THE EFFECTS OF VOICE-OVER, SUPERIMPOSITION AND COMBINATION REDUNDANCY STATEMENTS AS PRODUCTION VARIABLES IN INSTRUCTIONAL TELEVISION

Barry Martin Wagner

A THESIS

in

The Department

of

Education

Presented in Partial Fulfillment of the Requirements for the Degree of Master of Arts at Sir George Williams University Montreal, Canada

March, 1974

Abstract

THE EFFECTS OF VOICE-OVER, SUPERIMPOSITION AND COMBINATION REDUNDANCY STATEMENTS AS PRODUCTION VARIABLES IN INSTRUCTIONAL TELEVISION

Barry M. Wagner

The impact of three television production techniques, voice-over, superimposition and a combination of both were manipulated as redundant instructional units to study their potential for increasing information acquisition gained from a television program. The effectiveness of these techniques was compared to a simple program devoid of all redundancy segments. Learning was measured on a 27-item multiple choice questionnaire with a Kuder-Richardson reliability of .80. Five hundred grade 7 students participated with 100 randomly assigned to each of three treatment groups; plus 100 each in the simple and control groups respectively. Single classification ANOVA and Newman-Keuls test revealed significance between Ss who viewed superimposition ($p < .05$) and combination treatment programs ($p < .01$) compared to Ss who viewed the simple program. The voice-over treatment did not yield significant results. The strength of superimposition affirms the superiority of the visual modality when redundant instructional units are placed in the body of an ITV production.

Acknowledgements

The writing of acknowledgments is usually one of the last pages written before a thesis is completed. At this time we have an opportunity to reflect back on the many long hours spent planning and implementing the study and to thank those who gave very generously of their time, effort, advice and cooperation. I would like to extend my appreciation to the following people and organizations who helped make this project possible:

The Department of Communications, Ottawa, who supported this project through a research contract held by Dr. Gary Coldevin;

Dr. Gary Coldevin, whom I worked for as a research assistant and who also acted as my thesis supervisor. His devotion to this study, patience, understanding and assistance throughout assured the successful completion of this thesis;

Dr. Gary Boyd, Professor Tom Allen and Professor Graham Martin who served as members of my thesis examining committee;

Ludy Edwards, my fellow research assistant and cohort during the past year;

J. Warren Kelly and Gord Perry who sacrificed their free time to assist in the editing and dubbing of video tapes;

Reg Thornton, who provided valuable research assistance through the planning and formulation stages of this thesis.

Finally, to the administration staff and students of the following schools: Corpus Christi, Howard S. Billings and St. Thomas. Their cooperation through all phases of experimentation is gratefully appreciated.

I would also like to thank Madeleine Weiler for her assistance and tangible contributions in the process of typing the final draft of this thesis.

Contents

Chapter 1

Introduction

SCOPE OF STUDY

Television as an instructional medium is a well established tool in most educational institutions. In fact, many schools have their own production facilities in the form of studios, workshops and trained personnel. These facilities represent a considerable budgetary investment and illustrate the confidence placed in television and its teaching abilities.

Is this confidence well placed? The answer is yes. Research affirms the use of television as a valid instrument for instruction. However, this answer does not imply confirmation without qualification.

That television is better than, equal to, or more successful than some other mode of instruction is encouraging indeed. Hideya (1956) summarized approximately 400 studies evaluating the use of instructional television to teach virtually any conceivable academic subject in a curriculum.

Many of these studies, in fact a majority of them, found no significant differences between the use of television as an instructional tool and any other medium, usually an equivalent lecture presentation by a teacher. Present day experiments continue to elicit the same results: no significant differences.

Schwarzwalder (1960) was one of the first instructional television (ITV) researchers to examine presentation techniques which are unique to the television medium. He noted that many studies do not involve television as a unique medium with potential for developing particularly effective visual presentation devices.

The no significant difference findings imply that television does have instructional abilities. However, is this all educators want? Is this the only potential for television? The answer to both questions is a resounding no.

Television's potential is enormous. The impact of cable television, microwave, and satellite transmission would seem to necessitate serious investigation as to how television can best be used as an effective instructional medium. Comparing one talking head in front of a classroom to another talking head on a television screen is hardly doing justice to the production capabilities of television.

If we pause to reflect on the numerous specials and extravaganzas found on the commercial television channels can we not see the potential of the medium for instructional use? Advertisers know of television's dynamism and its ability to sell. Their messages are unfortunately of questionable value but they are prosperous. Television is a billion dollar success.

The yardstick of accomplishment is not the same for instructional television. If television is to continue to be a viable force in the future then research must attempt to identify how it can contribute to more efficient learning. While entertainment is hopefully a by-product of ITV, the coin of the instructional medium is learning.

Some of the techniques advantageously employed in commercial television could be adapted by instructional television producers. The problem remains to identify which techniques will be effective on the instructional side of the medium.

In the production of ITV programs the television producer has educational prescriptions as to the particular acquisitions and changes in motor skill, knowledge, attitude or motivation which are to result from exposure to the program. The producer is faced with the task of specifying and implementing that creative combination of pictures, language, music, visuals, and format and structure which is most likely to result in effective television instruction. Television educators and producers have developed customary production, cinematic and presentation techniques. Producers can only hope on the basis of their experience, that the techniques they employ will be effective in securing and holding the attention of the viewers for which the program is intended.

This study attempts to capitalize on the pitfalls and limitations of earlier ITV research. Rather than attempt to evaluate a television program as compared to another form of media, the approach of this research is to attempt to identify television production variables that may produce effective instruction.

PROBLEM STATEMENT

A production variable is any definable stimulus element which can be manipulated as a technique in an audio-visual program. Television employs a variety of content practices and techniques that contribute to the communication and education that may result from its use. One of the areas of television research that is almost completely unexplored is how production variables involved in the presentation of a teaching program affect learning from that program. Lumsdaine (1963) in delineating the direction of future media research believes that "what is needed are experiments which seek to reveal the influence of specific factors in the design characteristics of the media." The present study assesses the effects of specific auditory and visual stimuli used in ITV.

The principle objective of this research is to determine the effectiveness of production variables which would serve as a guide to teachers, producers and directors of ITV programs.

Electronic media such as television have the potential for transmitting complex audio and visual message elements simultaneously through two sensory channels. The term channel denotes the modality through which information is received by the human perceptual system; audio or video. Audiovisualists are inclined to believe that maximum communicative efficacy

can only be achieved through the use of both audio and visual forms of communication. Conversely, some research findings are diametrically opposed to the practical approach of audio-visualists. This approach states that information can only be absorbed through one channel at any one time. However, rarely in audio-visual research are the parts of a communication isolated and studied.

Berlo (1960) noted the paucity of information regarding the benefits of various message channels. He saw this situation as dictating the need for a concerted research effort by those in the field of communications. More than 10 years later we are still lacking this information. Research has not been forthcoming.

Comparative studies are in sharp contrast to the type of media research needed as defined by Lumsdaine (1963). "The effects of a particular variable should instead be studied by manipulating the variable experimentally by controlled variation." Lumsdaine adds that this type of research requires identical alternate versions of the particular media instrument to be tested. The only difference existing between these instruments is in respect to the specific variable under study. The design of the present study utilizes such an approach as defined by Lumsdaine.

Ives (1971) identified the problem for research

> ... as the need to generate a body of empirical knowledge about the instructional effects of television. For this task better techniques of analysis leading to more complete descriptions of instructional outcomes are a vital pre-requisite. The approach proposed here begins with specific programs, identifies effects that the program may produce, defines more vigorously the variables that may produce the effects and subsequently undertakes experimental studies to investigate further the variables and their effects.

Television as an educational tool has grown tremendously in recent years but few educators would claim they have been able to use the medium to the limit of its potentialities. Too much time, effort, and money have been expended investigating the relative effectiveness of television as compared to another medium. There are literally hundreds of reports saying television does teach. These "comparative effectiveness studies" (Briggs, Campeau, Gagne, & May, 1967) compare one medium with another rather than identifying the component elements of each medium that may contribute to its effectiveness.

ITV researchers would be well advised to define and isolate the myriad techniques that are combined to create an instructional program. Do these techniques contribute materially to the producers' desired communication message? If yes, then how can they be improved? If not, then why are they used? Valid television production techniques that contribute worthwhile results to student learning should be developed and

refined. Those that clearly have no advantage should be employed sparingly.

The question is, "what can the producer do within the program to help viewers learn whatever it is they are expected to learn?" (Schramm, 1971). This approach is an internal examination of the medium to discover which elements of a television production are beneficial in increasing the level of information acquisition derived from that program.

A production variable is a tool of the trade for the television producer. As the chemist and the engineer have their specific body of techniques to perform effectively in their environment, the television producer needs and uses production techniques. The problem for the television producer is to know which production variables will increase the instructional effectiveness of television.

Shepherd (1967) identified seven categories of production variables:

(1) camera factors

(2) lighting

(3) setting

(4) graphic devices

(5) audio factors

(6) performer variables

(7) opening-closing format.

The effectiveness of audio factors, graphic devices and a combination of audio and video are isolated for study in this thesis. The specific audio factor is voice-over while the graphic device is superimposition.

Both audio and video serve as reinforcing experiences during the program. That is, they do not add new information but they multiply learning opportunities. Travers (1964) refers to reinforcing experiences as redundancy or safety factors in the design of a teaching situation.

Teachers, producers and directors of instructional programs do not know how to present material most effectively on television. Too often they work according to custom rather than science. What is lacking are production techniques that have proven to be effective. "In order to understand and use the full potential of television, we must begin to engage in a systematic study of television aesthetics," (Zettl, 1968).

Educators and producers who use television for instructional purposes should have data outlining the relative effectiveness of various television production variables. The present study determines the effectiveness of instructional television programs utilizing voice-over, superimposition, or a combination of these variables and whether they contribute to more significant learning than programs that do not contain them.

RELATED RESEARCH

"In contrast to the hundreds of experimental comparisons of ITV with conventional classroom teaching reported in the literature, there are at most a few score of studies specifically on the content and strategies of ITV," (Schramm, 1971). These studies investigated color, camera angles, eye contact, lighting, picture size, speed of presentation, music and teacher-media interaction. There are virtually no studies investigating production variables as identified herein.

There is considerable research in the area of instructional films (Hoban & van Ormer, 1950; Reid & McLennan,1967). The findings of some have been applied to ITV, often without justification. There are many differences between the film and television media; size of picture, photographic detail, and viewing environment. Without doubt many of these findings cannot be extrapolated beyond their immediate results mainly because of poor experimental designs and lack of control of variables under study.

Most of the film research which has compared the learning from the auditory or visual channels, or both, has used disparate serial tests of verbal materials or nonsense syllables. At best these findings can only apply directly to such material. Educators should be cautious in adopting any evidence from these studies without further investigation.

May and Lumsdaine (1958) found " . non-verbal stimuli when combined with the verbal explanations form a total pattern which has more power than words alone to evoke the desired response."

The evidence is inconclusive in affirming the benefit of either audio or video. In some experiments, auditory presentation has been rather consistently better than visual, whereas in other studies the opposite results have been obtained (Hoban & van Ormer, 1950). There is evidence that the influence of any motion picture depends to a very great extent on the reinforcing experiences that occur before, during, or after the film showing. In the ITV programs under study the voice-over and superimposition serve as reinforcing redundancy segments during the presentation.

A brief summary of a perceptual theory of communication is helpful in analyzing the effects of production techniques. "As to future research ... it is to be hoped that the relationships of visual communication techniques to theoretical models of perception and learning would be investigated more thoroughly than in the past," (Anderson, 1972).

There is a long tradition of intuitive and theoretical support for the superiority of word picture communications. It is generally thought that pictures and words together perform a more effective function than either one can perform alone.

Empirical evidence does not conclusively validate the aural-visual combination so readily adopted by television producers. Some have found the presentation of information through two channels to be significantly more effective than single channel presentation while others have discovered the opposite.

Broadbent's theory of perception (1958) has been the foundation for research investigating multi-channel communications. His theoretical model of the human perceptual system states that only one main channel carries auditory and visual signals from the sense organs to the higher centres of the brain. The second channel input is retained for a very brief period of time in a short term memory-bank. When a channel is opened this "second channel information" is used. Broadbent's theory leads us to hypothesize that redundant information presented through more than one channel may not necessarily lead to more efficient learning.

Severin's cue summation theory (1968) states that stimulus cues in each channel are additive in their effect. His theory points out that multi-channel communications which combine words in two channels (aurally and visually) will not result in significantly greater gains than a single channel communication since the added channel does not provide additional cues.

