DIFFERENTIAL EFFECTS OF MASSED VS. SPACED REPETITIONS WITHIN INSTRUCTIONAL COMMUNICATIONS

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Abstract

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Four television programs were produced for experimental investigation of repetition variables: one without repetitions of instructional units (SIMPLE); and three with spaced repetitions (SR), massed repetitions (MR), and summarized repetitions (SUM) presented in a 3 Blocks x 3 Treatments structure. Using a post-test only control group design, programs and measures of retention were administered to five groups of seventh-graders in the Montreal area (n = 97, N = 485). Analysis of variance and Newman-Keuls multiple factor comparisons were used to analyze group means and means for combined repetition blocks. All repetition means were significantly greater (p less than .01) than SIMPLE or CONTROL means. SR combined block means were significantly greater (p less than .05) than MR and SUM combined block means. Results indicate repetitions, especially spaced repetitions, of internally structured and conceptually related instructional units significantly increase learning from instructional communications mediated by television.

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Preface

In researching materials and writing the final draft of this thesis, an effort was made to thoroughly examine the dimensions of repetitions of instructional units mediated by teachers and by audio-visual instruments. The experimental part of this thesis used the television medium and results are clearly applicable to instructional television programs intended to promote retention of information. However, an effort was also made to compare experimental results reported in this thesis with the results gleaned from extant literature on massed vs. spaced repetition and repetition vs. no repetition. Finally, in an effort to explain the results in terms of the learning process, some theorizing to coalesce logical and empirical evidence was offered in the Discussion section.

The basic assumption underlying the design and execution of this project was: empirical results of instruction ought to correspond to some of the theories about what goes on in the learning process. Further, if there is correspondence with established theories, then the empirical results may be valuably applied to instruction mediated not only by television, but by other instruments as well.

Thus, the reader who is not interested in theory or philosophy may not wish to belabor the following: Review of Relevant Literature, as no relevant research in instructional television per se has been reported; and Discussion, excepting the section concerning limitations of conclusions.

Introduction

DEVELOPMENT OF PROJECT

This project originated with research into available literature comparing the effects of spaced vs. massed repetitions in increasing a learner's capabilities. Theoretically, the results gleaned from the literature in educational psychology would aid in the further development of the EDSIM model for a "computer-based educational game in which the game player's decisions will simulate instructional communications within a simulated classroom" (Mitchell, 1972, p. 1). Unfortunately, there was little research on effects of repetitions of communications using school-related subject material presented by a teacher or mediated by audio-visual instruments. Those research studies not subject to criticism for use of nonsense syllables, either did not control presentation of materials, compared repetitions using different media in the same experiment, inadequately operationalized repetition types, did not use a control group, or allowed hours or days to lapse between repetitions or reviews. The literature survey also unveiled a few studies which denied the value of repetition in any form. In addition to following a true experimental design, it seemed necessary to present instructional materials in a reproducible form with minimum stimulus variability. As a production variable, the effect of repetitions of instructional units per se in addition to the temporal conditions should be investigated. Thus, in conjunction with Communications Canada and under the supervision of Dr. Gary Coldevin at Sir George Williams University, the video tape format (television) was used for the development and production of instructional programs for the purposes of: 1) comparing effects of instructional communications without repetitions of conceptually related instructional units to communications with such repetitions; and 2) comparing effects of spaced to massed repetitions of conceptually related instructional units.

INSTRUCTIONAL COMMUNICATIONS

"The more effective the communication process, the more effective learning is likely to be " (Collier, 1967, p. 175); thus, communication and learning should be defined.

An instructional communication for increasing learning requires the exchange and translation of knowledge into information, ideas, or viewpoints in order to develop common understandings; it requires the creation in the learner's mind of "a replica of the images and ideas in the mind of the communicator " (Minnick, 1968, p. 84). The effectiveness of the communication may thus be assessed by the responses to questions about the information contained within the communication.

In this study, learning is the acquisition and development of capabilities as assessed with reliable and valid retention measures. The essential elements of the learning cycle, the cycle concerned with increasing an intended learner's capabilities, seem to be expressed in the sequence of events capsulized below:

> The learner is exposed to some material or stimuli; he must interact with that material in some active fashion as writing, talking, thinking or reasoning; and the adequacy of the interaction must in some way be evaluated and reinforced (Holland and Doran, 1973, p. 288).

