treatment groups per replication. All subjects were selected to provide a homogeneous group, as far as possible, per replication. Random sample procedures were used in assigning subjects to treatments.

(2) The three-by-three factorial research design provided for nine separate cells, with one subject per cell, per replication. Each cell received a different treatment, per replication. The control-group cell received no projected media, whereas the other cells received the treatment called for by their location in the research design.[4]

(3) Since each replication was an independent experiment, it was possible to use two driver-education instructors, each working with one group of nine boys and with one group of nine girls.

(4) All students who volunteered to take part met the requirements of the research design. They were given the same basic preliminary driver-education instruction, but with no instructional media being used. This was necessary because the control group would drive the freeway course with no additional instruction. At the end of this non-media instruction in correct driving, including freeway driving, a paper-and-pencil test was given to determine which students were most

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[4] Supra, chapter iii, p. 58. See Figure 1.

nearly homogeneous in their knowledge of freeway driving. Those nine students whose scores were most nearly alike, per replication group, were selected as subjects and were assigned to treatment cells by random means. An assignment form was prepared for the subjects in each replication. No instructional media, other than that of the treatment, was given these subjects. All subjects for each cell and for all replications were given the treatment required by the experimental design. Then they drove the freeway course. A complete record of all Drivometer scores was kept for each student. The control group received no projected instructional media of any kind before driving the freeway course.

(5) No driving was done when either winds higher than fifteen miles per hour or rains introduced additional hazards that could have biased the results.

(6) All subjects received their test drive no later than one and one-half hours following the treatment in order to control for the possible effects of forgetting.

Following the completion of the data collection, the data were analysed. It was expected that the conclusions of this study would be relevant to other types of learning experiences.

Summary

In this chapter the design of the study has been specified in detail--including, (1) population, (2) required materials, (3) statistical hypotheses, (4) experimental

procedures and design, and (5) the experimental design.

The population was limited to volunteer, beginning students in high school driver education who were placed into four homogeneous groups, as nearly as possible, on the attributes of their scores on a paper-and-pencil test, their sex, and their instructor. However, the assignment of each subject to a given treatment for his replication was accomplished by random means.

After selection and non-media driving instruction, treatments as called for in the experimental design were given. Data were then collected by the Drivometer as each student drove the same freeway course used in the test. All necessary controls and limitations were observed.

Finally, from the data provided by the Drivometer, individual and group means were computed for the four variables measured and recorded by the Drivometer. The data were coded, cards were punched, and the results were analyzed by the professional staff at the Michigan State University Computer Center, using the Control Data Corporation 3600 computer.

CHAPTER IV

ANALYSIS OF THE DATA

Reported in this chapter is a compilation of the findings of the study on the four variables measured by the Drivometer. The data on steering wheel reversals per minute, speed change per minute, accelerator reversals per minute and brake applications per minute have been analyzed as a function of the mode of instruction used and the resulting attitudinal and behavioral changes induced, if any.

In analyzing the data for each of the four variables the Control-Data-Corporation 3600 computer first computed the mean score of column one which consisted of the horror film and the standard film. To the documentary materials were added the non-documentary materials for columns two and three. The factorial analysis of variance between the means of the three columns and the F statistic significance level was reported when column one was compared with columns two and three.

The analysis of rows followed the same plan. The mean score for row one, the projected non-documentary materials--consisting of the four filmstrips of the Ford Motor Company and the Disney film--was compared to the mean scores when rows

two and three, the documentary projected materials, were added to row one. The factorial analysis of variance between the means of the three rows was computed, and the F statistic significance level was reported when row one was compared with rows two and three.

The four attributes of driver skill, for both rows and columns, were analyzed by comparing the mean of column one with the mean of columns two and three, or the mean of row one with the mean of rows two and three, to determine the significance of the differences in the means. If significance was found, a further test located its specific source.

The hypothesis tested in this study was:

H_{O_1}: No differences exist between the mean Drivometer scores of students who have been exposed to one mode of instruction and the mean Drivometer scores of students who have been exposed to another mode of instruction.

Symbolically: H_{O_1}: $M_1 = M_2$

Findings of the Study

On the variable of steering-wheel reversal rate per minute, measured across columns, column one had a mean score of 25.93, column two had 32.32, and column three had 30.29 steering-wheel reversals per minute. The difference in means between columns one and two was 6.39 reversals, whereas the difference between columns one and three was 4.36 reversals. The standard deviation for column one was 3.00; for column two, 5.53; and for column three, 5.39.

TABLE 1.--Sub-Effects Table for Factorial with Replicates Design

Dependent Variable is Steering-Wheel Reversals.

SUM	FREQUENCY	MEAN	MEAN INCREMENT	SUM OF SQUARES	STANDARD DEVIATION	SUM OF SQUARED DEVIATIONS FROM THE MEANS	COLUMN	ROW
1062.61	36	29.52		30364.35	5.34	999.35		
311.19	12	25.93	-3.59	8169.21	3.00	99.79	1	
387.20	12	32.27	2.81	10075.30	5.53	336.50	2	
363.53	12	30.29	0.79	11300.75	5.89	307.91	3	
330.66	12	30.06	0.54	11047.67	4.35	209.04		1
356.57	12	29.71	0.20	11050.10	6.43	454.92		2
345.32	12	28.78	-0.74	10066.57	5.44	335.96		3

A factorial analysis of variance was used to determine the significance of the differences between column means on the variable of the steering-wheel reversal rate. An F value of 4.96 was computed when the non-documentary materials were added to the documentary materials. The addition of the non-documentary materials to the documentary materials was significant at an alpha .01 level of confidence.

TABLE 2.--Analysis of Variance Table for Factorial with Replicates Design.

Dependent Variable is Steering-Wheel Reversals.

SOURCE OF VARIANCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STATISTIC
Columns	256.12	2	128.06	4.96	0.01
Rows	10.43	2	5.21	0.20	0.82
Interaction	35.75	4	8.94	0.35	0.85
Remaining Error	697.05	27	25.82		
Total	999.35	35			

Remaining Error is Replication Effect Plus All Interactions Between Replications and Other Effects.