Travers (1964) summarizing and contributing to the earlier work of Broadbent found no significant differences between two channel presentations and single channel (visual) presentations of information. He did note significant differences between either the visual-aural or visual only channels over the aural channel alone. This suggests that the implementation of multi-channel information inputs may not necessarily be more effective in contributing to information transmission than the use of a single channel.

Whereas some of Travers' findings might provide us with a clue indicating the direction of future research in this area we should also realize the limitations of his results. Most of his experiments used nonsense syllables, thus making it easier for the experimenter to control variables. The results of these findings have very limited applications to the everyday production situations and decisions faced by a television producer. The present study attempts to verify the use of production variables in a meaningful situation.

Klapper (1958) compared a highly visualized form of a television lesson with a blackboard or normal classroom presentation of the same material on television. The program making heavy use of production devices was favored over the normal presentation by a ratio of 9:1. Klapper summarizes that we have not yet learned which kinds of visual aids and

audio devices are most effective in helping the student to learn specific kinds of information.

Barrow and Westley (1958) hypothesize that there is an ideal or optimum rate at which materials can be presented on television but they are not explicit as to how this rate can be determined. Viewers tend to maintain their attention when the material is familiar, meaningful, and related. Their suggestions are however hypotheses and should be accepted as such.

Aylward (1960) stated that more efficient television communication could be achieved by utilizing production techniques which enhance viewer attention. He studied communicator image size, program editing, and program background and found significant differences ($p < .05$) among experimental groups. Aylward concluded that more efficient television communication will result if relevant production techniques are used that heighten attention without distracting.

Two studies of production techniques are of direct concern here. One is an inventory of techniques used in television while the other examines some specific techniques. Neither investigates the use of voice-over and superimposition as identified in the present study.

Shepherd (1967) compared production techniques found in commercial television and ETV. It was found that ETV

production made use of the same techniques as commercial television. Shepherd noted that "... in general commercial television tended to be more dynamic in production than did ETV." His research is clearly the first step in the analysis of production techniques used in television. In suggesting future research he sees "...the major question now as, what about these techniques. Do they in fact have an impact on the audience?"

Schwarzwalder (1960) examined three production techniques as they affected learning mastery scores in fifth grade science. Visual continuity, visual reinforcement, and visual manipulation were investigated. Two levels of visual reinforcement were outlined. The first level used "supered" graphics, while on the second level there were no "supers." He found superimpositions of reinforcing terms or visuals added significantly ($p<.10$) to learning. Schwarzwalder does not clearly specify how the visuals were used so it is impossible to draw any conclusive results from his study to the present one. A .10 level of significance also detracts some credence from the results, although it may indicate the direction of future findings.

The previously stated research is the only available evidence on the relative effectiveness of superimposition. The present study follows from and hopefully will add to the findings presented by Schwarzwalder (1960).

RATIONALE FOR THE STUDY

The objective is to validate the use of superimposition, voice-over and superimposition/voice-over as relevant instruments of television production. The results will attempt to answer the following two questions:

1) Does the use of superimposition, voice-over, or a combination of superimposition and voice-over contribute to greater information acquisition derived from a television program when compared to a simple program lacking these techniques?

2) Which of the three techniques will be the most effective production variable in contributing to the greatest amount of information acquisition derived from a television program?

Prior to discussing the possible directions of our findings based on previous research, it is necessary to operationally define several terms.

A production variable is a definable process, method or technique of producing audiovisual stimuli. Every form of media has its specific techniques. Some are unique to that form of communication, while many are common to numerous media.

Superimposition is a production technique by which a word, phrase or sentence is superimposed or placed over a picture of the presenter talking or any other picture or image

being shown on the television screen. A superimposition may be either static, and stay in one position on the screen, or rolling up or down the screen at a suitable pace to be easily read by the viewer. For example, the credits at the end of a television program are superimpositions.

The term voice-over refers to a spoken voice heard over the picture being seen on the television screen. The source of the voice is not seen on the screen at the same time. When a narrator is used to describe a movie that voice is voice-over.

In this study when voice-over and superimposition are combined, a narrator's voice will read the superimposed sentences simultaneously as they are shown on the television screen.

A simple program is identified herein as a television program that does not contain either deliberate superimposition or voice-over redundant segments in the body of a television program.

Data pertaining to "what happens when information from multi-channel inputs are received by the human perceptual system" must often be analyzed with conjectural value due to the inferential nature of the research. The direction and results of many experiments are formulated in an abstract theoretical framework which does not always permit one to draw conclusive

deductive results. Therefore the findings of one experiment sometimes refute the conclusions of a similar study primarily due to the theoretical interpretation of the researcher.

It should be emphasized that while the present study seeks to establish a theoretical basis, its main thrust is a practical application as opposed to a theoretical one.

Travers (1964) concludes from his research in audio-visual information transmission that any event that multiplies learning opportunities would be expected to increase learning. Since the use of superimposition, voice-over and a combination of both, serve as reinforcing experiences or redundancy segments that multiply learning opportunities, it might be expected that all techniques would consequently be effective treatments. The question remains: which one(s) will be most effective?

Travers (1964) found that the human perceptual system has a more efficient capacity to absorb and assimilate information through the visual channel than through the aural channel. This qualification is noteworthy.

While the multiplication of learning experiences would quite naturally be expected to contribute to greater learning, Travers also suggests that the channel which receives this information may contribute to more or less efficient learning.

Schwarzwalder provides us with an empirical basis which may also support the trend previously noted by Travers. Schwarzwalder (1960) found television centered techniques such as superimpositions in themselves do add materially to learning.

There is less evidence to substantiate the use of voice-over as a production variable other than as an event which multiplies learning opportunities. It may, however, be hypothesized from Schwarzwalder's research that voice-over is also a television centered technique and would therefore add materially to learning. It should be emphasized that this is a hypothesis and not a finding of Schwarzwalder's previously discussed study.

We note conflicting evidence in analyzing differences that may accrue between the use of both superimposition and voice-over in what is defined as a combination treatment. Little can be stated with certainty that is directly applicable to the present investigation.

Voice-over and superimposition are used consistently by television producers as a matter of fact occurrence. A rationale for their confidence in these techniques is not apparent.

On the one hand there appears to be logical prima facie evidence supporting the combination treatment. That is,

voice-over and superimposition serve as a double reinforcing event. Each variable acts as a cue or code for the other one. The benefit of such an approach is not clearly apparent. To summarize the findings of Broadbent (1958), Travers (1964, 1966), and Severin (1968), the transmission of information through multi-channel inputs does not necessarily lead to the reception of more information as compared to the transmission of information through single channel inputs.

This evidence would lead us to conclude that while the combination treatment may appear to be twice as powerful since it contains twice as much potentially available information, the information carried in one channel is superfluous. The combination treatment should, however, be at least as effective as either of the single channel treatments. The possibility also exists that it may be more effective on the principle that if the viewer does not assimilate the information through one channel the "safety factor effect" inherent in the other channel will then take over.

Finally, the importance of the simple treatment in this study will be outlined. Too many other studies investigating content variables in media have only compared the experimental treatment against the control group. When differences were found between the experimental and control groups, the researchers claimed success for their experimental treatment.

The fact is, this is not a valid conclusion (Ives, 1971). The authority of research using such an experimental design is dubious at best. Results can be attributed to any other number of factors that are interacting within the treatment. These factors may or may not be the experimental treatment interacting in combination with a factor not being manipulated.

A tangible method that may help to rectify this problem is to produce an exact version of the media program being measured, identical except for the specific variable being manipulated. Only then can valid comparisons be made between two programs, one testing the experimental techniques and the other devoid of these techniques. Results from this type of research design can then be attributed to the differences between the treatments, or the experimental variable. The present study utilizes this method of experimental design.

Chapter 2

Procedure

PRODUCTION OF TELEVISION PROGRAMS

Television programs available from private sources and libraries were analyzed for their suitability in meeting the objectives of this study. It was decided that none of the programs examined would be appropriate in this instance since it was necessary for certain techniques to be isolated and controlled in a pure state. The order of presentation of the variables in question also had to be presented in a sequential form following a rigorous pattern that would allow for tight experimental control.

With these restrictions and qualifications it was deemed necessary to write and produce four television programs especially for the purposes of this experiment. The three experimental programs had to contain the three techniques; voice-over, superimposition and combination in a method that could be subjected to thorough testing in the schools.

Choosing the topic for the programs was also a matter of prime concern in deciding upon their potential design. The subject presented had to be interesting and educative. In attempting to find schools where these programs could be tested

it was found very helpful to offer programs which contained educational content. This pleased school boards, principals and teachers and made the task of gathering a sample much easier. However, the motivation of students is not directed to television for solely educational content. They want to be entertained and informed. Even though the style of the programs was documentary in fashion many students found the experience entertaining and enjoyable. The subject matter content had to be at an appropriate level of comprehension for the target population. It was considered that another experimenter might want to replicate this study on older Ss so the content of the programs had to be suitable for a wide age range. Finally, the subject matter had to be of a novel nature so that prior knowledge of Ss would not contribute to any significant degree to the final results of the experiment.

After accounting for all of the above criteria the topic of "Forests and Fires" was chosen. The programs do not espouse the edict that all forest fires are bad but rather present a more modern interpretation of the role of fire in the forest. Fires, very often benefit and promote a healthy forest environment.

The structure of the programs are of a documentary nature. One narrator or presenter is on screen reading. Key shots of slides of forests, animal life, and forest fires are

shown in the background as a suitable "frame" for the presenter. (A key is an electronic effect which superimposes the image of one camera into the image of another.) Graphs and charts are used as functional visual aids to elaborate and illustrate the message presented.

Each 16-minute program is composed of three information presentation blocks that center around the main theme of "Forests and Fires." These blocks are: 1) forest fires damage and destroy forest life and habitation; 2) lightning fires often benefit the forest; 3) controlled burning (fires deliberately set by forest rangers under the proper wind and weather conditions) promotes healthy forest growth. There is no physical division in the programs per se but rather a smooth transition in the script which allows the narrator to flow from one unit of information to another while still maintaining program continuity (see Appendix A).

All programs were produced in Studio A at Sir George Williams University. A full studio crew was employed for this production. Video tape recording employed one-inch black and white IVC 800 series machines. The final editing and dubbing down to one-half inch video tape was completed at Scarborough College, University of Toronto. The dubs were recorded on the Sony 3600 series video tape machines which were also used for the playback of the programs in the schools.

Before the final assembly of programs was completed, "intro's" and "extro's" were added including a short musical segment in the background. The final version of all programs is approximately 16 minutes each in length.

DESIGN OF TELEVISION PROGRAMS

The design of the programs was mentioned earlier. Each program is composed of three information presentation blocks. The following is a more detailed account of the actual construction of the programs in whole and in part. This explanation is necessary to understand the rationale behind the testing and analysis.

Since television presents a linear series of temporal combinations of visual images and verbal statements it is relatively easy to separate and isolate these as instructional units. That is, the temporal period within a program at which specific information is presented can be isolated. If the measures of educational outcome directly sample the information conveyed by the instructional units, then the relationship between the three production techniques and the outcome may be directly established.

Each television program consists of 15 instructional units comprising the experimental production variables. Five instructional units are contained in each of the three information presentation blocks as defined in the previous section. Thus the section on forest fire damage contains five instructional units and controlled burning contains five instructional units. These instructional units comprise three redundant statements each, for a total of fifteen redundant statements

in each information presentation block. The entire program therefore contains forty-five redundant statements in the form of the production variable being examined (see Appendix A).

Figure 1 illustrates the placement of each of the three production variables and the information presentation block in which they occur. Each technique occurs in a different location in each of the three programs, an important experimental control consideration. All the questions directly measure the information contained in the instructional units.