Within the learning cycle, the nature and form of the material or stimuli will affect in some way the adequacy of the learner's interaction with the material. In the case of audio-visual presentations designed to change a learner's performance, not only do readability (Lumsdaine, 1963) and complementarity (Glaser and Cooley, 1973) of the audio and visual elements cause changes in the learning cycle, but the structure and organizations of instructional sequences and their repetitions also have impact.

Within the learning process, the aim of repetition in instructional communications is to accomplish:

> ... nontransitory organizational changes in cognitive structure accompanying this process as the learner responds to initial and successive presentations of the learning task (Ausubel, 1968, p. 273).

While learning and retention may thus imply repetition within the instruction and induced covert practice within the learner, the specific temporal conditions of the repetitions may also affect learning outcomes.

Review of Relevant Literature

REPETITION VS. NO REPETITION

No studies have been found concerning the effectiveness of repetition of internally structured and conceptually related instructional units in increasing learning from an instructional communication mediated by television. However, research studies on repetition of nonsense syllables, whole films, scenes and sequences, examples, filmstrips, reviews, and discussions have generally supported the claim that successive presentations of instructional materials produce learning increments: Hayman and Johnson (1963) reviewed three such studies; Reynolds and Glaser (1964) reviewed three other such studies; Ausubel (1968) reviewed six other such studies; Brenner, Walter, and Kurtz (1970) reported learning increments as a result of repetition; Reid (1971) reviewed still another four studies; and finally, Gay (1973) reviewed two other such studies. Thus, at least nineteen different studies since 1924 (the earliest study cited) have reported learning increments as a result of diverse forms of repetition. There do not appear to have been any replications of specific studies (i.e., each study had a different repetition form and/or different learning materials). Furthermore, the effectiveness of repetition in increasing retention of meaningful material has been questioned by a number of studies cited in Ausubal (1968). Although these studies denying the efficacy of repetition were not as recent as some of those supporting repetition for learning increments, and although most of them are subject to methodological criticisms

> ...primarily with respect to the inadequate control procedures used in presentation of the experimental material and other proactive and retroactive material which might affect retention (Reynolds and Glaser, 1964, p. 297),

the results cannot be entirely discounted. Gagné (1971) has also cited a series of studies including Reynolds and Glaser (1964) to discount "the effects of repetition immediately after learning," (p. 28)--effects assessed by different measures of retention.

MASSED VS. SPACED REPETITION

No studies have been found concerning the effectiveness of massed vs. spaced repetition of internally structured and conceptually related instructional units in increasing learning from an instructional communication mediated by television. The available research reports, however, are characterized by obscure definitions or distinctions between the terms "massed" and "spaced;" the research to date is also subject to challenges of stimulus variability in method of presentation of repetitions of instructional units. Often "spaced," "delayed," or "distributed" effects vs. "massed" or "immediate" effects were compared concerning repetitions, practice, reviews and information feedback. Often nonsense syllables served as the experimental base for extensive generalizations about differential effects of spacing and massing of repetitions. Repetitions were sometimes exact, sometimes varied; sometimes assessment of effects were based on feedback and testing, sometimes on testing and retesting.

Concerning massed vs. spaced repetitions, the most relevant study (Reynolds and Glaser, 1964) was based on a biology computer assisted instruction (CAI) program with intervals between spaced repetitions occupied by other instructional materials and with no intervals between massed repetitions: the program of 14 units in biology with 1344 frames was administered to intact eighth-grade science classes; the study was long-term with days intervening between repetitions. The findings of the CAI-repetition study conducted in two parts with randomized block designs for treatments suggested that

> ...the often-criticized monotony of repetition found in many early programs may in fact be of little value in enhancing retention and may be profitably replaced by a series of short instructional sequences in several related topics, each interspersed with short reviews of the preceding material (Reynolds and Glaser, 1964, p. 298).