When the steering-wheel reversal rate per minute was measured across rows, row one had a mean score of 30.06, row two had 29.70, and row three had 29.78. The difference in the mean between rows one and two was 0.35 reversals per minute, but the difference between rows one and three was 0.28 reversals. The standard deviation for row one was 4.35; for row two, 6.43; and for row three, 5.44.[1]

[1] Supra, chapter iv, p. 64. See Table 1.

A factorial analysis of variance was used to determine the significance of the differences between row means on the variable of steering-wheel reversals per minute. An F value of 0.20 was computed when the documentary materials were added to the non-documentary materials. Adding the documentary materials to the non-documentary materials was not significant with an alpha level of 0.82.[2]

When the possible interaction between the rows and the columns was computed, no significant interaction was found. Computing the row and column interaction gave an alpha level of confidence of 0.85.[3]

The computer analysis did not identify which of the non-documentary materials, when added to the documentary materials, produced the significant difference which was found. A further analysis, "Scheffe's" test, was performed for this purpose.

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[2] Supra, chapter iv, p. 65. See Table 2.

[3] Ibid.

TABLE 3.--Scheffe's Test

Dependent Variable is Steering-Wheel Reversals.

$S^2 = (3 - 1)(F_{.95,2,33})$ $= 2 \times 3.28 = 6.56$ $= 2.56$	$\hat{\sigma}_c^2 = 25.8167\ (1/12 + 1/12)$ $= 25.8167 = 4.3028$ $\hat{\sigma}_c = 2.07$

$S\hat{\sigma}_c = 2.07 \times 2.56 = 5.30$ (At .05 level, a value of 5.30 or larger is necessary to be significant.)

	X_2	X_3
X_1	$(X_1 - X_2)$	$(X_1 - X_3)$
X_2		$(X_2 - X_3)$
X_3		

		X_2 Filmstrips 32.39	X_3 Disney film 30.22
X_1 (Control & Documentary)	35.33	6.39	4.39
X_2 (Ford filmstrips)	32.39		-2.03
X_3 (Disney film)	30.22		

Only the Ford filmstrips exceeded the required .05 significance level value of 5.30.

An alpha of .05 confidence level was selected, and the difference in the means between columns one and two and also between columns one and three was computed. The difference in the means between columns one and two was significant at an

alpha level of .05, but the difference in means between columns one and three was not significant at an alpha level of .05. Therefore, the Ford Motor Company sound-filmstrips produced the majority of the variance found between columns when the non-documentary materials were added to the documentary materials.

On the variable of speed changes per minute measured across the columns, column one had a mean score of 12.83, column two had 14.91, and column three had 12.82. The difference in means between columns one and two was 2.08 speed changes per minute; however, the difference between the means of columns one and three was 0.01 speed changes per minute. The standard deviation for column one was 2.41; for column two, 2.12; for column three, 2.06 speed changes per minute.

TABLE 4.--Sub-Effects Table for Factorial with Replicates Design.

Dependent Variable is Speed Change.

SUM	FREQUENCY	MEAN	MEAN INCREMENT	SUM OF SQUARES	STANDARD DEVIATION	SUM OF SQUARED DEVIATIONS FROM THE MEANS	COLUMN	ROW
486.65	36	13.52		6773.54	2.36	194.98		
153.95	12	12.83	-0.69	2039.10	2.41	54.05	1	
173.89	12	14.91	1.39	2716.11	2.12	49.61	2	
153.82	12	12.82	-0.70	2018.33	2.06	46.61	3	
147.89	12	12.32	-1.19	1895.35	2.57	72.73		1
169.15	12	14.10	0.58	2435.66	2.16	51.36		2
169.61	12	14.13	0.62	2442.53	2.03	45.24		3

A factorial analysis of variance was used to determine the significance of the differences between the column means. On the variable of speed changes per minute, an F value of 3.61 was computed when the non-documentary materials were added to the documentary materials. Adding the non-documentary materials was significant at an alpha level of confidence of .04.

TABLE 5.--Analysis of Variance Table for Factorial with Replicates Design.

Dependent Variable is Speed Change.

SOURCE OF VARIANCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STATISTIC
Columns	34.71	2	17.35	3.61	0.04
Rows	25.67	2	12.83	2.67	0.09
Interaction	4.76	4	1.19	0.26	0.91
Remaining Error	129.84	27	4.81		
Total	194.98	35			

Remaining Error is Replication Effect Plus All Interactions Between Replications and Other Effects.

When the speed change per minute data was measured across the rows, row one had a mean score of 12.32; row two had 14.10; and row three had 14.13 speed changes per minute. The difference in the means between rows one and two was 1.78 speed changes per minute, whereas the difference in the means of rows one and three was 1.81 speed changes per minute. The standard deviation for row one was 2.57; for row two, 2.16;

and for row three, 2.03.[4]

A factorial analysis of variance was used to determine the significance of the differences between row means on the variable of speed change per minute. An F value of 2.66 was computed when the documentary materials were added to the non-documentary materials. Adding the documentary materials to the non-documentary materials was not significant at the required .05 alpha level of confidence, since an alpha of .09 was computed.[5]

When the possible interaction between the rows and the columns was computed, no significant interaction was found. Computing the row and column interaction gave an alpha level of 0.91.[6]

The computer analysis did not identify which non-documentary materials, when added to the documentary materials, produced the significant difference which was found. A further analysis, "Scheffe's" test, was performed for this purpose. An acceptable alpha level of confidence was set at .05, and the difference in the means between columns one and two as well as between columns one and three was computed. The difference in the means between columns one and two was not significant. Nor was the difference in the means between columns one and three significant.

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[4] Supra, chapter iv, p. 69. See Table 4.
[5] Supra, chapter iv, p. 70. See Table 5.
[6] Ibid.

TABLE 6.--Scheffe's Test

Dependent Variable is Speed Change.

$S^2 = (3 - 1)(F_{.95,2,33})$ $= 2 \times 3.28 - 6.56$ $= 2.56$	$\hat{\sigma}_c^2 = 4.8090\ (1/6)$ $= .8015$ $\hat{\sigma}_c = .90$

$S\ \hat{\sigma}_c = 2.56 \times .90 = 2.30$ (At .05 level, a value of 2.30 or larger is necessary to be significant.)