The construction of program one will be elaborated on to illustrate the exact use of the production variables. During information presentation block one, the damage caused by forest fires, the superimposition redundant statements are shown on the television screen over a slide keyed in the background. All superimposition titles are white in color and large enough to be read by all Ss in the experimental classroom. There is no audio for the duration of the superimposition instructional unit. Upon completion of the three statements in the superimposition instructional unit the narrator continues with the program until the next superimposition instructional unit. After five superimposition instructional units and the completion of the "forest fires cause damage"

Content and Design of Television Programs Indicating Placement of Instructional Units

	PROGRAM I	PROGRAM II	PROGRAM III	PROGRAM IV
INSTRUCTIONAL UNIT I	Forest Fires Damage Superimposition	Forest Fires Damage Voice-Over	Forest Fires Damage Combination	Forest Fires Damage Simple
INSTRUCTIONAL UNIT II	Forest Fires Lightning Voice-Over	Forest Fires Lightning Combination	Forest Fires Lightning Superimposition	Forest Fires Lightning Simple
INSTRUCTIONAL UNIT III	Forest Fires Control Burn Combination	Forest Fires Control Burn Superimposition	Forest Fires Control Burn Voice-Over	Forest Fires Control Burn Simple

Figure 1.

presentation block, the second presentation block, lightning fires, and its accompanying instructional unit, voice-over, is employed. The voice-over treatment occurs when the narrator's voice is reading the redundant statements over a slide on the television screen. Aside from the slide there is no other visual support during the voice-over treatment. Statements are read at an average rate of speech as ordinarily heard on radio or television; 140-150 words per minute. After five instructional units of the voice-over treatment have been completed the combination treatment is presented. This technique combines both superimposition and voice-over. That is, superimposition statements are shown on the screen, over a slide in the background, while the narrator simultaneously reads the statements. Upon the completion of five combination instructional units and the information presentation block on controlled burning the program is terminated.

The difference between each program (see Figure 1) is one of placement of the specific production variables. The design of the instructional units, the statements in each instructional unit, the amount of time the units are on the screen, and the background slides used are all identical for each program. Again, the only difference between programs is where the production variable occurs. Everything else is constant. The strategy for rotating the instructional treat-

ment units minimizes the possible effects of placement and/or content. If placement of any treatment does contribute to learning acquisition then the results of this investigation will be spuriously attributed to that treatment, rather than to the placement of the treatment. The design of the programs also controls for pre-entry knowledge of Ss since each treatment occurs in each of the three information presentation blocks. Therefore, results will not be spuriously attributed to experimental treatment when they may in fact be a function of the Ss prior knowledge.

The fourth program is defined as a "simple treatment." This program does not implement any of the three production variables under study but it does cover the same teaching points as the experimental programs. It contains no redundant statements. It is in fact a simple or pure form of the experimental programs. This type of production allows us to test for the effect of the production techniques themselves, when compared to a simple production which is void of these techniques. To summarize, the simple program is not testing an experimental technique in itself but instead allows us to affirm any results with more confidence since the experimental programs are weighed against the simple version of the same program.

INSTRUMENTATION AND TESTING DESIGN

This study employs a posttest only control group factorial design which controls for all sources of internal validity and most sources of external validity applicable to the problem under investigation (Campbell & Stanley, 1963).

There is one discrete independent variable with five levels, and one dependent variable with one level. The five levels of the independent variable are: 1) superimposition; 2) voice-over; 3) combination of superimposition and voice-over; 4) simple control; and 5) classic control. The dependent variable is posttest measures after treatment. The classic control group does not see any programs and receives only the posttest. All posttests are identical.

The experimental design is illustrated:

R	X1	01	Experimental Program One
R	X2	02	Experimental Program Two
R	X3	03	Experimental Program Three
R	X4	04	Simple Program Four
R		05	Classic Control Group

R = randomized selection of subjects

X = experimental treatment

O = administration of posttest

The test questionnaires were designed to measure cognitive acquisition of information presented in the tele-

vision programs. The final version of the test, after pretesting the questionnaire, was comprised of 27 multiple choice items with four choices available for each answer (see Appendix B). The 27 questions comprised nine questions from each of the three information presentation blocks. Nine questions measured information acquisition gained from the superimposed treatment, nine questions measured information acquisition gained from the voice-over treatment and nine questions measured information acquisition gained from the combination treatment. There was no physical separation of the questions on the questionnaire itself. Items were numbered from 1-27. All questions are supported by the redundant production variable instructional units. The questions measure whether the production techniques used in the instructional units contribute significantly to learning. Each question was derived from information presented in the instructional units.

At the end of the questionnaire six additional items were drawn up to gather certain socio-economic data. These items were included in the questionnaire so that the researcher could get an accurate representation of the construction of the sample. The demographic characteristics of the sample are reported in the following section (see p.35).

Prior to the actual implementation of the experiment the questionnaire was pretested to determine if it possessed

the required psychometric properties of reliability and validity. Sample questionnaires were administered to 30 students at Corpus Christi School. These Ss represented a sample of the target population to be used later for the final study. Instructions to Ss and testing conditions were the same as those supplied to all Ss when the final experimentation was carried out.

Reliability of questionnaires was determined by computing item discrimination and item difficulty. Questions which did not distinguish adequately between high and low respondents were discarded. The pretest version of the questionnaire contained 45 multiple choice items which were systematically reduced to the 27 items comprising the final questionnaire (see Appendix 3). The Kuder-Richardson 20 formula revealed a final test reliability of .80. Since all questions were derived from the program content itself the questionnaire possessed the necessary content validity.

The experimental treatment was completed during one 50-minute class period. One 23-inch Electrohome television monitor, stand, and Sony 3600 one-half inch video tape recorder were brought into the classroom. Two experimenters were present in each classroom. While one set up the equipment, the other gave directions to Ss as to the nature of the experiment:

> We are here today to show you a short television program called "Forests and Fires." After the program we are going to give you a test so that we can determine if the program was useful to you. The results of the test will help us to design better television programs in the future. If you are not sure of what to do you may ask questions. After you have finished the questionnaire we would like to hear your comments on the program.

All programs were shown to Ss on classroom size 23-inch monitors mounted on standard 4-foot stands. Ss were seated as close as possible to the front. Equipment was positioned so that the maximum horizontal viewing angle was less than 30 degrees for Ss nearest the receiver (Gordon, 1970).

SAMPLE

To enable this study to be sufficiently sensitive in finding a difference between treatments if one does exist and to make the results appropriately generalizable a sample of 500 Ss was employed. The sample comprised 20 grade 7 classes from two high schools in suburban Montreal: Howard S. Billings in Chateauguay and St. Thomas in Pointe Claire. Both schools are situated in middle class and upper middle class communities and are relatively large. Howard S. Billings has 2800 students and St. Thomas has approximately 3000 students. Audio-visual communications equipment and facilities were present in the schools so the introduction of television receivers into the classrooms was not a foreign occurrence to the students.

One hundred Ss (four classes) were randomly assigned to each of the five groups being tested; superimposition, voice-over, combination, simple and classic control. Occasionally the total amount of students in four classes was larger than 100. Rather than eliminating these Ss from the experiment they were included as part of the sample so all classes were kept intact. When more than 100 questionnaires were collected from any one group, these were randomly reduced to n = 100. The inclusion of extra Ss allowed for the discarding of incomplete questionnaires.

Analysis of socio-economic data indicated approximately

75% (N = 369) of the sample was 12 years of age, 17% was 13 years of age (N = 86), while the remaining few were 11 (N = 33) and 14 (N = 11). One 15 year old S was recorded. The sex composition of the sample contained 282 males (56.4%) and 218 females (43.6%). The largest single group of respondents (40%) came from a household where one or more parents was employed in a professional capacity (Dominion Bureau of Statistics, 1961). White Collar and Blue Collar households comprised 29% each of the remainder of the sample, while 2% did not respond to this question. All but two of the Ss had at least one television set in the home.

STATISTICAL PROCEDURES

Marginals were first generated for all data to produce means and standard deviations for each group. Single classification or one-way analysis of variance (ANOVA) with five levels of the independent variable was employed to determine the effects of the experimental treatments. All treatments were measured against both the classic control group and the simple treatment program. To analyze differences between the three treatments themselves a single classification ANOVA with three levels was computed, the levels representing the three experimental treatments. If the analysis of variance tests suggested a significant difference between means, the means were then further analyzed using the Newman-Keuls multiple comparison method (Ferguson, 1971) to validate significant differences. An F ratio with $p < .05$ is the level of significance reported for all data.

Chapter 3

Results

The television programs were so designed that each one contained each of the three experimental treatments occurring in various positions in the body of the program (see Figure 1). The control considerations for this design were previously elaborated upon and need no further mention here.

For the statistical analysis each program is divided or split into its three information presentation blocks. Thus for example, the score of 100 Ss on the superimposition treatment variable in program one is added to the score of the 100 Ss on the superimposition treatment variable in program two, which are both added to the score of the 100 Ss on the superimposition treatment variable in program three. The same procedure applied for both the voice-over treatment variable and the combination treatment variable. For the simple treatment program scores from each of the three information presentation blocks in that program were summed and the regular computations to derive means and standard deviations were computed.

The total S count for each experimental treatment yields n = 100. Means and standard deviations for all redundancy treatment groups are shown in Table 1. Means and standard deviations for both the simple treatment (n = 100) and

classic control Ss (n = 100) for a total N = 500 are also included.

TABLE 1

Means and Standard Deviations for Five Groups

Treatment Groups	N	Mean	Standard Deviation
1	100	14.8600	3.6405
2	100	14.1200	3.6189
3	100	15.2600	3.5975
4	100	13.3400	5.0417
5	100	7.9400	2.8562

N = 500 $\quad \overline{X} = 13.1040 \quad \sigma = 4.6442$

NOTE: Group 1 = Superimposition

Group 2 = Voice-Over

Group 3 = Combination

Group 4 = Simple

Group 5 = Control

Table 2 illustrates the results of the single factor ANOVA for all five treatment means. The analysis of variance revealed significant overall effects ($p < .001$; df = 4) between the five treatments. Since significance between treatments

was found the Newman Keuls test was applied to all means to determine which means were in fact significant (see Table 3).

TABLE 2

Single Factor ANOVA on Five Group Means

Source	Sum of Squares	df	Mean Squares	F
Between Groups	3548.67	4	887.17	60.88*
Within Groups	7213.92	495	14.57	
Total	10762.59	499		

*$p < .001$

TABLE 3

Application of Newman Keuls Test to Determi[redacted]
Significant Differences Between Five Group M[redacted]

Treatment	Means	$\bar{X}5$	$\bar{X}4$	$\bar{X}1$	$\bar{X}2$	$\bar{X}3$
Control	$\bar{X}5$ = 7.94	---	5.40*	6.18*	6.92*	7.32*
Simple	$\bar{X}4$ = 13.34		---	0.78	1.52**	1.92*
Voice-Over	$\bar{X}1$ = 14.12			---	0.74	1.14
Superimposition	$\bar{X}2$ = 14.86				---	0.40
Combination	$\bar{X}3$ = 15.26					---
	Wr (.05) = 1.05		1.26	1.38	1.47	
	Wr (.05) = 1.38		1.57	1.67	1.75	

** $p < .05$
* $p < .01$

The application of the Newman Keuls test indicated that all experimental treatments were significantly better ($p < .05$)

than the results achieved by the classic control group. All programs were found to be very effective teaching instruments and therefore each program achieved its teaching goal in that it relayed novel views on the benefits of forest fires.

Further analysis revealed the superimposition treatment as being significantly greater ($p<.05$) than the simple treatment. The combination treatment was also significantly greater ($p<.01$) than the simple treatment. However, the voice-over treatment was not found to be significantly greater than the simple treatment.

Preliminary investigation of this data would seem to indicate that although redundancy instructional units as identified in this experiment may contribute to significant gains in cognitive acquisition, the technique used to produce these instructional units is a prime consideration. The human organism does seem to perform a subconscious selection process and the results of this experiment and others would seem to suggest the relative inefficiency of the auditory mode for some tasks as compared to other available production techniques employing a different sensory modality.

Analysis of variance for differential effects between the three experimental treatments did not indicate significant

differences ($p < .08$; df = 2) between the superimposition, voice-over and combination techniques (see Table 4). Because of the investigative nature of this study these results were considered worthwhile to subject to further examination. The Newman Keuls means comparison test was applied to the three treatment means (see Table 5).

TABLE 4

Single Factor ANOVA on Three Experimental Treatment Means

Source	Sum of Squares	df	Mean Squares	F
Between Groups	66.91	2	33.45	2.55*
Within Groups	3889.84	297	13.10	
Total	3956.75	299		

* $p < .08$

Although the findings of the three way ANOVA cannot be reported at the desired .05 level of confidence, the direction of results is encouraging. A definite superior trend was noted which supported the findings of the three treatment techniques when compared to the simple treatment in the five level ANOVA. A similar trend was found when comparing the means of the combined treatment with the means of the voice-over treatment. Combination is seen to be superior to voice-over ($p < .06$). Again, a trend was indicated between superimposition and voice-over ($p < .09$). No superior trend was found to exist

between the mean comparisons of the combination and superimposition treatments.