These results, however, cannot be generalized to instruction mediated by television without empirical verification. Concerning spacing within films, however, test breaks of about a minute duration when interspersed in a 30-minute instructional film resulted in increased learning; the rest breaks that were characterized by silence produced greater learning than rest breaks for relaxing music or nonrelated announcements (Pockrass, 1961 reviewed by Schramm, 1971). Rest breaks of silence between repetition generally characterize the operationalization of spaced practice or repetitions. In some studies, however, repetitions were immediately preceded by an elaboration of instructional content as when spaced practice was designated as a summary.

Concerning massed vs. spaced (distributed) practice, it is nearly impossible "to make any generally valid statements"

Schramm, 1971, p. 27). Schramm (1971) cited Ash (1950) and Miller and Klier (1961) who found no significant differences, Maccoby and Sheffield (1958) who found massed to be less effective than spaced practice for a sequential learning task, and Ash and Jaspen (1953) who found spaced to be more effective than massed practice for a military task. Lumsdaine (1963) cited several of the same studies to support the generalization that results, though somewhat inconsistent, tend to favor the conditions which may be regarded as spaced practice. A series of studies cited by Ausubel (1968) were summarized as finding massed to be more effective than spaced practice for immediate retention, but spaced to be more effective than massed for delayed retention (p. 292). Prather and Berry (1973) also cited the studies of Rothkopf (1969) and Underwood and Eckstrand (1967) who found spaced to be more effective than massed practice for retention of motor and verbal skills.

Concerning massed vs. spaced review, Schramm (1971) cited Miller and Levine (1961) who found massed to be more effective than spaced review or no review for science material and McGuire (1961) who found spaced to be more effective than massed review. Gay (1973) cited Ausubel and Youssef (1965), Reynolds and Glaser (1964), and Spitzer (1939) who found spaced to be more effective than massed reviews for meaningfully related material. Gay (1973) found that groups with reviews spaced 1 and 7 days after learning retained more than groups with reviews of 1 and 2 days after learning for retention of mathematical rules. But "spaced reviews have consistently been found to be equally effective irrespective of time of occurrence " (Gay, 1973, p. 172) based on the reports of Ausubel (1966), Peterson, Ellis, Toohill, and Kloess (1935), and Sones and Stroud (1940)--all cited by Gay (1973). Reynolds and Glaser (1964) found spaced to be more effective than massed review for groups with equivalent prior knowledge for retention of biology information (CAI). Generally, "the effects of reviews have been inadequately investigated for verbal information." and for intellectual skills (Gay, 1973, p. 172).

Concerning delayed information feedback (DIF) vs. immediate information feedback (IIF), studies indicating greater effectiveness for DIF were Sturges (1969) and More (1969) cited in Prather and Berry (1973)--these studies did not control for distribution of practice. (The implication here is that information feedback is distinct from repetition or practice.) Studies supporting IIF effectiveness were Angell (1949) cited in Schramm (1971), and Bugelski (1964), Gagné (1965), Skinner (1969) cited in Prather and Berry (1973). No significant differences between IIF and DIF were found in six studies reviewed by Sassenrath and Spartz (1972). While Sassenrath and Spartz (1972) found IIF to be about equal to DIF of up to one day on measures of delayed retention, Prather and Berry (1973) found DIF to be significantly better than IIF on measures of delayed retention--both studies concerned retention of historical essay material. Prather and Berry (1973), however, found no significant differences on a measure of immediate retention.

NUMBER OF REPETITIONS

No studies have been found concerning the desirable number of repetitions within an instructional communication mediated by television. Although the optimum number will probably vary with the complexity of the communication, it has been shown in several reports that greater than three repetitions produced decreasing increments in learning: Yoakum (1924) cited in Ausubel (1968); McTavish (1949), Lumsdaine, Kulzer, and Kopstein (1961) cited in Lumsdaine (1963) and in Schramm (1971); Kendler, Cook, and Kendler (1956), Ash and Jaspen (1953) cited in Ausubel (1968); and Cook (1960) cited in Schramm (1971). The explanations for the decrease ranged from the supposition that there is simply less and less to learn after each repetition to the supposition that fatigue and/or boredom increase(s) as the number of repetitions increases. Furthermore, after identifying classroom parameters and average time to learn for specified student intelligence, teacher experience, lesson time, wasted time, and redundancy variables, Karp (1972) concluded that time gained through successive repetitions without testing does not compensate for time lost in repeating units for students who have already learned the material (based on computations from a numerical model to suggest optimal redundancy in the learning situation). The conclusions based on the Karp model do not seem to apply to nonindividualized instruction mediated by television. Although a recent study on repetitions of instructional materials identified "a regular trend of higher performance with increased repetition," (Reynolds and Glaser, 1964, p. 291), this does not deny the trend of diminishing returns after greater than three repetitions and "the relevance of this relationship in more complex learning situations is limited" (Reynolds and Glaser, 1964, p. 293).