	X_2	X_3
X_1	$(X_1 - X_2)$	$(X_1 - X_3)$
X_2		$(X_2 - X_3)$
X_3		

		X_2 Filmstrips 14.91	X_3 Disney film 12.82
X_1 (Control & Documentary)	12.83	-2.08	.01
X_2 (Ford filmstrips)	14.91		2.09
X_3 (Disney film)	12.82		

Neither the Ford filmstrips, nor the Disney film are significant by themselves.

Although neither teaching media produced, by itself, the significant difference found when both were added to the documentary media, it is obvious in comparing the means that almost all of the significance was the result of the Ford

Motor Company sound-filmstrips. Mean differences between the documentary materials when the Ford Motor Company filmstrips were added was 1.79 speed changes per minute, whereas that produced by adding the Disney film to the documentary materials was a minus 0.01.[7]

On the variable of accelerator reversals per minute, measured across the columns, column one had a mean score of 15.00, column two had 13.25, and column three had 15.25 accelerator reversals per minute. The difference in the means between columns one and two was 1.75 reversals; however, the difference between the means of columns one and three was 0.25 accelerator reversals per minute. The standard deviation for column one was 10.28; for column two, 3.54; and for column three, 7.65.

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[7] Supra, chapter iv, p. 69. See Table 4.

TABLE 7.--Sub-Effects Table for Factorial with Replicates Design.

Dependent Variable is Accelerator Reversals.

SUM	FREQUENCY	MEAN	MEAN INCREMENT	SUM OF SQUARES	STANDARD DEVIATION	SUM OF SQUARED DEVIATIONS FROM THE MEANS	COLUMN	ROW
522.00	36	14.50		9730.00	7.86	2161.00		
180.00	12	15.00	0.50	3850.00	10.22	1150.00	1	
159.00	12	13.25	-1.25	2445.00	5.55	338.25	2	
183.00	12	15.25	0.75	3435.00	7.65	644.25	3	
155.00	12	12.92	-1.58	2409.00	6.08	406.92		1
113.00	12	9.42	-5.00	1171.00	3.11	106.92		2
254.00	12	21.17	6.67	6150.00	8.39	773.67		3

A factorial analysis of variance was used to determine the significance of the differences between column means on the variable of accelerator reversals per minute. An F value of .035 was computed when the non-documentary materials were added to the documentary materials. Adding the non-documentary materials to the documentary materials was not significant for the attribute of accelerator reversals per minute and gave an alpha level of 0.71.

TABLE 8.-- Analysis of Variance Table for Factorial with Replicates Design.

Dependent Variable is Accelerator Reversals.

SOURCE OF VARIANCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STATISTIC
Columns	28.50	2	14.25	0.35	0.71
Rows	873.50	2	436.75	10.82	0.001
Interaction	169.00	4	42.25	1.05	0.40
Remaining Error	1090.00	27	40.37		
Total	2161.00	35			

Remaining Error is Replication Effect Plus All Interactions Between Replications and Other Effects.

When the accelerator reversals per minute were measured across the rows, row one had a mean score of 12.92, row two had 9.42, and row three had 21.17 accelerator reversals per minute. The difference between rows one and two was 3.50 reversals per minute, but the difference between rows one and three was 8.25 accelerator reversals per minute. The standard

deviation for row one was 6.02; for row two, 3.19; and for row three, 8.30.[8]

A factorial analysis of variance was used to determine the significance of the differences between row means on the variable of accelerator reversals per minute. An F value of 10.22 was computed when the documentary materials were added to the non-documentary materials. Adding the documentary materials to the non-documentary materials was highly significant with an alpha level of confidence of better than .001.[9]

When possible interaction between the rows and the columns was computed, no significant interaction was found. Computing the row and the column interaction gave an alpha level of confidence of 0.40.[10]

The computer analysis did not identify which of the documentary materials, when added to the non-documentary materials, produced the significant differences found. A further analysis, "Scheffe's" test, was performed for this purpose. An acceptable alpha level of confidence of .05 was selected, and the difference in the means between rows one and two as well as between rows one and three was computed. Both the differences in means between rows one and two and between rows one and three were significant. Therefore, each of the documentary materials by itself could have produced the significance found.

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[8] Supra, chapter iv, p. 74. See Table 7.
[9] Supra, chapter iv, p. 75. See Table 8.
[10] Ibid.

TABLE 9.--Scheffe's Test

Dependent Variable is Accelerator Reversals.

$S^2 = (3 - 1)(F_{.05,2,33})$ $= 2 \times 3.28 - 6.56$ $= 2.56$	$\hat{\sigma}_c^2 = 40.3704\ (1/6)$ $= 6.7284$ $\hat{\sigma}_c = 2.59$

$S\ \hat{\sigma}_c = 2.59 \times 2.56 = 6.63$ (At .05 level, a value of 6.63 or larger is necessary to be significant.)

	X_2	X_3
X_1	$(X_1 - X_2)$	$(X_1 - X_3)$
X_2		$(X_2 - X_3)$
X_3		

		X_2 Filmstrips 9.42	X_3 Disney film 21.17
X_1 (Control & Documentary)	12.92	3.50	8.25
X_2 (Ford filmstrips)	9.42		11.75
X_3 (Disney film)	21.17		

Both the Horror film and the Standard film were significant by themselves at the .05 level or better.

On the variable of brake applications per minute, measured across the columns, column one had a mean score of 9.17, column two had 10.08, and column three had 8.75 brake

applications per minute. The difference in the means between columns one and two was 0.91, whereas the difference between the mean of columns one and three was 0.42 brake applications per minute. The standard deviation for column one was 3.19; for column two, 4.14; and for column three, 2.67.

TABLE 10.--Sub-Effects Table for Factorial with Replicates Design.

Dependent Variable is Brake Applications.