TABLE 5

Application of Newman Keuls Test to Determine Direction of Differences Between Three Experimental Treatment Means

Treatment	Means	$\bar{X}1$	$\bar{X}2$	$\bar{X}3$
Voice-Over	14.12	---	0.74*	1.14**
Superimposition	14.86		---	0.40
Combination	15.26			---
	Wr (.06) =		0.94	1.13
	Wr (.09) =		0.73	0.96

* $p<.09$

* $p<.06$

These analyses reveal the strength of the visual modality. In all instances the superimposition and/or combination treatments were found to be superior to the voice-over treatment.

Chapter 4

Discussion and Conclusions

This study sought to answer whether the use of superimposition, voice-over and a combination of both as television production techniques, would contribute significantly to learning as compared to a "simple" television program lacking any redundant production techniques.

Superimposition and combination treatments were found to have differentially significant effects over the simple program presentation. The voice-over technique did not contribute any significantly greater results over the simple program presentation. The use of redundancy instructional units in this study, did produce significant results. However, Travers' (1964) declaration that "... any event that multiplies learning opportunities would be expected to increase learning," needs further qualification. To Travers' previous statement we would have to append his theory outlining the importance of the specific channel receiving the information. The implication of the findings clearly point to the superiority of the visual channel in receiving and assimilating information.

For an instructional television program to be instructive it must first elicit and sustain, to some degree, the

interest or attention of the viewer. The information and experiences conveyed by ITV, or any instructional medium, simply will not be acquired and processed as learning unless seen and heard. Thus the only programs which can be educationally effective are those which induce the student viewer to look and listen. Obviously this factor is not ignored in the production of ITV programs but the common practice of filling both the audio and visual channels with a continuous flow of information would seem to have little theoretical support in many instances.

The results presented would seem to confirm much of the earlier research on the relative efficacy of multi-channel communications. When information is redundant and transmitted through two sensory modalities, nothing appears to be gained by doing so.

Henneman and Long (1954) emphasize that traditionally the visual sense has been much better exploited than the auditory. "The human receiving mechanisms are thus much more in tune to receive this kind of stimuli (visual) since they have been accustomed to and sampled from a large range of stimuli." This finding reported more than 20 years ago before the widespread advent of television, established a basis for what might be termed "subconscious preference" of the visual channel.

The television viewer exhibits a keen awareness and ability to interact with visual forms of stimulation. This is not a cause and effect relationship due to the unique and dynamic form of the television medium. Rather, it has its roots in the peculiarity of the viewers visual acuity. The visual channel is able to process more information than the auditory channel due to the greater overall sensitivity to spatially and temporally distributed stimuli combined.

The human organism possesses a distinct ability to use various forms of visual stimulation because the perceptual system and its accompanying visual receiving senses is developed more fully than its audio counterpart.

When Ss were viewing the redundant instructional units in the form of superimposition statements they were reacting with this information in a positive form. They were actively engaged in reading the titles. This would seem to be an almost mandatory qualification for effective learning. The student is in some way participating in the instructional process. The use of superimposition enables the viewer to reread the statements for words missed or not understood on the first reading. The voicing of identical statements does not afford this opportunity. Once the statement is spoken it does not re-occur. Contact with the information presented in that message is lost.

The television producer would be well advised when designing programs calling for redundancy segments (in fact he would be well advised to include them in some form in all programs), to consider the use of superimposition as defined in this experiment. While the indications from this study certainly cannot be considered as a global recommendation of this technique per se, superimposition is and can be a worthwhile production technique for various purposes.

When redundant instructional units are employed the superiority of superimposition over the voice-over technique would certainly merit the wide employment of the former at the expense of the latter. The limitations of voice-over must be realized. In many experiments in audiovisual information transmission, the present one included, the audio mode was very often shown to be less effective than either the visual or visual-aural combination. The reason as noted earlier, may be attributed to the limitations of the human auditory system.

The voice-over treatment may not have been an effective production instrument because the information coded in it lacks "referability" or the opportunity a human receiver has to refer back to a message. Though the length of time for all production treatments was held constant (i.e. the length of time taken to narrate the voice-over and the length of time the superimpositions were on the screen), referability was

still inherent in each instructional unit. This is a strong advantage for the visual presentation or use of superimposition statements. The conclusion deduced would seem to indicate that the greater the referability possessed by a visual presentation system, the greater will be its advantages over an auditory system.

The simplicity of producing voice-over instructional units would not allow us to preclude its use completely. It is a very simple technique and does not require the expenditure of extra sums of money or time as does the use of superimpositions which have to be produced in a graphics workshop. As data have shown from this experiment, there is little empirical support to justify voice-over as a singular production variable. However, in combination with superimposition both have proven to be useful.

When producing instructional television programs for young children or those who have reading difficulties voice-over would quite naturally be the production technique to employ if the producer wishes to provide the learners with redundancy segments in the body of the television program. Children with learning difficulties need the "safety factor" effect present in redundancy segments. Voice-over would be a valuable technique to manipulate.

The problem of the relative efficiency of the auditory

and visual channels becomes a noteworthy one when the same information can be coded in two equally effective ways; one for transmission through the ear and one through the eye. For the ITV producer we cannot strongly support the use of voice-over as a sole production technique when redundancy segments are needed. If facilities are available to produce superimpositions then the recommendations of this study would have to advocate their use as instructional units. One must be cautious in generalizing the results of this research to numerous other possible applications that may appropriately employ any or all of these techniques mentioned, since the results of all research specifically depend on the unique aspects of that particular study.

The strong performance of the combination treatment poses an obvious question. If research has failed to demonstrate any particular advantage for the transmission of redundant information through more than one sensory channel, then why did the combination treatment prove significantly more effective than the simple treatment?

The combination treatment is composed of both the superimposition statements and the voice-over reading the statements. The power of the superimposition technique has already been spoken of and shown to be very effective. On the other hand the voice-over is generally quite ineffective

in producing significant learning gain. Therefore it would seem reasonable to attribute the success of the combination treatment to its constituent part, superimposition.

Whether the viewer simply discards the voice-over segment of the combination treatment or not is unknown, although it has been suggested that the human perceptual system cannot handle redundant information from two sources. One is clearly extraneous and in this instance it would appear to be the voice-over treatment. The possibility does exist that the addition of the voice-over treatment might contribute minimally to the superimposition treatment in that the former acts as an extra "safety factor" in the redundancy segment.

In the combination treatment we find one technique reinforcing another. Although superimposition may be isolated as the strong link in the combination treatment, the viewer may be choosing, or at least have the option of a choice, through a subconscious process as to which treatment he will attend to. The viewer receives the identical information regardless of what channel he does select. Therefore if he tunes out, intentionally or otherwise, the other channel will pick up the same information from the channel he has tuned out. Thus what might be termed a double safety or redundancy factor is operating.

Drawing upon the results and keeping in mind the spec-

ificity of the program content and the audience characteristics it may be summarized that superimposition is a highly viable and successful production technique. This conclusion is deduced from a limited empirical background investigating superimposition but the finding is also based on a larger theoretical support framework (Travers 1964, 1966; Broadbent 1958; Day & Beach, 1950). The combination treatment can be recommended for circumstances similar to those in which it would be appropriate to employ superimposition. Although the combination treatment was shown to be effective in this experiment, implications for its use cannot be stated as strongly as those for superimposition. The strength of the combination effect may be due in whole or in part to the strength of the superimposition treatment it contains. As discussed earlier the double safety factor effect may contribute partial success to the combination technique. The reasons for the power of the combination treatment are not clearly understood and with this consideration the television producer should use it skillfully. Finally, no empirical support has been found which would justify the use of voice-over as a redundant television production technique.

RECOMMENDATIONS FOR FUTURE RESEARCH

The paucity of applicable research findings in the area of instructional television would seem to dictate an urgent need for further replicable studies falling under the broad rubric of production or content variables in television.

The first step would be to organize an inventory or classification of possible production variables that could be isolated in a television program. These variables could be manipulated by the researcher to examine their effect on various learning tasks. A taxonomy of production techniques would indeed be a worthwhile project in itself leading to more fruitful investigations than the present collection of comparative effectiveness studies.

Some areas however, do not appear to require further research attention. The use of color, camera angles, and sophisticated lighting techniques for example, have generally been found to be ineffective in contributing to more or less effective overall learning derived from an ITV production. Generally speaking, "simplicity of presentation," is the most effective method of television production.

Elaborate production strategies are simply not useful. However, the importance of simple, easily manipulable audio and video techniques seeks further investigation.

Many of the drawbacks of earlier research in multi-

channel communications has been due to the fact that programs being evaluated were comprised of nonsense syllables and the like. While this is an honest effort to introduce stringent research controls, it is of little value beyond the experiment itself. Experiments applying these techniques in meaningful situations would be of greater worth to the educational users of television. The entire area of channel effectiveness studies needs far more research effort than it has received in the past. The body of theoretical research stating the ineffectiveness of multi-channel communications is fairly conclusive. The question remains whether empirical research will prove or disprove this hypothesis.

Prior to the formulation of any whole picture of the audio and video components in ITV, more knowledge needs to be gathered on the individual components themselves. Such knowledge might be a likely outcome of any investigations that systematically identify and confine television content variables. Specifically, various methods of employing the audio component of this medium merit further insight. Aside from the contribution of musical backgrounds there is a dearth of experimental literature dealing with the audio element in television. Once again, we find many theoretical formulations but empirical results would seem to be mandatory requisites for any concrete conclusions to be drawn.

Interaction effects between audio and/or video presentations and various learning tasks would be a propitious area to explore. Basically, this study and most others require that learning be measured on a paper and pencil test. Would there be differences in effectiveness noted if learning was measured orally? Or if the measurement was based on the demonstration of psychomotor skills? In these instances which channel would prove most effective? Which one least so?

Before considering new approaches and areas for ITV exploration, Ives (1971) stated that we must first analyze our measurement instruments. Rather than using norm-referenced measures which seek to measure variability among students he suggests we design criterion-referenced measures to measure precise instructional outcomes which may be due to our television program. The employment of a skilled psychometrician would certainly be a valuable addition to any team of ITV researchers.

Research following from the immediate results of this study would be most welcome. Primarily, this study should be replicated at an earlier and later grade level to note if any interaction effects might exist between age and treatment variables. The common characteristics of the human perceptual system would seem to preclude any interaction effects of this nature but other interactions such as blocking for IQ might

provide interesting results.

Different styles of program presentation and of audio and video redundancy elements might be defined and manipulated for investigation. Also, the most beneficial number of redundancy elements in the body of a television program, regardless of their audio or video nature, would establish some firm guidelines for ITV producers. The fact that redundancy is generally a powerful element in the design of audiovisual programs has been firmly established by Travers (1964). The physical nature of the redundancy elements should be analyzed to determine which ones are the most profitable for use. Additional research directing itself to some of these questions would most certainly add valuable knowledge to the sparse collection of extant data.

SUMMARY

Television presents information through two sensory modalities, the aural and visual channels. The effectiveness of presenting redundant instructional units through these channels was the purpose of the present study. The redundant instructional units took the form of voice-over statements, superimposition statements and a combination of voice-over and superimposition occurring simultaneously. The primary focus of the study was to ascertain what effects the employment of these techniques might have on learning acquisition derived from a television program.

Four television programs were produced. Three contained the production variables as noted and the fourth was classified as a "simple program" containing no production variable redundancy segments. This production design allowed differential effects between the experimental programs and the simple program to be attributed to the production techniques themselves. All groups were further measured against a classic control group subjected to no experimental treatments.

The topic of all programs was "Forests and Fires." Each 16-minute black and white production was divided into three information presentation blocks: 1) fires damage forest life; 2) lightning fires benefit forest life; 3) deliberately

set controlled burn fires benefit forest life. Each of the three information presentation blocks was further divided into five instructional units comprising the production treatment itself. The production variables occurred in the form of redundancy statements. The voice-over production treatment consisted of the narrator reading three statements with no further visual support other than a slide of the forest on screen. The superimposition treatment contained three statements which appeared on the television screen over a picture of the forest on screen. There was no audio support in this treatment. The combination treatment had both a narrator reading the three redundancy segments simultaneously as they appeared on the television screen. This latter treatment is a combination of the first two treatments. Very strict experimental controls were built into all programs and the design of instructional units so as to allow for maximum confidence in discernable significant results.