Therefore, in this study repetitions of instructional units will be limited to three in number. (See Appendix A for details on instructional units used in this study; there were actually three varied repetitions of a basic concept, but the specific unit was repeated only once in each of the programs with internally structured repetitions--i.e., the presenter read aloud the instructional unit as part of the content within the script for the instructional program and later read aloud the instructional unit as it appeared on the television monitor over a background slide.)

ICONIC VS. DIGITAL REPETITION

In terms of communication a distinction between iconic and digital signs for reference to an object or concept is relevant to the selected form of repetition. "Photographs, drawings, sculpture and maps are iconic signs because they in some way look like their referents," but "words, numbers, Morse code and semaphore are examples" of digital signs because they in no way resemble their referents (Levie and Dickie, 1973, p. 861). Thus, a digital sign parallels "a verbal symbolic model" (Mitchell, 1973, p. B5)--visual and aural repetition of instructional units were verbal symbolic models in this study and were, therefore, designated as digital signs or digital repetitions, i.e., the instructional repetition was "flashed" on the television monitor as the presenter read the content aloud. Because digital signs do not resemble their referents, they must be interpreted by the receivers or learners. However, the use of digital signs for repetition of instructional units is favored for two reasons: 1) digital signs minimize irrlevant cues, and 2) digital signs are especially useful "to communicate a concept that has already been learned" (Levie and Dickie, 1973, p. 862).

AUDIO VS. VIDEO REPETITION

Normally auditory signals are considered finite and non-preservable as compared with video signals or displays which are longer lasting. This distinction applies to simultaneous audio-visual presentation of digital repetitions because "speaking rates average about 150 words per minute while adult reading rates are commonly in excess of 300 words per minute" (Levie and Dickie, 1973, p. 868). (In other words, theoretically, a viewer could read a repetition twice while the repetition was being read aloud by the presenter.) Levie and Dickie responded to Travers' (1967) conclusion that there is no advantage to two sensory modalities over a single modality when the same words are presented in both audio and video channels by reiterating the findings of individual differences in processing and storing information. Time is also required for the learner to switch receiving from one channel to the other even when the information is redundant; thus, "producers of audio-visual materials should be aware of the frequency and speed with which they are asking their audience to engage in channel switching" (Levie and Dickie, 1973, p. 872)--see also Schramm (1971).

Because of the difference in reading and listening rates (corresponding to reading and speaking rates) covert repetitions in the form of silently re-reading a repeated instructional unit was possible in this study; but because the initial presentation of the instructional unit was presented via the audio channel alone (the unit was read aloud by the presenter as part of the content), digital repetition in the video channel was absent and internal repetition by silent rehearsal by the learner was minimized.

Because of the time required for a learner to switch reception of information from one channel to the other (visual to aural reception from video and audio channels), it logically follows that spaced repetitions (with time intervals between repetitions) would allow more time for switching than would repetitions in the massed or summary form (without time intervals between repetitions). Spaced repetitions would also allow for more internal rehearsal of information content by the learner during the time intervals between repetitions (although both audio and video repetitions within instructional programs ended simultaneously--i.e., the visual display of a repeated instructional unit ended when the presenter finished reading the unit aloud).

Formulation of Hypotheses

Before presenting the hypotheses eventually formulated to guide the investigation of effects of specific forms of repetition on learning, the conditions to remain constant across instructional communications were clearly identified and distinguished from the conditions to be systematically manipulated.