SUM	FREQUENCY	MEAN	MEAN INCREMENT	SUM OF SQUARED	STANDARD DEVIATION	SUM OF SQUARED DEVIATIONS FROM THE MEANS	COLUMN	ROW
336.00	36	9.33		3596.00	3.34	390.00		
110.00	12	9.17	-0.17	1120.00	3.19	111.67	1	
121.00	12	10.08	0.75	1409.00	4.14	188.92	2	
105.00	12	8.75	-0.58	987.00	2.67	78.25	3	
105.00	12	8.75	-0.58	1033.00	3.32	114.25		1
120.00	12	10.00	0.67	1366.00	3.88	166.00		2
111.00	12	9.25	-0.08	1197.00	3.02	100.25		3

A factorial analysis of variance was used to determine the significance of the differences between column means on the variable of brake applications per minute. An F value of

0.53 was computed when the non-documentary materials were added to the documentary materials. Adding the non-documentary materials was not significant with an alpha level of confidence of 0.60.

TABLE 11.--Analysis of Variance Table for Factorial with Replicates Design.

Dependent Variable is Brake Applications.

SOURCE OF VARIANCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STATISTIC
Columns	11.17	2	5.58	0.53	0.60
Rows	9.50	2	4.75	0.45	0.65
Interaction	85.33	4	21.33	2.03	0.12
Remaining Error	284.00	27	10.52		
Total	390.00	35			

Remaining Error is Replication Effect plus All Interactions Between Replications and Other Effects.

When the brake application per minute data was measured across the rows, row one had a mean score of 8.75 applications, row two had 10.00, and row three had 9.25 brake applications per minute. Although the difference in the mean

between rows one and two was 1.25, the difference between rows one and three was 0.50 brake applications per minute. The standard deviation for row one was 3.20; for row two, 3.88; and for row three, 3.02.[11]

A factorial analysis of variance was used to determine the significance of the differences between row means on the variable of brake applications per minute. An F value of 0.45 was computed when the documentary materials were added to the non-documentary materials. Adding the documentary materials to the non-documentary materials was not significant with an alpha level of confidence of 0.55.[12]

When the possible interaction between the rows and the columns was computed, no significant interaction was found. Computing the row and the column interaction gave an alpha level of confidence of 0.12.[13]

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[11] Supra, chapter iv, p. 78. See Table 10.
[12] Supra, chapter iv, p. 79. See Table 11.
[13] Ibid.

TABLE 12.--Summary Table

		Approx. significance probability of the F statistic
Steering wheel reversal rate	Columns	0.01
	Rows	0.82
	Interaction	0.85
Speed change	Columns	0.04
	Rows	0.09
	Interaction	0.91
Accelerator reversal rate	Columns	0.71
	Rows	0.001 (or better)
	Interaction	0.40
Brake applications	Columns	0.60
	Rows	0.65
	Interaction	0.12

Discussion of the Findings

Although four variables of driver performance are measured and computed by the Drivometer, the literature on Drivometer research as well as the personal conferences with Greenshields show conclusively that the four attributes vary considerably in their sensitivity and in their ability to

measure attitudinal and behavioral changes in drivers. The importance which can be attached to these different attributes varies accordingly.

As measured by steering wheel reversals, tracking the vehicle required constant driver attention. Changes in the driver's emotional responses are reflected by the steering-wheel reversal rate. The more the driver is nervous or unsure, the more steering-wheel reversals per minute will be recorded. It has been well-documented in the literature that the steering-wheel reversal rate varies directly with the emotional state of the driver. The more nervous or insecure the driver feels, the higher will be the steering-wheel reversal rate. Because of this factor, the steering-wheel reversal rate has been shown to be the most sensitive of all the attributes measured.[14]

The three-by-three factorial design provided for nine discrete treatments, which were so arranged that all the three cells of column one had a single characteristic in common. None of these three cells received any exposure to the non-documentary materials. In every case, the treatments given the cells of column two included the treatments given the cells of column one. In addition, the common factor of the non-documentary materials for that column was added. Thus, the Ford Motor Company sound-filmstrips were added as the common factor for column two. In the same way, the Disney film was the common factor added to all cells of column three. Therefore, adding the

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[14]These statements are fully documented in Chapter II.

treatment effects of columns two and three gave the mean effect of the non-documentary materials.

The same procedure was followed for the rows. Row one had in common the absence of any documentary materials. Row two added the common factor of the horror film, the first of the documentary materials; and row three added the second of the documentary materials, the standard film. Adding the treatment effects of rows two and three gave the mean effect of the documentary materials. On the attribute of steering-wheel reversals per minute, adding the non-documentary materials to the documentary materials proved to be highly significant, giving an F value .01. The further analysis using "Scheffe's" test showed that most of the significance found was due to column two, The Ford Motor Company sound-filmstrips. From these results, it seems apparent that the use of the documentary materials had little effect upon beginning driver-education students. The non-documentary materials, especially as represented by the Ford Motor Company sound-filmstrips, showed evidence of being both an efficient and effective means of changing student attitude and behavior.

A further important consideration concerned the direction of the induced changes which occurred. Although previous Drivometer research had used the category of the beginning driver, the term did not refer to the novice driver, but rather to the newly licensed driver. In addition, previous Drivometer research had used various categories of

experienced drivers. Such previous research has shown that the more effective instructional media has been, the more efficient will be the driver and the lower will be the steering-wheel reversal rate per minute, other things being equal. From the newly licensed driver to the very experienced driver, the lower the steering-wheel reversal rate, the more effective has been the media.

One of the skills which goes along with driving experience, is the awareness of possible danger or problem situations in the driving environment. One result of good instructional media for experienced drivers is providing additional awareness of these possible problem areas and giving instruction in their best solution. The experienced driver, therefore, acquires more confidence in his ability to control fully both the driving situation and his vehicle. When emotional tension has been lessened, steering-wheel reversals per minute are reduced. Previous Drivometer research has shown that tension and steering-wheel reversals are highly and positively correlated. Hence, the steering-wheel reversal rate per minute is less. Conversely, anything which increases emotional tension and produces nervousness in experienced drivers will be reflected by a corresponding increase in the steering-wheel reversal rate per minute.

Novice drivers also reflect emotional tension by a change in steering-wheel reversals. They, however, do not react to possible danger areas in the driving environment as do experienced drivers. Unless they have been made aware of

these potential danger areas, no chains of experience are linked to produce this type of learning. And without experience, no meaningful learning can take place. Most novice drivers remain unaware of all except the most obvious and serious danger areas. They simply have not been conditioned to and have not learned about potential driving hazards. The less awareness such novice drivers seem to have of potential danger and hazards, the more this appears to reduce their emotional tension, which is reflected in lower steering-wheel reversals. They simply do not appear to worry about potentially dangerous driving situations because novice drivers have no personal or vicarious knowledge about most of these situations. They cannot worry about a situation if they are not aware of its importance or existence.