The sample population consisted of 500 grade 7 students with 100 Ss being randomly assigned to each experimental group, plus 100 each randomly assigned to the simple and control groups, respectively. The independent variables being manipulated were the production treatments, while the measure of post-test scores served as the dependent variable. A 27-item multiple choice questionnaire was administered to measure cognitive

learning acquisition derived from the television programs.

Two single classification ANOVAs were computed. One test employed all five independent variables while the second consisted of only measuring differential effects between the three experimental treatments themselves.

The five level ANOVA revealed significant overall differences ($p<.001$) between groups and confirmed the direction of results predicted for this study. All experimental treatments were shown to be superior to the classic control group while the superimposition ($p<.05$) and combination treatments ($p<.01$) were found to be significantly superior to the simple treatment. The voice-over treatment yielded no significance over the simple treatment. Comparison of differential effects of the three experimental treatments did not reach the desired level of significance although the superiority of superimposition and combination treatments was indicative of the results noted earlier.

The design of television programs using superimposition and combination treatments as outlined in this study should prove to be a productive addition to most ITV programs. In the final analysis the superimposition treatment would appear to be the most efficient technique. The addition of audio to the visual treatment may account for overcrowding or confusion in the perceptual system. The strength of the com-

bination treatment as described in this study may be due in fact to its superimposition component since dual-channel communication is not usually more efficient than single channel communication.

Considerable theoretical research exists defining the ability of the human perceptual system to utilize information from a multi-channel communication source. The present research has attempted to define these techniques in a practical situation and to manipulate them for examination. Implications from this study could be adopted for use by ITV producers and educators who wish to provide redundancy segments in their productions.

Areas of future research should attempt to define relevant production techniques that may contribute to more effective learning from television. Audiovisualist researchers would be well advised to shift their approach from a theoretical framework to one of empirical investigation.

References

Anderson, C.M. In search of a visual rhetoric for instructional television. Audio-Visual Communication Review, 1972, 20, 1, 43-63.

Aylward, J.L. Jr. A study of the effect of production techniques on a televised lecture. Dissertation Abstracts, 1962, 22, 1660-1661.

Barrow, L.C. & Westley, B.H. TV effects. Research Bulletin No. 9. Madison, Wisconsin University Television Laboratory, 1958.

Berlo, D.K. The process of communication. New York: Holt, Rinehart & Winston, 1960.

Briggs, L.J., Campeau, P.O., Gagné, R.M., & May, M.A. Instructional media: A procedure for the design of multimedia instruction, a critical review of research, and suggestions for future research. A final report to the U.S. Office of Education, Pittsburgh: American Institutes for Research, 1967.

Broadbent, D.E. Perception and communication. New York: Pergamon Press, 1958.

Campbell, D.T., & Stanley, J.C. Experimental and quasi-experimental designs for research on teaching, in N.L. Gage (Ed.), Handbook of research on teaching. Chicago: Rand McNally, 1963, 171-246.

Chu, G., & Schramm, W. Learning from television: What the research says. Washington: National Association of Educational Broadcasters, 1967.

Day, W.F., & Beach, B R. A survey of the research literature comparing the visual and auditory presentation of information. Charlottesville: University of Virginia, 1950.

Dominion Bureau of Statistics, Occupational classification manual. Ottawa: Queen's Printer, 1961.

Ebel, R.L. Measuring educational achievement. Englewood Cliffs: Prentice Hall, 1965.

Ferguson, G.A. Statistical analysis in psychology and education. New York: McGraw-Hill, 1971.

Gordon, G.N. Classroom television. New York: Hastings House, 1970.

Hayman, J.L. A comparison of three presentational methods in ETV. Dissertation Abstracts, 1962, 22, 3678-3679.

Henneman, R.H., & Long, E.R. A comparison of the visual and auditory senses as channels for data representation. (WADC Tech. Rep. No. 54) Washington, D.C.: 1954.

Hideya, K. An inventory of instructional television research. Ann Arbor: University of Michigan, 1956. ERIC ED 001 341.

Hoban, C.F. Jr., & Van Ormer, E.B. Instructional film research 1918-1950. New York: Arno Press & The New York Times, 1970.

Hoban, C.F. The usable residue of educational film research, in New teaching aids for the American classroom. Institute for Communication Research, Stanford University, California: 1959. ERIC ED 003 146.

Ives, J.M. A strategy for instructional television research. Audio-Visual Communication Review, 1971, 19, 2, 149-160.

Klapper, H.L. A prospective of televised instruction. College teaching by television. Washington, D.C.: American Council in Education, 1958.

Lumsdaine, A.A. Instruments and media of instruction, in N.L. Gage (Ed.), Handbook of Research on Teaching. Chicago: Rand McNally, 1963, 583-682.

May, M.A. & Lumsdaine, A.A. Learning from films. New Haven: Yale University Press, 1958.

Reid, J.C. & McLennan, D.W. Research in instructional television and film. Washington, D.C.: U.S. Government Printing Office, 1967.

Schramm, W. The research on content variables in ITV. A working paper, Institute for Communication Research, Stanford University, 1971.

Schwarzwalder, J.C. An investigation of the relative effectiveness of certain specific television techniques on learning. (Report No. NDEA-V11a-085 FR) Twin City Area Educational TV Corp.: St. Paul, 1960. ERIC ED 014 913.

Severin, W. Another look at cue summation. Audio-Visual Communication Review. 1967, 15, 3, 233-246.

Severin, W. Cue summation in multiple communication. Madison: University of Wisconsin, Wisconsin Research and Development Center for Cognitive Learning, 1968.

Shepherd, J.R. A comparitive analysis of production techniques found in randomly selected commercial and education programs. Eugene: University of Oregon Institute for Community Studies, Educational Television Project Preliminary Report, 1967. ERIC ED 022 360.

Travers, R.M.W. Research and theory related to audiovisual information transmission. Salt Lake City: University of Utah, Bureau of Educational Research, 1964. ERIC ED 003 625.

Tuckman, B.W. Conducting educational research. New York: Harcourt, Brace, Jovanovich, 1972.

Zettl, H. The study of television aesthetics. Educational Broadcasting Review, 1968, 2, 1, 36-40.

Zettl, H. Television production handbook. San Francisco: Wadsworth Publishing, 1961.

Appendix A

DETAILED EXPLANATION OF INSTRUCTIONAL UNITS

There were a total of fifteen instructional units with the first five (1-5) appearing in section one of each program, the second five (6-10) in section two of each program, and the third five (11-15) in section three of each program. Each instructional unit was composed of three separate redundant information statements contained within each program. The statements numbered and lettered below are written in the form corresponding to the actual form used in the information keying techniques, e.g., "2½" instead of "two and one half" may begin a sentence. The numbers and letters assigned to each instructional unit did not appear in the graphics used for keying. Each instructional unit, though titled below after the appropriate group number, was not titled in any of the programs.

1. Importance of the forest industry.

   a. The forest industry employs over 300 thousand people.
   b. 20 percent of Canada's exports are forest products.
   c. 50 percent of Canada's land mass is covered by forests.

2. Destruction caused by forest fires.

   a. There are 6-8,000 forest fires yearly in Canada.
   b. Forest fires burn more than 2 million acres or 10 percent of all productive land.
   c. Over 18 million dollars worth of trees are lost yearly through forest fires.

3. Types of forest fires.

   a. A ground fire smoulders and burns beneath the surface.
   b. A surface fire starts and burns on the surface.
   c. A crown fire spreads from the surface to the tree tops.

4. Causes of forest fires.

   a. Over 75 percent of all forest fires are started by man.
   b. 34 percent of man caused fires result from carelessness.
   c. Some man caused fires result from railway and forest industry accidents; others are set for wilful destruction.

5. Ways to fight forest fires.

   a. Canada spends over 18 million dollars a year to fight fires.
   b. Money is spent on lookout towers, bulldozers, and waterbombing.
   c. Prevention is the most effective method of fighting fires.

6. Characteristics of lightning fires.

   a. 25 percent of all forest fires are started by lightning.
   b. Lightning fires usually occur during the presence of rain.
   c. Lightning fires are usually surface fires which do little damage.

7. Characteristics of a dense forest.

   a. Deadfall and underbrush serve as fuel for fires.
   b. Underbrush robs large trees of nourishment.
   c. Insects attack and weaken large trees.

8. Characteristics of a regularly burned forest.

   a. Litter and underbrush accumulate less in a regularly burned forest.
   b. Insects that attack trees are killed off in a regularly burned forest.
   c. Large trees are strengthened in a regularly burned forest.

9. Results of small fires.

   a. The mineral content of the soil increases after small fires.
   b. Small fires create open spaces.
   c. Small fires clear off litter from the surface floor.

10. Benefits to animals in regularly burned areas.

   a. 2 1/2 times as many deer live in a regularly burned area.
   b. Game birds are unable to find food when litter is deeper than 6 inches.
   c. 3 times as many birds live in a regularly burned area.

11. Uses of fire by early man.

   a. Early man used fires to clear lands for hunting and grazing.
   b. Early man used fires to clear areas for home building.
   c. Early man used fires to create fields for planting.

12. Specific uses of fire by early man.

   a. Ashes from fire served as fertilizer.
   b. Fire eliminated weeds and competing plants.
   c. Fire promoted the flowering of chia, a seed producing plant.

13. Conditions for controlled burning.

   a. The area should be damp when starting a controlled burn.
   b. For controlled burning the wind should be calm.
   c. The burn should be started in the late afternoon.

14. Methods for controlled burning.

   a. Valleys and hills are burned from the top down.
   b. Open areas are burned from natural boundaries such as roads and streams.
   c. The drip torch method, using a mixture of gas and oil which sticks to vegetation makes burning more effective.

15. Benefits of controlled burning.

a. Controlled burning restricts build up of deadfall and underbrush.
b. Controlled burning clears areas for birds and animals to live in.
c. Controlled burning increases the mineral content of the soil.

SCRIPT SYMBOLS AND ABBREVIATIONS

An Arabic numeral placed flush with the left margin designates the camera shot number for both video and audio portions. If the shot number is level with a blank audio portion, there was no sound for the duration of the corresponding video portion. Shots were sequentially numbered in program IV, but in programs I, II, and III the letter "T" followed by an Arabic numeral identified the intervention of an experimental treatment. The numbers in the treatment designations correspond to the numbers assigned to the instructional unit groups.

The letter "C" followed by an arabic numeral designates the camera number, e.g., C1 is read as camera one. The conventional signals used to designate framing shots are MS for a medium shot, CU for a close-up, and TCU for a tight close-up. An abbreviation for "telecine", TC, designates a visual switch to a slide. The abbreviation, VTR, designates a video tape recording.

The term "KEYED INTO" as it appears in the scripts designates a special electronic effect which superimposes the image of one camera into the image of another. In production of programs I, II and III, white letters on black poster board were used for keying into the image of the telecine camera resulting in an effect similar to the

"information super" (Zettl, 1961). For all programs, the presenter was positioned in front of an evenly lighted flat white screen so that the image of the presenter, with the keying technique, could cut into the image of the telecine camera.

All visual images are briefly identified in parentheses next to the designated video shot. Visual images for treatments are identified by numbers and letters to designate the instructional units which appeared over the image described in parentheses after TC.

SCRIPT FORMS

The audio portion of all scripts was written to clearly designate the spoken word. Thus numbers and percentages such as 300,000 and 50% were spelled out to indicate they were to be read respectively as "three hundred thousand" and "fifty percent".

Both video and audio portions of all scripts were systematically changed to correspond to operational definitions of the different forms of the units considered as experimental treatments. Specific content and phraseology for video and audio portions were constant throught programs I, II and III. Program IV differed substantially from programs I, II and III to the extent that instructional units present in the latter were absent in the former.

Although four complete scripts were used in the actual production of the programs, only the script for program IV is presented in complete form. In the modified scripts presented in programs I, II and III the video and audio portions which did not differ from program IV are designated by the term "same" under the appropriate portions. The minor video changes from program IV were made because of technical production requirements. These changes are specified in the modified scripts.