First, the conditions to remain constant were described. All instructional units would be related to a basic concept; three such units would exist for each concept; there would be an equal number of concepts and units for all programs; each unit would be repeated once in each of three programs, but would not be repeated in one program; all programs would be divided into three major message sections; each major message section would be composed of an equal number of concepts and units. All instructional units would be digital in form; initial presentation would be through the audio channel alone, but the repetition of a unit would be simultaneously presented through both audio and video channels. (See Appendix A for itemization of units, concepts, and division into sections for instructional programs.) Other conditions, not related to repetition form, but kept constant across programs and experimental groups, are described in the following section on procedure.

Second, the conditions to be systematically manipulated were described. Two forms of massed repetition were operationalized as units of repetition presented without intervals between repetitions:

one form (MR) was presented immediately following the initial instructional communication of a single concept and the other (SUM) was presented at the end of an instructional sequence containing five related concepts (allowing for an interval between the initial communication and the repetitions)--in other words, the second form was a summary. Spaced repetitions (SR) were operationalized as units of repetition presented immediately following the initial instructional communication of a single concept, but with a 7-second audio-video pause between each repetition--two seconds being a natural audio pause for the presenter in the program, and an additional five seconds arbitrarily chosen for delineation between SR and the two forms of massed repetition (MR and SUM). (Note: The audio-video pause between spaced repetitions was described by the absence of aural and visual repetition of the instructional unit, but a background slide of some related forest scene remained on the television monitor.)

Using the definitions and elaborations given above, the following hypotheses were then formulated:

H_1 = Repetition of internally structured and conceptually related instructional units is more effective than a single instructional communication in increasing learning; and

H_2 = Spacing is more effective than massing of internally structured and conceptually related repetitions of instructional units in increasing learning.

Procedure

The procedures followed to investigate the formulated hypotheses were preplanned to control for as many extraneous variables as possible in order to maximize the probability of results reflecting actual treatment effects. As the relevant extant research using meaningfully related materials in the investigation of effects of repetition has reported results for subjects from grades six, seven, and eight, it seemed reasonable that subjects for this study should be from at least one of those grades. To control for stimulus variability in the presentation of information, video tape recordings were used for presentation of information. To distribute effects of intervening extraneous variables (such as changes in background noise, in intra-group characteristics, in time of day, or in order of presentation of each type of repetition) a randomized block design was used for the presentation of repetition types to each experimental group.

POPULATION AND SAMPLE

Subjects for the control group and for each experimental treatment were 97 seventh-grade students enrolled in suburban schools in the Montreal area in November 1973: Corpus Christi, St. Thomas, and Howard S. Billings. Thus the total N was 485, 97 for each of the five groups, each of the groups being comprised of four classes. The subjects were students in intact, but nonstreamed classes. Classes streamed according to specific student abilities or aptitudes were not used for control or experimental groups.

PRESENTATION MEDIUM

The video tape recording (VTR) format was selected for presentation of instructional materials on forests and fires. Selection of the television medium for presentation of a reproducible set of carefully planned instructional units served to minimize stimulus variability. All television programs used the same basic script, with the prime difference between SIMPLE and repetition programs being the absence of repetitions of instructional units from the former; all were black and white VTRs viewed on 23-inch monitors in classrooms with 25-41 students in each class in comparable lighting conditions and in comparable viewing conditions; all were approximately 20-minute programs; all had the same person (presenter) delivering the instructional materials which were written and scripted in documentary style; and all structured repetitions of instructional units within programs were digital (verbalized) with simultaneous input from both audio and video channels.

EXPERIMENTAL DESIGN

A five-group post-test only control group design was selected to control for testing effects, testing-treatment interactions, and individual learner differences (e.g., history); the use of non-streamed classes obviated the need for individual randomization. The experimental design as follows designates experimental groups instead of treatments per se. R designates the random nature of the groups, E designates an experimental group, and O designates an observation.