Effective instructional media for novice drivers should make them aware that such potential driving hazards do exist and should provide appropriate instruction for their solution. The more effective the driver education media, the more aware students should become of these hazards and potential danger areas. This awareness should increase tension as well as reduce security and increase nervousness. Thus, there should be a corresponding increase in the steering-wheel reversal rate per minute. For novice drivers, a higher reversal rate seems to be identified with more effective and efficient instructional media.

This assumption of higher steering-wheel reversal rates is logical for novice drivers when they have been

exposed to efficient driver-education instructional media. In addition, a conference with Greenshields confirmed his agreement with this position,[15] as did the findings of this study. There has been little previous empirical research using the Drivometer as the device with which to measure the driving responses of novice drivers. The results as shown in Table 1 of this study seem to support this assumption.

In regard to the variable of speed change per minute, results in the same direction were observed. Adding the non-documentary materials to the documentary materials produced a difference in means which was significant at the .04 alpha level of confidence. But most of the behavioral changes induced by the non-documentary materials were due to the Ford Motor Company filmstrips. There was a difference of only 0.01 speed changes per minute between columns one and three, which compared the documentary materials with the Disney film. Yet there was a difference of 0.08 speed changes per minute when column two, the Ford filmstrips, was added to column one, the documentary materials.

The row mean variance was not significant at the .09 alpha level of confidence. Nor was there significant interaction for either the steering-wheel reversal or speed change analysis.

On the variable of accelerator reversals, a different pattern appeared. Adding the non-documentary materials to

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[15]Interview with Dr. Bruce Greenshields, the Department of Transportation Engineering, the University of Michigan, July, 1966.

the documentary materials was not significant at the 0.71 alpha level of confidence. Apparently for the attribute of accelerator reversals per minute, the non-documentary materials had little effect beyond that produced by the documentary materials. But the reverse was not true. Adding the documentary materials to the non-documentary materials was highly significant at the .001 alpha level of confidence, or better. With "Scheffe's" test, both of the documentary materials were significantly different from the non-documentary materials. Yet the differences were in opposite directions. The mean for the non-documentary materials was 12.99; for the horror film, 9.42 and for the standard film, 21.17. These results are in agreement with an analysis of various subject-Drivometer responses prepared by Shinn and Reel.[16]

Having been used first, the non-documentary materials apparently produced an awareness in the subject of the importance of the driving task and the possible hazards involved. A mean Drivometer accelerator-reversal rate per minute of 19.92 was the result. Adding the horror film to the non-documentary materials caused a significant decrease in accelerator reversals. The most likely explanation for these results is that an increased awareness of the dangers inherent in the driving situation, as shown by the horror film, was reflected in a marked reluctance to use the accelerator. Unlike in the case

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[16]Bob Shinn and Tom Reel, Untitled memorandum, dated October 6th, 1965, whose subject was "Research Vehicle and Drivometer" (East Lansing: Highway Traffic Safety Center, Michigan State University), p. 8.

of steering, subjects had much more voluntary control of their use of the accelerator; therefore, the effect of the horror film apparently was to inhibit use of the accelerator.

When the standard film was added to the non-documentary materials, the accelerator reversal rate increased by a highly significant amount. The mean for the non-documentary materials was 12.92. Adding the documentary materials in the form of the standard film increased the mean reversal rate to 21.17 reversals per minute. The standard film apparently blocked and inhibited the subject's attitude and behavior which had been conditioned by the non-documentary materials, effecting a much increased accelerator use.

As listed by Shinn and Reel, several causes have been found for a high accelerator reversal rate.[17] Among these is the lack of attention to, or the concern with, the driving environment. Typical symptoms of this condition, in addition to a high accelerator reversal rate, are over-adjustment to traffic conditions, caused by inattention and by following the car ahead too closely. They regarded ignorance and the lack of concern for potential dangers which might be present as the causes of this type of poor driving behavior.[18]

The analysis supports these findings. Adding the standard film to the non-documentary materials must have produced an apparent soothing effect which caused the subjects in this treatment group to forget behavior induced by the non-

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[17] Ibid.
[18] Ibid.

documentary materials, thereby reducing the subjects' attention and concern. The important concepts taught, together with the attitudes formed by the subjects' exposure to the non-documentary materials, apparently were severely inhibited due to the retro-active interference of the documentary materials, as represented by the standard film.[19]

No significant interaction effects were found.

The analysis of the brake application data showed no significance in the columns, in the rows, or through interaction. Although brake application data is provided by the Drivometer, in most cases, brake applications would seem to be more a product of the unique driving conditions of each test run, rather than a highly valid measure of behavioral and attitudinal changes. From the analysis of the brake application data, it can be seen that no meaningful pattern of responses occurred in any category.

Summary

One hypothesis was tested in this study. The alternative hypothesis, H_1, pertained to the efficiency and effectiveness of each of the four modes of instruction studied for the four attributes tested. The testing instrument, an automobile-mounted computer, recorded student responses on the four main variables of the driving task. The results of

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[19] Robert M. Gagne, The Conditions of Learning (New York: Holt Rinehart and Winston, 1965), p. 105.

findings pertaining to each of these four variables are summarized in table 12.[20]

Based upon the findings reported by the computer analysis and summarized in Table 12, the null hypothesis was rejected and the research hypothesis was accepted for the three attributes of the steering-wheel reversal rate, the speed change, and the accelerator reversal rate. The null hypothesis was accepted only for the attribute of brake applications. Brake applications have been shown by previous research to be the least important measure of driver performance.

The researcher has reported and interpreted the analysis of the data collected through available research evidence. Since little previous evidence exists in which the Drivometer was used to measure driving responses of novice drivers, he realizes that other interpretations are possible. But he considers other valid interpretations to be unlikely. However, the need for additional research in this area is recognized. It was shown that students who have been exposed to one mode of instruction will make different Drivometer scores than will students who have been exposed to another mode. In addition, it was shown that one mode, the non-documentary materials, produced evidence of positive behavioral and attitudinal changes, whereas the documentary materials either inhibited such positive change or else made no difference.