PROGRAM IV: SIMPLE

	Video.	Audio.
1.	C1 (title) KEYED INTO TC (mountain forest)	
2.	VTR (boy walking through forest followed by scene of raging forest fire)	MUSIC Maybe you visited a forest this year, near your home or at a country place. MUSIC
3.	C2 TCU (screen) ZOOM OUT TO MS (presenter) KEYED INTO TC (crowded forest)	When forests are burned, everybody suffers. Forests are homes for thousands of animals and birds, plants and trees. And Canada's forests are important for her economy. In fact, the forest industry is the second most important industry in Canada, after tourism. Even tourism is somewhat dependent on forests. The forest industry also employs over three hundred thousand people. And twenty percent of Canada's total exports are forest products. Canada is, in fact, a nation of forests.
4.	C3 MS (presenter) SLOW ZOOM IN TO	Although it's hard to believe when you live in the city, about fifty percent of Canada's land mass is covered by forests. And many things you use every day like papers and pencils, come from trees.
5.	CU (presenter)	So when forests are burned, plants and animals lose their homes, people lose places for recreation, and Canada's economy loses valuable income. Such losses occur every year when six to eight thousand forest

Video.	Audio.
	fires burn more than two million acres of forests. That's a yearly loss of ten percent of the area the forest industry uses to make forest products. It's also a yearly loss of over eighteen million dollars worth of trees.
6. C2 MS (presenter) KEYED INTO TC (fire)	And forest fires also destroy property, damage the soil, and kill and injure wildlife -- which is also a loss to trappers. When a severe fire occurs the forest soil can be so damaged that it may be generations before it can again support a productive forest.
7. C2 MS (presenter) KEYED INTO TC (fire)	A severe fire can completely change the character and economy of a region in which it occurs. There are three general types of forest fires: the ground fire, the surface fire, and the crown fire.
8. C3 (graphic, ground fire)	The ground fire usually smoulders beneath the surface of the forest where it burns deeply in thick deposits of moss, peat, decomposed leaves and other debris. A ground fire can even survive an entire winter under the snow and break out in the spring.
9. C1 (graphic, surface fire)	The surface fire is the most common type of forest fire. It starts on the surface of the forest floor where it feeds on dead leaves, branches and other vegetation. The fire can burn on the chips caused by saws, chips known as logging slash,

	Video.	Audio.
		in areas where lumber men have been at work, or on tree stumps and fallen trees.
10.	C3 MS (presenter)	The crown fire is the most dangerous and destructive partly because it usually occurs in dense dry forests when there's a strong wind.
11.	C1 (graphic, crown fire)	It's so intense and spreads so rapidly that it doesn't stay on the surface but reaches up to the tops or crowns of the trees. The fire then feeds on the branches and leaves of the living trees causing more fire and destruction than if it had stayed on the forest floor. The heat and updraft produced by a crown fire are tremendous so that flying embers are often carried by the wind to start new fires far away from the main one.
12.	C3 MS (presenter) ZOOM IN TO CU (presenter)	Although the first two types of fires can be put out, nothing can be done to the crown fire except to let it burn itself out and to make sure it doesn't spread.
13.	C3 CU (presenter)	You may be surprised to learn that over seventy-five percent of forest fires are started by people.
14.	C1 (graphic, carelessness)	The vast majority, about thirty-four percent of this seventy-five percent, are caused by the carelessness of people using the forest for recreation: campers, hunters, fishermen, hikers, and other casual forest visitors.

	Video.	Audio.
15.	C2 MS (presenter) KEYED INTO TC (fire in forest)	Their weapons are simple and known to everyone -- a carelessly discarded cigarette or match or a campfire that hasn't been properly extinguished.
16.	C2 MS (presenter) KEYED INTO TC (fire)	But a few are set on purpose for wilful destruction. Still others are accidentally set by railroads and forest industries in the normal course of their work.
17.	C3 CU (presenter)	And Canada spends over eighteen million dollars a year to prevent or put out forest fires. Much money is spent on equipment such as lookout towers, bulldozers, and water bombing airplanes, and thousands of men risk their lives fighting forest fires.
18.	C1 (graphic, Smokey the bear)	But the most effective way of fighting fires is to prevent them from happening in the first place because forest fires can be dangerous and destructive.
19.	C3 CU (presenter)	If you don't know how or if you don't remember how to prevent forest fires, then you can learn.
20.	C2 MS (presenter) KEYED INTO TC (burned forest)	And it's important. Next year the forest you visited this year may not be there.
21.	C3 MS (presenter)	But not all forest fires are bad. In fact, some fires are beneficial for plants, animals, and people. Some smaller ones are necessary for the inhabitants of the forest. Nature has a way of making all the natural elements of a forest

	Video.	Audio.
	ZOOM IN TO CU (presenter)	work together for the benefit of the forest. And fire is one of the natural elements of a forest. Twenty-five percent of all the forest fires in Canada are caused naturally; that is, they are <u>not</u> caused by man.
22.	C1 (graphic, lightning)	Most of these natural fires are caused by lightning -- fires which usually occur before and after a rainstorm when the ground is still wet.
23.	C3 MS (presenter)	These fires are usually surface fires which aren't severe and don't spread rapidly.
24.	C3 MS (presenter)	When can nature live with fires? The only way to answer this question is to consider the nature and structure of a dense forest.
25.	C1 (graphic, dense forest)	As the years pass, a great deal of clutter gathers on the forest floor. First there's what's known as deadfall. This is the litter caused by dead leaves, branches, plants and trees. Then there's underbrush caused by the growth of small plants, ferns, and even tiny trees. When this deadfall and underbrush go unchecked, a number of things begin to happen.
26.	C3 CU (presenter)	First the underbrush competes for nourishment from the soil with the big trees. As a result the big trees are weakened and much more likely to burn. Also numerous insects, such as the bark beetle, attack the big

	Video.	Audio.
27.	C2 MS (presenter) KEYED INTO TC (bark beetle)	trees, weakening them further. The weakened trees are then easily burned. Moreover the dense deadfall and underbrush serve as fuel to the fire. The fire then spreads and reaches the tops of the trees.
28.	C1 (graphic, dead forest)	The result of a fire in such a dense forest can be total destruction. The litter, the underbrush, and the trees are all destroyed. The forest is dead.
29.	C3 (graphic, nondense forest)	But in a forest that's been regularly burned by small lightning fires, the litter doesn't accumulate as much, the underbrush doesn't grow as much, and the big trees are strong because there's less competition for nourishment from the soil, and because the small fires have killed off attacking insects. The small fires instead of killing off everything have just cleared off excessive growth and deadfall.
30.	C2 MS (presenter) KEYED INTO TC (small ground fire)	Thus, if a fire starts in this type of forest, it tends to stay near the surface.
31.	C2 MS (presenter) KEYED INTO TC (small ground fire)	In fact in many ways the forest plant and animal life may be healthier because of the small fire.
32.	C3 MS (presenter)	Studies have shown, for example, that the mineral content of the soil -- so important for the growth of plants and trees -- actually increases after a small fire.

	Video.	Audio.
33.	C2 MS (presenter) KEYED INTO TC (forest and sunlight)	Small fires clear open spaces, and small fires clear off litter from the forest floor.
34.	C3 MS (presenter)	If a forest's too dense animals can't forage through the forest to find food or a place to stay.
35.	C2 MS (presenter) KEYED INTO TC (deer)	One study showed that there were two and a half times more deer in an area that had been burned than in a neighbouring area that had gone unchecked by fire.
36.	C3 MS (presenter)	And game birds, such as partridges or quail aren't able to find food in the forest when the litter's deeper than six inches. Water birds such as ducks living on the lakes also need cleared areas in the forest shoreline to nest and feed in,
37.	C2 MS (presenter) KEYED INTO TC (birds on shore)	a fact supported by another study which found over three times as many birds living in a burned area than in an area that hadn't been burned.
38.	C3 CU (presenter)	As you can see then, not all forest fires are bad. Some are essential for a forest to flourish. It's important to remember that fires are just as much a part of nature as man. Both have the potential for hurting and for helping the forests.
39.	C2 MS (presenter) KEYED INTO TC (forest)	It's usually the responsibility of forest rangers to put out fires for the benefit of forests and people. But sometimes,

Video.	Audio.
	they actually start them, for the same reason.
40. C2 MS (presenter) KEYED INTO TC (forest)	The earliest inhabitants of our country started and used fires for a variety of reasons. They used them for hunting and to improve grazing lands for their cattle. They burned small areas of forests to clear areas for building their homes and to make fields for planting their crops.
41. C3 MS (presenter)	But the most important use of fire by early man was crop cultivation. They used ashes from the fires as fertilizer for their fields, and they used fire to eliminate weeds and other plant species that competed against the crops they wanted to cultivate.
ZOOM IN TO	
CU (presenter)	For example, the Indians knew that the easiest way to promote the flowering of chia, a favourite seed producing plant, was to set fire to the fields in which the plants grew. This stimulated the growth of the plant and eliminated competition from other less desirable plants.
42. C2 MS (presenter) KEYED INTO TC (jungle forest)	Because early man's home was in or near the forest, he became an important part of the forest life. He understood and loved the forest and never caused unnecessary destruction. To severely burn the forest would have been like burning his source of food. So, when early man set fires, he was careful to keep them small and under control.

	Video.	Audio.
43.	C3 CU (presenter)	Nowadays, we're beginning to follow the experience of the Indians. We know that the forest is an important natural resource and that it should be protected. At the same time, we're finding that fires can be beneficial to man, to forests, and generally to nature.
44.	C2 MS (presenter) KEYED INTO TC (man and drip torch)	Controlled burning is the name of the process forest rangers use to deliberately plan and set fires in a controlled area. A controlled burn is started only under the proper conditions. First the area to be burned should be damp as it is after a recent rain. The burn should never be started when the forest's dry.
45.	C3 MS (presenter)	Second, the wind should be very calm since high winds tend to spread a fire. And, finally the burn should be started in the late afternoon because nightfall brings coolness, dew and ideal fire spotting conditions.
46.	C3 MS (presenter)	Although formerly, controlled burns were started by simply using matches or rakes with burning embers, the most modern method is to use the drip torch.
47.	C1 (graphic, man and drip torch)	
48.	C1 (graphic, man and drip torch)	The drip torch is a can with a long spout, containing a mixture of gasoline and fuel oil. The oil sticks to the vegetation and makes the burning more effective.

	Video.	Audio.
49.	C3 CU (presenter)	The techniques of controlled burning vary according to the nature of the land.
50.	C1 (graphic, valley fire)	To burn a canyon or valley, it's best to start from the top and work down. If a fire were started at the bottom, the whole side would burn very quickly because fire causes upward winds -- upward winds which could fan the fire over the rim and out of control. By working from the top down, only a small part of the area is burned at a time.
51.	C3 (graphic, mountain fire)	Hills and mountains should be burned in a downward direction for the same reasons, one horizontal belt at a time. For example, if two upper belts on a mountain are burned off, they can then act as barriers to a third fire started by a drip torch on the horizontal belt just below the first two.
52.	C1 (graphic, fire from natural boundary)	The most common and spectacular artificial or controlled burns begin from natural boundaries, such as roads, streams, or barren ground. Such fires merge to a common center, where powerful updrafts speed up the burning and form a towering mushroom cloud of smoke -- a fire that may be out within an hour.
53.	C3 (graphic, open area fire)	The cooler, snowy forested regions act as natural boundaries -- as natural firestops. Later, when the forests are free of snow, they can be burned.

	Video.	Audio.
		So the open spaces also take their turn in halting the fire's spread.
54.	C2 MS (presenter) KEYED INTO TC (forest and litter)	Why do forest rangers use controlled burning? Often to imitate nature, to do the job that nature sometimes forgets to do.
55.	C2 MS (presenter) KEYED INTO TC (forest and litter)	Controlled burning can prevent large build ups of deadfall and underbrush, can clear areas for birds and animals to live and find food in, and can increase the mineral content of the soil.
56.	C3 CU (presenter)	What's the advantage of controlled burning? It's controllable. Experts can choose the proper weather and soil conditions and can restrict the burning to a pre-defined area; they can keep the fire from burning out of control.
57.	C2 MS (presenter) ZOOM IN TO TCU (screen) KEYED INTO TC (forest)	Controlled burning is the most effective method man has yet devised for keeping fires in harmony with the balance of nature.
58.	VTR (boy walking through forest)	MUSIC
59.	C1 (production credit) KEYED INTO TC (forest and sunlight)	

PROGRAM I: SUPER - V.O. - COMB.