R	E_1	O_1
R	E_2	O_2
R	E_3	O_3
R	E_4	O_4
R	CONTROL	O_5

The three repetition treatments were administered to the same group of subjects for each program to reduce the magnitude of error used in comparison of means for the separate repetition treatments. The treatments were rotated across program sections to minimize order of treatment effect, to minimize influence of external variables such as fatigue or noise distraction, and to minimize effect of content change. The use of equal numbers of subjects for each group facilitated independence of the experimental variables. The experimental design for repetition treatments per se is best described as a randomized block experiment in which the nonstreamed students in experimental blocks were effectively assigned to treatments with each treatment occuring only once in each block. The particular 3 Blocks x 3 Treatments arrangement may be considered a Latin square design in which each treatment occured only once in each row and column (Ferguson, 1971, pp. 201-205). The experimental groups and programs and subdivisions are schematically represented in Table 1.

TABLE 1

Group and Program Combinations

Section	Group				
	1	2	3	4	5
	Program				
	I	II	III	IV	Control
1	SIMPLE	MR	SUM	SR	No program
2	SIMPLE	SUM	SR	MR	
3	SIMPLE	SR	MR	SUM	

Note.--SIMPLE designates no repetition; MR designates massed repetition; SUM designates summary; SR designates spaced repetition.

BASIC SCRIPT DESIGN

All programs were titled "Forests and Fires," but the following headings were used to identify the particular script to be used for each program.

Program I: SIMPLE

Program II: MR-SUM-SR

Program III: SUM-SR-MR

Program IV: SR-MR-SUM

The term SIMPLE designating no repetition, indicates the absence of repetitions of instructional units within program I. The abbreviations SR, MR, and SUM designating the treatments of spaced repetition, massed repetition, and summary indicate the precise treatment for each section within programs II, III, and IV where the sections were constant while the treatments were rotated.

	Program I	Program II	Program III	Program IV
Section I	SIMPLE	MR	SUM	SR
Section II	SIMPLE	SUM	SR	MR
Section III	SIMPLE	SR	MR	SUM

The content of programs was selected for novelty of information. The repetitions of instructional units one through five for section I emphasized the importance of the forest industry, the destruction caused by forest fires, the different types of forest fires, the causes of forest fires, and the ways of fighting forest fires in Canada. The repetitions of instructional units six through ten for section II emphasized the characteristics of lightning fires, the characteristics of a dense forest, the characteristics of a regularly burned forest, the results of small fires, and the benefits to animals in regularly burned areas. The repetitions of instructional units eleven through fifteen for section III emphasized the general uses of fire by early man, the specific uses of fire by early man, the conditions for controlled burning, the methods for controlled burning, and the benefits of controlled burning. Each section, however, contained the messages capsulized below.

Section I:	Forest fires are harmful and should be prevented.
Section II:	Lightning fires are beneficial and should not always be prevented.
Section III:	Controlled burning is a good method for fighting fires and should be used.

The treatment and intervening shots for each television program are schematically represented in Table 2. Refer to Appendix A for detailed information on program scripts.

TABLE 2

Treatments and Intervening Shots across Programs

Video shots	Program I	Program II	Program III	Program IV
1-4[a]	1-4	1-4	1-4	1-4
T1[b]	Omitted	MR1	Omitted	SR1
5	5	5	5	5
T2	Omitted	MR2	Omitted	SR2
6-12	6-12	6-12	6-12	6-12
T3	Omitted	MR3	Omitted	SR3
13-16	13-16	13-16	13-16	13-16
T4	Omitted	MR4	Omitted	SR4
17-20	17-20	17-20	17-20	17-20
T1	Omitted	Omitted	SUM1	Omitted
T2	Omitted	Omitted	SUM2	Omitted

Video	Program I	Program II	Program III	Program IV
T3	Omitted	Omitted	SUM3	Omitted
T4	Omitted	Omitted	SUM4	Omitted
T5	Omitted	MR5	SUM5	SR5
21-23	21-23	21-23	21-23	21-23
T6	Omitted	Omitted	SR6	MR6
24-28	24-28	24-28	24-28	24-28
T7	Omitted	Omitted	SR7	MR7
29-30	29-30	29-30	29-30	29-30
T8	Omitted	Omitted	SR8	MR8
31-33	31-33	31-33	31-33	31-33
T9	Omitted	Omitted	SR9	MR9

TABLE 2--Continued.