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[20] Supra, chapter iv, p. 81. See Table 12.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The efficiency and effectiveness of two combinations of the four modes of instruction were investigated in this study. They were composed of: (1) documentary materials and (2) non-documentary materials.

Mounted in the test automobile, a digital computer, the Drivometer, was used as the un-biased testing device with which were recorded the effects of the various treatment conditions in regard to the four variables of driver performance measured and recorded by the Drivometer. These variables were (1) steering-wheel reversals per minute, (2) speed changes per minute, (3) accelerator-reversals per minute, and (4) brake applications per minute.

A three-by-three factorial analysis design was used, consisting of a control group and eight treatment groups in which four independent replications were employed. Subjects for each replication were selected from beginning Summer School driver education classes at Sexton High School in Lansing, Michigan. After meeting the requirements of the research design, volunteers were finally selected by the use

of a paper-and-pencil test--given after the basic, non-media driving instruction--so that those chosen were as nearly homogeneous as possible in their knowledge of freeway driving. All subjects for each replication were of the same sex and had the same instructor. Every student, per replication, was assigned to treatments by random selection. The random distribution of uncontrolled variables was assumed by the research design.

One hypothesis was examined:

H_1: Students who have been exposed to one mode of instruction will make different mean scores on the Drivometer than will students who have been exposed to another mode of instruction.

The area of freeway driving was selected as being most suitable for the administration and control of the testing procedures involving the Drivometer. A standard driving course on the freeway, northward in the direction of Grand Rapids, Michigan, was selected to allow students to perform a variety of freeway driving tasks. After the treatment called for by the research design, treated students drove the standard course. A record was made of the four attributes measured by the Drivometer.

Following the completion of all treatments and testing, the resulting data was analyzed. The hypothesis was supported on the attributes of steering-wheel reversals, speed changes, and accelerator reversals. Significant differences were found between the means of the columns when the non-documentary materials were added to the documentary

materials for the two attributes of steering-wheel reversals and speed changes. Only on the attribute of accelerator reversals were row mean differences significant. In regard to the most highly sensitive attribute, steering-wheel reversals per minute, as well as the second most sensitive attribute, speed changes per minute, when the non-documentary materials were added to the documentary materials, highly significant findings resulted. Concerning the attribute of accelerator reversals per minute, the addition of the documentary materials to the non-documentary materials gave highly significant results. However, these results showed a reduction of reversals when the standard film was included. With this attribute only, significant results seemed to be of a negative, rather than a positive nature. No significance occurred on the attribute of brake applications per minute.

A further analysis, "Scheffe's" test, was performed to determine whether one, or both, of the two non-documentary materials was the cause of most of the significance found for the attributes of steering-wheel reversals and speed changes. For steering-wheel reversals, the Ford Motor Company sound-filmstrips produced the bulk of the significance found when the non-documentary materials were added to the documentary materials.

The data collected by the Drivometer not only supported the hypothesis for three of the four attributes tested but also indicated the type of projected non-documentary materials which were most effective and efficient in this study.

Conclusions

The following conclusions are drawn from the results of this study, but they apply only to instructional materials used with novice driver education students:

(1) For the documentary materials, no positive learning was found; there were recorded several instances of negative learning--that is, learning which tended to inhibit the positive learning produced by the non-documentary materials. Gagne calls this either retroactive or pro-active interference depending upon when it occurs.[1] Therefore, the continued use of such documentary media is highly questionable.

(2) In regard to the most highly sensitive attribute, steering-wheel reversals, as well as the next most sensitive attribute, speed changes, the non-documentary materials produced both highly significant and positive behavioral changes.

(3) Of the two different non-documentary materials, the factual, straightforward teaching format of the Ford Motor Company sound-filmstrips caused the bulk of the positive and significant behavioral changes which were recorded.

(4) Projected instructional media which are used for teaching purposes should be specifically designed and produced to teach only the concept or concepts desired.

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[1]Robert M. Gagne, The Conditions of Learning (New York: Holt Rinehart and Winston, 1965), p. 105.

(5) The use of general media not designed to teach specific concepts cannot be justified except, in some cases, as supplementary materials. Their use may inhibit rather than help produce behavioral changes in the desired direction.

(6) In the selection of combinations of teaching media, care must be taken to choose media which do not detract or inhibit other teaching media being used. All media used as a teaching mode should add to the desired behavioral changes.

(7) The Disney film, Freewayphobia, did not produce the positive behavioral changes which were exhibited by the Ford filmstrips. The Disney film, however, was superior to the documentary media. It seems likely that the addition of the excellent production techniques used, together with "Goofy" as the main character, may have distracted or inhibited the basic concepts being presented.

(8) The most effective and efficient instructional media should present the concepts to be learned in a serious manner; should not introduce anything which inhibits or interferes with the attention to, and the comprehension of, these concepts by the students; and should be concise and businesslike.

Implications for Future Research

As a result of the study and the analysis, certain problems and differences in data direction suggest the need

for future research.

If an un-biased measuring and testing instrument can be developed, a similar study in an area other than driver education should provide data for determining whether the results obtained in this study transfer to the use of instructional media in general.

As has been noted, the results of this study were in the opposite direction from those produced when experienced drivers were used as subjects in previous Drivometer research. It can be hypothesized that as novice drivers become more and more experienced, their scoring pattern on the steering-wheel reversals, at some level of experience, will reverse direction so that effective instructional media would produce lower, not higher Drivometer scores. A more extensive study with re-tests of the subjects is needed to prove the validity of this hypothesis.

In order to verify the best design for efficient and effective instructional media, a study should be devised in which projected teaching media are produced along the lines shown to be best by this study. Varied and controlled amounts of a possible detracting or an inhibiting format could be added to different versions of the same basic teaching mode in order to test the effectiveness of the different versions. Some entertainment or respite may be beneficial if added at the proper place and in the proper manner. Perhaps such a study could provide more information on this problem.