	Video.	Audio.
1.	Same	Same
2.	Same	Same
3.	Same	Same
4.	Same	Same
T1.	C1 (graphic 1) KEYED INTO TC (crowded forest)	
5.	Same	Same
T2.	C1 (graphic 2) KEYED INTO TC (fire)	
6.	TC (fire)	Same
7.	Same	Same
8.	Same	Same
9.	Same	Same
10.	Same	Same
11.	Same	Same
12.	C3 CU (presenter)	Same
T3.	C1 (graphic 3) KEYED INTO TC (fire)	
13.	Same	Same
14.	Same	Same
15.	C1 (graphic, carelessness)	Same

	Video.	Audio.
16.	C3 CU (presenter)	Same
T4.	C1 (graphic 4) KEYED INTO TC (fire in forest)	
17.	Same	Same
18.	Same	Same
19.	Same	Same
20.	C3 CU (presenter)	Same
T5.	C1 (graphic 5) KEYED INTO TC (burned forest)	
21.	Same	Same
22.	Same	Same
23.	C1 (graphic, lightning)	Same
T6.	TC (dense forest)	Twenty-five percent of all forest fires are started by lightning. Lightning fires usually occur during the presence of rain. Lightning fires are usually surface fires which do little damage.
24.	C2 CU (presenter)	Same
25.	Same	Same
26.	Same	Same
27.	Same	Same
28.	Same	Same
T7.	TC (burned forest)	Deadfall and underbrush serve as fuel for fires.

	Video.	Audio.
		Underbrush robs large trees of nourishment. Insects attack and weaken large trees.
29.	Same	Same
30.	TC (small ground fire)	Same
T8.	TC (small ground fire)	Litter and underbrush accumulate less in a regularly burned forest. Insects that attack trees are killed off in a regularly burned forest. Large trees are strengthened in a regularly burned forest.
31.	C3 MS (presenter)	Same
32.	C3 MS (presenter)	Same
33.	TC (forest and sunlight)	Same
T9.	TC (forest and sunlight)	The mineral content of the soil increases after small fires. Small fires create open spaces. Small fires clear off litter from the surface floor.
34.	Same	Same
35.	Same	Same
36.	Same	Same
37.	TC (birds on shore)	Same
T10.	TC (birds on shore)	Two and a half times as many deer live in a regularly burned area. Game birds are unable to find food when litter is deeper than six inches. Three times as many birds live in a regularly burned area.

	Video.	Audio.
38.	Same	Same
39.	Same	Same
40.	C3 MS (presenter)	Same
T11.	C1 (graphic 11) KEYED INTO TC (mountain forest)	Early man used fires to clear lands for hunting and grazing. Early man used fires to clear areas for home building. Early man used fires to create fields for planting.
41.	Same	Same
T12.	C1 (graphic 12) KEYED INTO TC (ground smoke)	Ashes from fire served as fertilizer. Fire eliminated weeds and competing plants. Fire promoted the flowering of chia, a seed producing plant.
42.	TC (jungle forest)	Same
43.	Same	Same
44.	Same	Same
45.	Same	Same
T13.	C1 (graphic 13) KEYED INTO TC (man and drip torch)	The area should be damp when starting a controlled burn. For controlled burning the wind should be calm. The burn should be started in the late afternoon.
46.	Same	Same
47.	C3 MS (presenter)	Same
48.	Same	Same
49.	Same	Same
50.	Same	Same

	Video.	Audio.
51.	Same	Same
52.	Same	Same
53.	Same	Same
T14.	C1 (graphic 14) KEYED INTO TC (forest and litter)	Valleys and hills are burned from the top down. Open areas are burned from natural boundaries such as roads and streams. The drip torch method, using a mixture of gas and oil which sticks to vegetation, makes burning more effective.
54.	TC (forest and litter)	Same
55.	C3 CU (presenter)	Same
T15.	C1 (graphic 15) KEYED INTO TC (forest)	Controlled burning restricts build up of deadfall and underbrush. Controlled burning clears areas for birds and animals to live in. Controlled burning increases the mineral content of the soil.
56.	Same	Same
57.	Same	Same
58.	Same	Same
59.	Same	Same

PROGRAM II: V.O. - COMB. - SUPER

	Video.	Audio.
1.	Same	Same
2.	Same	Same
3.	Same	Same
4.	Same	Same
T1.	TC (crowded forest)	The forest industry employs over three hundred thousand people. Twenty percent of Canada's exports are forest products. Fifty percent of Canada's land mass is covered by forests.
5.	Same	Same
T2.	TC (fire)	There are six to eight thousand forest fires yearly in Canada. Forest fires burn more than two million acres or ten percent of all productive land. Over eighteen million dollars worth of trees are lost yearly through forest fires.
6.	TC (fire)	Same
7.	Same	Same
8.	Same	Same
9.	Same	Same
10.	Same	Same
11.	Same	Same
12.	C3 CU (presenter)	Same
T3.	TC (fire)	A ground fire smoulders and burns beneath the surface.

	Video.	Audio.
		A surface fire starts and burns on the surface. A crown fire spreads from the surface to tree tops.
13.	Same	Same
14.	Same	Same
15.	C1 (graphic, carelessness)	Same
16.	C3 CU (presenter)	Same
T4.	TC (fire in forest)	Over seventy-five percent of all forest fires are started by man. Thirty-four percent of man caused fires result from carelessness. Some man caused fires result from railway and forest industry accidents; others are set for wilful destruction.
17.	Same	Same
18.	Same	Same
19.	Same	Same
20.	C3 CU (presenter)	Same
T5.	TC (burned forest)	Canada spends over eighteen million dollars a year to fight fires. Money is spent on lookout towers, bulldozers, and water bombing. Prevention is the most effective method of fighting fires.
21.	Same	Same
22.	Same	Same

	Video.	Audio.
23.	C1 (graphic, lightning)	Same
T6.	C3 (graphic 6 KEYED INTO TC (dense forest)	Twenty-five percent of all forest fires are started by lightning. Lightning fires usually occur during the presence of rain. Lightning fires are usually surface fires which do little damage.
24.	C2 CU (presenter)	Same
25.	Same	Same
26.	Same	Same
27.	Same	Same
28.	Same	Same
T7.	C1 (graphic 7) KEYED INTO TC (burned forest)	Deadfall and underbrush serve as fuel for fires. Underbrush robs large trees of nourishment. Insects attack and weaken large trees.
29.	Same	Same
30.	TC (small ground fire)	Same
T8.	C1 (graphic 8) KEYED INTO TC (small ground fire)	Litter and underbrush accumulate less in a regularly burned forest. Insects that attack trees are killed off in a regularly burned forest. Large trees are strengthened in a regularly burned forest.
31.	C3 MS (presenter)	Same
32.	C3 MS (presenter)	Same

	Video.	Audio.
33.	TC (forest and light)	Same
T9.	C1 (graphic 9) KEYED INTO TC (forest and sun-light)	The mineral content of the soil increases after small fires. Small fires create open spaces. Small fires clear off litter from the surface.
34.	Same	Same
35.	Same	Same
36.	Same	Same
37.	TC (birds on shore)	Same
T10.	C1 (graphic 10) KEYED INTO TC (birds on shore)	Two and a half times as many deer live in a regularly burned area. Game birds are unable to find food when litter is deeper than six inches. Three times as many birds live in a regularly burned area.
38.	Same	Same
39.	Same	Same
40.	C3 MS (presenter)	Same
T11.	C1 (graphic 11) KEYED INTO TC (mountain forest)	
41.	Same	Same
T12.	C1 (graphic 12) KEYED INTO TC (ground smoke)	
42.	TC (jungle forest)	Same
43.	Same	Same
44.	Same	Same

	Video.	Audio.
45.	Same	Same
T13.	C1 (graphic 13) KEYED INTO TC (man and drip torch)	
46.	Same	Same
47.	C3 MS (presenter)	Same
48.	Same	Same
49.	Same	Same
50.	Same	Same
51.	Same	Same
52.	Same	Same
53.	Same	Same
T14.	C1 (graphic 14) KEYED INTO TC (forest and litter)	
54.	TC (forest and litter)	Same
55.	C3 CU (presenter)	Same
T15.	C1 (graphic 15) KEYED INTO TC (forest)	
56.	Same	Same
57.	Same	Same
58.	Same	Same
59.	Same	Same

PROGRAM III: COMB. - SUPER - V.O.

	Video.	Audio.
1.	Same	Same
2.	Same	Same
3.	Same	Same
4.	Same	Same
T1.	C1 (graphic 1) KEYED INTO TC (crowded forest)	The forest industry employs over three hundred thousand people. Twenty percent of Canada's exports are forest products. Fifty percent of Canada's land mass is covered by forests.
5.	Same	Same
T2.	C1 (graphic 2) KEYED INTO TC (fire)	There are six to eight thousand forest fires yearly in Canada. Forest fires burn more than two million acres or ten percent of all productive land. Over eighteen million dollars worth of trees are lost yearly through forest fires.
6.	TC (fire)	Same
7.	Same	Same
8.	Same	Same
9.	Same	Same
10.	Same	Same
11.	Same	Same
12.	C3 CU (presenter)	Same

	Video.	Audio.
T3.	C1 (graphic 3) KEYED INTO TC (fire)	A ground fire smoulders and burns beneath the surface. A surface fire starts and burns on the surface. A crown fire spreads from the surface to tree tops.
13.	Same	Same
14.	Same	Same
15.	C1 (graphic, carelessness)	Same
16.	C3 CU (presenter)	Same
T4.	C1 (graphic 4) KEYED INTO TC (fire in forest)	Over seventy-five percent of all forest fires are started by man. Thirty-four percent of man caused fires result from carelessness. Some man caused fires result from railway and forest industry accidents. Others are set for wilful destruction.
17.	Same	Same
18.	Same	Same
19.	Same	Same
20.	C3 CU (presenter)	Same
T5.	C1 (graphic 5) KEYED INTO TC (burned forest)	Canada spends over eighteen million dollars a year to fight fires. Money is spent on lookout towers, bulldozers, and water bombing. Prevention is the most effective method of fighting fires.
21.	Same	Same

	Video.	Audio.
22.	Same	Same
23.	C1 (graphic, lightning)	Same
T6.	C3 (graphic 6) KEYED INTO TC (dense forest)	
24.	C2 CU (presenter)	Same
25.	Same	Same
26.	Same	Same
27.	Same	Same
28.	Same	Same
T7.	C1 (graphic 7) KEYED INTO TC (burned forest)	
29.	Same	Same
30.	TC (small ground fire)	Same
T8.	C1 (graphic 8) KEYED INTO TC (small ground fire)	
31.	C3 MS (presenter)	Same
32.	C3 MS (presenter)	Same
33.	TC (forest and sunlight)	Same
T9.	C1 (graphic 9) KEYED INTO TC (forest and sunlight)	
34.	Same	Same

	Video.	Audio.
35.	Same	Same
36.	Same	Same
37.	TC (birds on shore)	Same
T10.	C1 (graphic 10) KEYED INTO TC (birds on shore)	
38.	Same	Same
39.	Same	Same
40.	C3 MS (presenter	Same
T11.	TC (mountain forest)	Early man used fires to clear lands for hunting and grazing. Early man used fires to clear areas for home building. Early man used fires to create fields for planting.
41.	Same	Same
T12.	TC (ground smoke)	Ashes from fire served as fertilizer. Fire eliminated weeds and competing plants. Fire promoted the flowering of chia, a seed producing plants.
42.	TC (jungle forest)	Same
43.	Same	Same
44.	Same	Same
45.	Same	Same
T13.	TC (man and drip torch)	When starting a controlled burn, the area should be damp. For controlled burning the wind should be calm. A controlled burn should be started in the late afternoon.

	Video.	Audio.
46.	Same	Same
47.	C3 MS (presenter)	Same
48.	Same	Same
49.	Same	Same
50.	Same	Same
51.	Same	Same
52.	Same	Same
53.	Same	Same
T14.	TC (forest and litter)	Valleys and hills are burned from the top down. Open areas are burned from natural boundaries such as roads and streams. The drip torch method, using a mixture of gas and oil which sticks to vegetation, makes burning more effective.
54.	TC (forest and litter)	Same
55.	C3 CU (presenter)	Same
T15.	TC (forest)	Controlled burning restricts build up of deadfall and underbrush. Controlled burning clears areas for birds and animals to live in. Controlled burning increases the mineral content of the soil.
56.	Same	Same
57.	Same	Same
58.	Same	Same
59.	Same	Same

Appendix B

QUESTIONNAIRE

INSTRUCTIONS: Each of the incomplete statements or questions below is followed by several possible answers.

In the space provided, put a check next to the answer you think is most correct.