Video shots	Program			
	I	II	IIII	IV
34-37	34-37	34-37	34-37	34-37
T6	Omitted	SUM6	Omitted	Omitted
T7	Omitted	SUM7	Omitted	Omitted
T8	Omitted	SUM8	Omitted	Omitted
T9	Omitted	SUM9	Omitted	Omitted
T10	Omitted	SUM10	SR10	MR10
38-40	38-40	38-40	38-40	38-40
T11	Omitted	SR11	MR11	Omitted
41	41	41	41	41
T12	Omitted	SR12	MR12	Omitted
42-45	42-45	42-45	42-45	42-45

Video shots	Program			
	I	II	III	IV
T13	Omitted	SR13	MR13	Omitted
46-53	46-53	46-53	46-53	46-53
T14	Omitted	SR14	MR14	Omitted
54-55	54-55	54-55	54-55	54-55
T11	Omitted	Omitted	Omitted	SUM11
T12	Omitted	Omitted	Omitted	SUM12
T13	Omitted	Omitted	Omitted	SUM13
T14	Omitted	Omitted	Omitted	SUM14
T15	Omitted	SR15	MR15	SUM15
56-59	56-59	56-59	56-59	56-59

TABLE 2—Continued.

Note.—MR designates massed repetition; SR designates spaced repetition; SUM designates summary.

[a]Arabic numerals designate shots intervening between treatments. These shots are not described here, but are detailed in Appendix A. Shots are sequentially listed.

[b]The letter "T" followed by an Arabic numeral designates a treatment from a specific repetition group number (see Appendix A for detailed list of repetition groups). All repetitions appeared in white letters over a background slide (digital).

TESTING DESIGN AND ADMINISTRATION

A preliminary questionnaire was designed for administration to a sample of 30 seventh-graders from Corpus Christi in the Montreal area. The test items were constructed to measure information gain and concept formation as a result of the defined repetition treatments. Appendix B contains the item analysis for the preliminary 45-item questionnaire (Table 9). According to Ebel (1965, pp. 75, 364) the optimum index of difficulty is .50 and the optimum index of discriminability is .40 or greater. However, a discriminability range of .30-.39 is considered acceptable, while items within the range of .20-.29 are considered marginal. Marginal items were revised for inclusion in the final questionnaire.

The selection of questions for data analysis in the final questionnaire was based not only on difficulty and discriminability indices, but also on content validity for each of the three major content sections in the television programs and their respective repetition treatments. Questions 1, 2, 4, 7, 10, 11, 13, 14, and 43 were selected from the preliminary questionnaire and renumbered as 1, 2, 3, 4, 5, 6, 7, 8, and 25 in the final data analysis for section I; questions 16, 19, 20, 21, 22, 24, 27, 28, and 44 were selected and renumbered as 9, 10, 11, 12, 13, 14, 15, 16, and 26 for section II; and questions 30, 31, 32, 33, 36, 38, 39, 41, and 45 were selected and renumbered as 17, 18, 19, 20, 21, 22, 23, 24, and 27 for section III. The questions renumbered as 25, 26, and 27 were based on a news story briefly capsulized in the questionnaire and were designed to require application of information presented in each of the three program sections; other items were designed to test recall.

Based on the 27 questions used in the final data analysis, Kuder-Richardson reliability (K-R 20), which does not assume items of equal difficulty, was computed (Tuckman, 1972, p. 139). The resulting r_{K-R} was 0.80, an acceptable reliability for a nonstandardized test (Ebel, 1965). Appendix C contains the final 27-item questionnaire in numbered form and its corresponding item analysis (Table 10) and reliability tabulations and computations (Table 11). The last page of each questionnaire solicited demographic and media accessibility information.

Before viewing each of the television programs, each group of subjects was given the same introduction concerning the nature of the project as research on the effectiveness of the program in conveying information on forests and fires. The questionnaires were administered immediately after program presentation. Students were asked to sign their names on the first page of the questionnaire followed by the assurance that the questionnaire was not a test, grades would not be given, and schools and teachers would not be informed of individual scores, but that names were needed for proper data analysis. It is assumed the name-identification requirement encouraged serious responses to items. Although attention was directed to the written instructions preceding the questions, the same instructions were also given orally. Program viewing and testing was accomplished within regular class periods of approximately 50 minutes.