In no case did the use of documentary materials provide significant positive behavioral changes when they were compared to non-documentary materials. The Drivometer tested only immediate psychomotor responses to the treatment media.

Current learning theory supports the belief that instructional media which produce the largest immediate behavioral change will also produce the greatest retention of that which has been learned. It seems logical to assume that for novice drivers, the teaching media which produced the greatest behavioral change would also produce the most lasting sub-liminal retention of the important concepts which had been learned: information which could prove invaluable in a future driving situation or an emergency.

Although unlikely, it is possible that the documentary media might produce poor Drivometer data as the result of immediate road-testing. Yet the shock-treatment of a Signal 30 type horror film might provide a deep-seated, sub-liminal reaction which could prove valuable in an emergency driving situation. On the other hand, in an emergency driving situation, the sub-liminal reaction--as a result of the subjects' having seen a Signal 30 type horror film--might very likely produce an increased feeling of panic, causing the driver to "freeze" to the wheel at a time when proper avoidance action could have prevented an accident.

Perhaps novice drivers also react in a different manner to informative non-documentary materials. Maybe a higher steering-wheel reversal rate does not indicate the most

effective instructional media when used with adolescent, novice drivers.

The results of this study showed large differences in the teaching media which were used. The most effective medium was a set of four sound-filmstrips, whereas the least effective media consisted of sound motion-pictures. Could the differences found reflect a basic superiority for the filmstrip, as a medium, over the medium of the motion-picture? The wealth of research evidence in the literature suggests that this is not the case. But the results of the present study cannot provide answers to the differences found in the medium, but only to the differences in the content. It is believed by the researcher that the content of the media, not the medium itself, was the important factor leading to the results that were obtained. However, additional research is needed to provide further information on this problem. A study could be designed to identify the desired basic behavioral changes together with the best content treatment with which to accomplish these learning goals. Both a motion-picture film and a filmstrip could be produced, containing precisely the same informative material and presented by the use of the same treatment strategy. Only the type of medium used would be different.

A study designed along these lines would not repeat other studies concerning the motion-picture film versus the filmstrip. What is suggested is that the original production

of a motion-picture and a series of filmstrips should be designed according to the findings of this study. In addition, an experiment should be designed similar to this study with a much greater variety of instructional media used and with many Drivometer evaluations. Attention could thus be given to the identification of specific learning patterns. Such a study should help point out the types of materials needed to produce behavior indicative of good driving. Perhaps actual driving experience is more effective in inducing such good driving behavior. The results of such studies should help clarify the implications of the importance of different types of media as shown by this study, if any implications actually exist.

The researcher does not believe that any of these possibilities are likely. Yet the results of this study alone can only point the way toward needed future research in such possible problem areas, no matter how unlikely they may seem to be.

These problems, along with others, have been researched by this experiment. Research evidence relating to the most effective and efficient production and to the use of instructional media is limited. This study is only one of many studies needed before an adequate body of research information can be provided upon which to base the production of instructional materials and guide their combined use as modes of instruction.

APPENDIX

PAPER-AND-PENCIL TEST

1. Approximately _____ percent of the people are killed within 30 miles of their homes.

2. Super highways are _____ times safer than surface highways.

3. What fraction of fatal accidents result from unknown causes?

4. How much Carbon Monoxide over an hour's exposure will induce drowsiness and result in loss of control?

5. The insurance companies find the average driver has a property damage accident every how many years?

6. The insurance companies find that the average driver has a personal injury accident every how many years?

7. At what ages, in terms of years, do the insurance companies find the most dangerous?

8. Name the three "piston pushers" from the A B C's of the automobile engine.

9. State the primary purpose of seat belts.

10. Name the five seeing-habits.

EXPLANATION AND VOLUNTEER FORM

We may want you to take part in a research study being conducted by Michigan State University.

If you would like to take part, please fill in the following blanks.

Statistical techniques will be used to select those who will actually take part in the experiment.

If you are selected and if you agree to participate in the study, your cooperation will be absolutely essential in completing your part of the experiment.

Before you agree to participate in the study, be sure that you will be able to complete your part in the experiment.

You will be needed for half a day. First, you will be shown driver training films or filmstrips; then you will drive a car on the freeway so that your responses can be measured and recorded by a small computer mounted in the glove compartment. We are interested in your responses to either the film or the filmstrip, or both, which you were shown. It must be emphasized that this experiment is in no way connected to your success in the driver training course. No grade or evaluation is attached to your performance in the experiment.

ANY QUESTIONS?

NAME _____

TEACHER _____

AGE _____

SEX _____

I have had no experience driving a car on public streets.

I agree to return to Sexton High School for the experiment: during the morning, if my classes are in the afternoon; and during the afternoon, if my classes are in the morning.

Signed _____

TREATMENT PLAN

TREATMENT	INSTRUCTOR	SUBJECTS(boys first)	TREATMENT MEDIA
One	Bond	McClellan & O'Connor	Case of Officer Hallibrand
	France	Walker & Christian	
Two	Bond	Ryan & Cronkright	Control
	France	Erickson & Maymaire	
Three	Bond	Hoover & Mojack	Disney film
	France	Lewis & Wilkinson	
Four	Bond	Sullivan & Brown	Disney film & Signal 30
	France	Chubb & Foote	
Five	Bond	Brooks & Morris	Disney film & Case of Officer Hallibrand
	France	Crane & Bryhan	
Six	Bond	Finch & Glass	Case of Officer Hallibrand & Ford filmstrips
	France	Hinton & Joslyn	

Seven	Bond	Morris (Bob) & Hicok	Signal 30
	France	Klco & Ferguson	
Eight	Bond	Carnege & Brackstone	Signal 30 & Ford filmstrips
	France	Hunter & Bowers	
Nine	Bond	Haywood & Keesaer	Ford filmstrips
	France	Jones & Barker	

DRIVOMETER

RECORD

FORM

SUBJECT _____

DATE: _____1966

SR	SC	LOCATION	EVENTS

(There should be as many lines as there are minutes of driving time, since one line is used to record the SR and the SC readings per minute.)

The Drivometer provides totals on SC, SR, AR, and SA, plus total running time.