EXAMPLE:

The population of Canada is slightly greater than _____

_____ a. 14 million people
_____ b. 18 million people
_____ c. 22 million people
_____ d. 26 million people

PLEASE ANSWER THE FOLLOWING ITEMS:

1. What percentage of Canada's exports are forest products?

_____ a. 20 percent
_____ b. 40 percent
_____ c. 60 percent
_____ d. 80 percent

2. What percentage of Canada is covered by forests?

_____ a. 20 percent
_____ b. 35 percent
_____ c. 50 percent
_____ d. 65 percent

3. What are the three main types of forest fires?

_____ a. ground, surface and controlled
_____ b. surface, controlled and crown
_____ c. ground, surface and crown
_____ d. ground, crown and controlled

4. How many people are employed by the forest industry in Canada?

_____ a. 100 thousand
_____ b. 200 thousand
_____ c. 300 thousand
_____ d. 400 thousand

5. What percentage of productive land is destroyed by forest fires in Canada each year?

_____ a. 10 percent
_____ b. 15 percent
_____ c. 20 percent
_____ d. 25 percent

6. What is the value of trees lost yearly through forest fires in Canada?

_____ a. 9 million dollars
_____ b. 12 million dollars
_____ c. 15 million dollars
_____ d. 18 million dollars

7. What percentage of man caused fires result from carelessness?

_____ a. 24 percent
_____ b. 34 percent
_____ c. 44 percent
_____ d. 54 percent

8. How much money does Canada spend each year to fight forest fires?

_____ a. 9 million dollars
_____ b. 12 million dollars
_____ c. 15 million dollars
_____ d. 18 million dollars

9. Lightning set forest fires often cause little damage because

_____ a. they usually occur in the presence of rain and remain on the surface
_____ b. they are started by lightning when the forest is damp

_____ c. they occur in non-dense forests when the wind is calm
_____ d. they usually start in dense forests when there is a light breeze

10. In a regularly burned forest, what happens to litter and underbrush?

_____ a. litter and underbrush accumulate more
_____ b. litter and underbrush accumulate less
_____ c. litter accumulates less but underbrush accumulates more
_____ d. litter accumulates more but underbrush accumulates less

11. In a regularly burned forest, what happens to large trees?

_____ a. they are weakened
_____ b. they are destroyed
_____ c. they are strengthened
_____ d. they are not affected

12. Why are forest fires beneficial to animals?

_____ a. they burn off branches which grow close to the ground
_____ b. they kill off attacking insects
_____ c. they keep the animal population under control
_____ d. they clear open spaces

13. In areas which have been burned, the deer population is likely to increase

_____ a. 2 1/2 times
_____ b. 4 1/2 times
_____ c. 6 1/2 times
_____ d. 8 1/2 times

14. Why do small natural fires help to prevent large forest fires?

_____ a. small fires alert forest rangers to potentially dangerous areas
_____ b. small fires increase the moisture content of the soil
_____ c. small fires serve as a warning to forest visitors
_____ d. small fires clear off underbrush and deadfall

15. How does a small forest fire benefit water birds such as ducks?

_____ a. it kills off natural enemies of water birds
_____ b. it prevents soil erosion from occuring on the shoreline
_____ c. it clears off the shoreline for water birds to nest in
_____ d. it leaves small branches and twigs which are used by water birds to build nests

16. Lightning fires are usually what type of fire?

_____ a. ground fire
_____ b. surface fire
_____ c. crown fire
_____ d. controlled burn

17. What wind conditions are necessary for starting a controlled burn?

_____ a. gusty winds blowing in the direction of the area to be burned
_____ b. updrafts for burning a limited area at a time
_____ c. wind conditions are not important
_____ d. a calm wind or no wind

18. What is controlled burning?

_____ a. a process used by experts to plan and start a fire in a controlled area under proper weather and soil conditions
_____ b. a process used by experts to plan and start a fire in any area under any weather and soil conditions
_____ c. a process used by anyone to plan and start a fire in a controlled area
_____ d. a process used by experts to plan and start an uncontrolled fire in an open area

19. Why is the oil and gasoline drip torch a good method for starting controlled burning?

_____ a. oil is the most economical fire starter
_____ b. oil causes the least smoke in controlled burning
_____ c. oil from the drip torch sticks to vegetation and increases ignition
_____ d. oil causes the least damage to healthy trees

20. What is the best time of day to start a controlled burn?

_____ a. early morning
_____ b. mid-day
_____ c. late afternoon
_____ d. night

21. What is the most common type of fire used by modern man in controlled burning?

_____ a. a crown fire
_____ b. a ground fire
_____ c. a surface fire
_____ d. a lightning fire

22. Why does modern man use fires for controlled burning?

_____ a. to promote the flowering of chia
_____ b. to destroy the bark beetle
_____ c. to clear areas so that new trees can be planted
_____ d. to clear off underbrush and deadfall

23. In what way has fire not been used for crop cultivation?

_____ a. harvesting the crops
_____ b. fertilizing fields with ashes from fires
_____ c. eliminating weeds and undesirable plants
_____ d. promoting the flowering of chia

24. Which of the following is not a tool for starting a controlled burn?

_____ a. lightning
_____ b. matches
_____ c. rakes with burning embers
_____ d. drip torch

In British Columbia during September, 1973, a purposely set fire was whipped out of control and raced through a nearby neighbourhood where it destroyed at least 30 homes. The area the fire was started in was timber dry. It had rained less than five days in the last two months before the fire was started. The fire began in a controlled slash burning program being carried out by the provincial forestry department. The slash was branches and chips left after the trees had been cut. The winds that sprang up sent the flames racing through the

timber and past the fire lines. The fire became so intense that fire fighters were unable to control it. The destruction of those areas that had been burned was total.

25. What is a controlled slash burn?

_____ a. a burn designed to clear off the dense underbrush in a forest
_____ b. a burn designed to create fertilizing for the mineral content of the soil
_____ c. a burn designed to stay near the surface so that harmful insects are killed
_____ d. a burn designed to clear off the branches and chips caused by logging operations

26. Could the destruction caused by this fire have been avoided?

_____ a. Yes, because controlled burns should only be started in the early spring when the snow has melted
_____ b. Yes, because the controlled burn should not have been started when the forest was dry
_____ c. No, because all controlled burns cause some destruction to nearby areas
_____ d. No, because only valleys and hills can be burned without causing some destruction to nearby areas

27. What type of fire do you think it was?

_____ a. a surface fire
_____ b. a crown fire
_____ c. a ground fire
_____ d. a lightning fire

Appendix C

TABLE 1

Item Analysis for Preliminary Questionnaire

Item	Analysis				Item	Analysis			
	Upper	Lower	Difficulty index	Discriminability index		Upper	Lower	Difficulty index	Discriminability index
1	5	3	0.50	0.25	23	5	5	0.63	0.00
2	2	1	0.19	0.13	24	6	2	0.50	0.50
3	6	5	0.69	0.13	25	7	3	0.63	0.50
4	8	6	0.88	0.25	26	4	2	0.38	0.25
5	6	7	0.81	----	27	7	1	0.50	0.75
6	8	6	0.88	0.25	28	8	0	0.50	1.00
7	3	1	0.25	0.25	29	6	1	0.44	0.63
8	4	4	0.50	0.00	30	8	4	0.75	0.50
9	4	3	0.44	0.13	31	7	2	0.56	0.63
10	2	2	0.25	0.00	32	7	1	0.50	0.75
11	5	1	0.38	0.50	33	6	1	0.44	0.63
12	8	1	0.56	0.88	34	8	4	0.75	0.50
13	5	3	0.50	0.25	35	6	4	0.63	0.25
14	5	2	0.44	0.38	36	4	2	0.38	0.25
15	6	0	0.38	0.75	37	6	2	0.50	0.50
16	5	2	0.44	0.38	38	6	2	0.50	0.50
17	3	0	0.19	0.38	39	6	1	0.44	0.63
18	8	3	0.69	0.63	40	7	2	0.56	0.63
19	7	2	0.56	0.63	41	5	3	0.50	0.25
20	5	0	0.31	0.63	42	2	1	0.19	0.13
21	7	0	0.44	0.88	43	4	0	0.25	0.50
22	8	3	0.69	0.63	44	6	1	0.44	0.63
					45	7	3	0.63	0.50

Note.--Difficulty and discriminability indices are based on division of upper 27% and lower 27% scorers correctly responding to each item according to the system outlined in Ebel (1965, p.347).

TABLE 2

Item Analysis for Final Questionnaire

Item	Analysis				Item	Analysis			
	Upper	Lower	Difficulty index	Discriminability index		Upper	Lower	Difficulty index	Discriminability index
1	5	3	0.50	0.25	14	6	2	0.50	0.50
2	2	1	0.19	0.13	15	7	1	0.50	0.75
3	4	8	0.88	0.25	16	8	0	0.50	1.00
4	3	1	0.25	0.25	26	6	1	0.44	0.63
5	7	1	0.50	0.75					
6	5	1	0.38	0.50	17	8	4	0.75	0.50
7	5	3	0.50	0.25	18	7	2	0.56	0.63
8	5	2	0.44	0.38	19	7	1	0.50	0.75
25	4	0	0.25	0.50	20	6	1	0.44	0.63
					21	4	2	0.38	0.25
9	5	2	0.44	0.38	22	6	2	0.50	0.50
10	7	2	0.56	0.63	23	6	1	0.44	0.63
11	5	0	0.31	0.63	24	5	3	0.50	0.25
12	7	0	0.44	0.88	27	7	3	0.63	0.50
13	8	3	0.69	0.63					

Note.--Difficulty and discriminability indices are based on division of upper 27% and lower 27% scorers correctly responding to each item according to the system outlined in Ebel (1965, p.347).

[a]Items 1-8 and 25 related to section I of programs; items 9-16 and 26 to section II; and items 17-24 and 27 to section III.

TABLE 3

K-R Reliability for Final Questionnaire

S[a]	Variance Unit			S	Variance Unit			Item[b]	K-R Unit			Item	K-R Unit		
	Score (X)	$X-\bar{X}$	$X-\bar{X}^2$		Score (X)	$X-\bar{X}$	$X-\bar{X}^2$		p_i[c]	q_i[d]	$(p_i)(q_i)$		p_i	q_i	$(p_i)(q_i)$
1	21	9.167	84.034	16	13	1.167	1.362	1	.533	.466	.248	14	.600	.400	.240
2	10	1.833	3.360	17	11	0.833	0.694	2	.133	.867	.115	15	.600	.400	.240
3	6	5.833	34.024	18	11	0.833	0.694	3	.800	.200	.160	16	.367	.633	.232
4	7	4.833	24.958	19	18	6.167	38.02	4	.367	.633	.232	26	.467	.533	.249
5	12	0.167	0.028	20	14	2.167	4.696	5	.433	.567	.246				
6	16	4.167	17.364	21	11	0.833	0.694	6	.333	.667	.222	17	.700	.300	.210
7	15	3.167	10.030	22	17	5.167	26.698	7	.433	.567	.246	18	.667	.333	.222
8	13	1.167	1.362	23	13	1.167	1.362	8	.433	.567	.246	19	.633	.367	.232
9	15	3.167	10.030	24	12	0.167	0.028	25	.300	.700	.210	20	.433	.566	.245
10	8	3.833	14.692	25	5	6.833	46.690					21	.467	.533	.249
11	23	11.167	124.702	26	4	7.833	61.356	9	.500	.500	.250	22	.600	.400	.240
12	2	9.833	96.688	27	3	8.833	78.022	10	.567	.433	.246	23	.533	.467	.249
13	14	2.167	4.696	28	15	3.167	10.030	11	.367	.633	.232	24	.533	.467	.249
14	17	5.167	26.698	29	15	3.167	10.030	12	.533	.467	.249	27	.500	.500	.250
15	9	2.833	8.026	30	5	6.833	46.690	13	.700	.300	.210				

Note.--Calculations proceed as shown below.

Calculation of variance:

$\Sigma X = 355$, $N = 30$, $\bar{X} = 11.833$, $\Sigma (X-\bar{X})^2 = 787.770$

Variance = $\Sigma (X-\bar{X})^2/N-1 = 787.770/29 = 27.164$

$= \sigma^2$ = unbiased estimate.

Calculation of r_{K-R} using K-R 20:

$K = 27$, $\Sigma (p_i)(q_i) = 6.219$

$r_{K-R} = (K/K-1)(\sigma^2-\Sigma p_i q_i)/\sigma^2$

$= (27/26)(27.164-6.219/27.164) = (1.038)(.771)$

$= .800 - r_{K-R}$ = acceptable reliability.

[a] Subjects were randomly numbered.

[b] Items 1-8 and 25 related to section I of programs; items 9-16 and 26 to section II; and items 17-24 and 27 to section III.

[c] p_i designates the proportion of subjects responding correctly to the item.

[d] q_i designates the proportion of subjects responding incorrectly to the item.