DRIVOMETER

RECORD

FORM

TOTALS

SUBJECT _____

DATE: _____ 1966

SR rate = SR ÷ RT (Running Time)

SC rate = SC ÷ RT

SR rate = _____

SC rate = _____

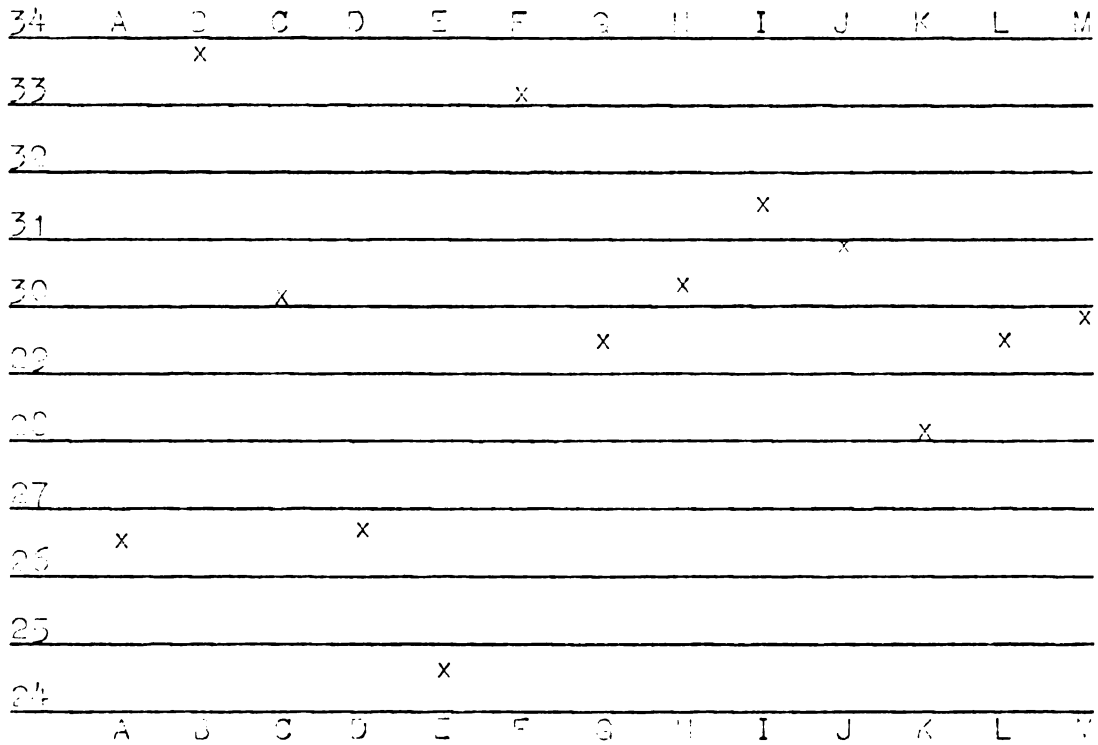
AR = _____

SA = _____

RT = _____

STEERING-WHEEL REVERSAL RATE

MEAN SCORES



A = Control group--mean = 26.41
B = Ford filmstrips--mean = 33.73
C = Disney film--mean = 30.03
D = Horror film--mean = 26.73
E = Standard film--mean = 24.66
F = Horror film and Ford filmstrips--mean = 33.00
G = Horror film and Disney film--mean = 29.40
H = Standard film and Ford filmstrips--mean = 30.23
I = Standard film and Disney film--mean = 31.46
J = Grand mean for boys--30.96
K = Grand mean for girls--28.06
L = Grand mean--29.51
M = Grand mean--less the control group--29.90

PHOTOGRAPH

NUMBER

ONE

The Drivometer-equipped research vehicle and the researcher behind the wheel: Mr. France and subjects.


LE 4255

PHOTOGRAPH

NUMBER

TWO

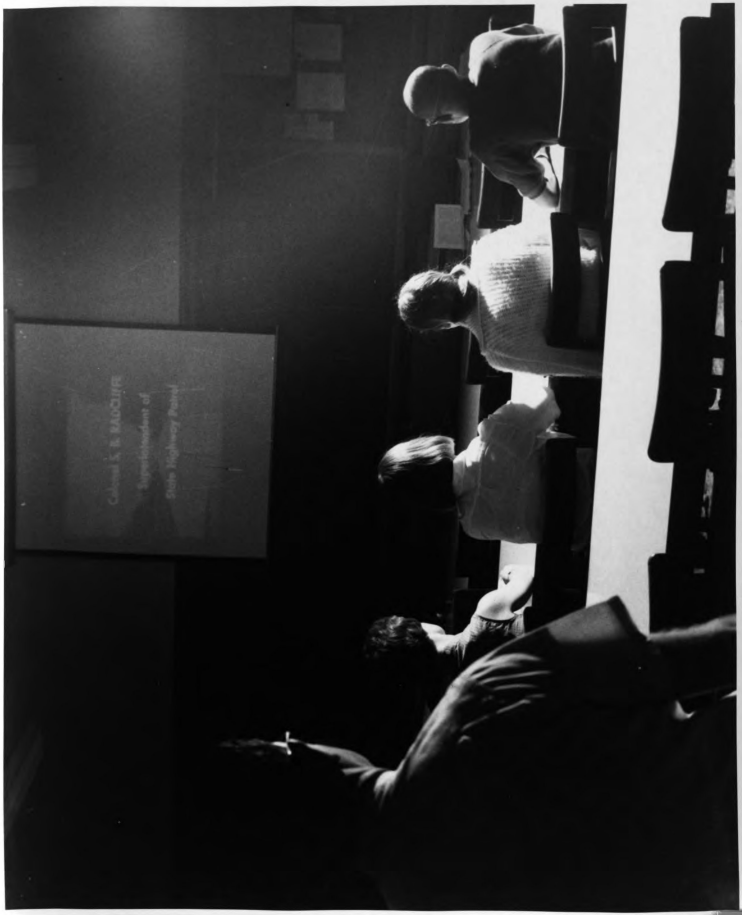
The researcher explains the Drivometer as Mr. France and a subject observe.

PHOTOGRAPH

NUMBER

THREE

Treating a group of subjects.


Colonel C. S. RAGSDALE
Superintendent of
State Highway Patrol

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