STATISTICAL CODING AND ANALYSIS

Questionnaires were coded alphanumerically for subject and group identification and numerically to denote specific responses on standard 80-column computer cards. The format and coding system was identical for all groups for computer interpretation in statistical analyses. Each of 27 possible correct responses received one point.

Scores were computed and submitted to analysis of variance, which divides the sum of squares (the individual score minus the average, squared and then summed) into additive parts to which the Newman-Keuls method of multiple comparisons was then applied with a prespecified significance level of .05. Three sets of comparisons were executed: 1) comparison of means between program and control groups; 2) comparison of means between combined repetition blocks and simple and control groups; and 3) comparison of means between combined repetition blocks. The second set is a replicative comparison of the first (repetition vs. no repetition) and the third set is a replicative comparison of the second (MR vs. SUM vs. SR).

For each set of comparisons, means were ranked from low to high, studentized ranges (applicable for equal treatments and equal numbers of subjects) were computed for ordered pairs of means, and the criterion values for sequentially adjacent means for the specified degrees of freedom were determined. The Newman-Keuls method used followed the steps outlined in Ferguson (1971, pp. 271-272).

In ordering means, $\bar{X}_1$ denoted the lowest mean, $\bar{X}_2$ the next highest, etc. Studentized ranges were computed by dividing the difference between ordered pairs of means by $s_{\bar{X}}$, where

$$s_{\bar{X}} = \sqrt{s_w^2/n}$$

where s_w^2 denoted the estimated within group variance, and n denoted the number of subjects in each group.

The systematic comparison of studentized ranges with criterion values of Q_2 through Q_5 followed the scheme below for the rank order of $\bar{X}_1$ for the lowest mean to $\bar{X}_5$ for the highest (the same pattern for comparison applied when $\bar{X}_3$ was the highest and Q_2 and Q_3 were criterion values).

	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_4$	$\bar{X}_5$
$\bar{X}_1$	--	Q_2	Q_3	Q_4	Q_5
$\bar{X}_2$	--	--	Q_2	Q_3	Q_4
$\bar{X}_3$	--	--	--	Q_2	Q_3
$\bar{X}_4$	--	--	--	--	Q_2
$\bar{X}_5$	--	--	--	--	--

Thus, if the value of the studentized range exceeded the Q value, the differences between means were significant at the specified levels.

Although the Latin square design for repetition treatments accounted for differences in group characteristics, demographic and media accessibility indices were tabulated to allow comparison across groups.

Results

The results for program and control groups, for combined repetition blocks, simple, and control groups, and for combined repetition blocks alone as expressed in analysis of variance tables and in the application of multiple factor comparisons using the Newman-Keuls method are based on the following mean scores.

CONTROL	8.09
PROGRAM I	13.61
PROGRAM II	15.71
PROGRAM III	16.93
PROGRAM IV	17.11
MR	16.10
SUM	16.28
SR	17.37

Program I was the only program without repetitions of instructional units; programs II, III, and IV contained mixtures of the three forms of repetition being investigated; MR denotes the combined massed repetition blocks; SUM denotes the combined summary blocks; and SR denotes the combined spaced repetition blocks. (Note: The total possible retention score was 27.)

The Newman-Keuls method represents a compromise between controlling for Type I error (of finding a difference between means when no difference exists) and for Type II error (of not finding a difference when a difference exists).

PROGRAM AND CONTROL GROUPS

Program I (SIMPLE) was the only television program without internally structured repetitions of instructional units, while programs II, III, and IV contained a mixture of three different types of repetitions. The classic control group viewed no program.

Using the analysis of variance (ANOVA) for program and control groups (Table 3), the overall F, s_b^2/s_w^2, was calculated as 55.94, which was significant at better than .01.

TABLE 3

ANOVA for Program and Control Groups

Source	Statistical Unit		
	Sum of Squares	df	Variance Estimate
Between	5216.10	4	$1304.02 = s_b^2$
Within	11189.50	480	$23.31 = s_w^2$
Total	16405.60	484	F = 55.94

Both .05 and .01 criterion values (df=480) were listed for comparison against studentized ranges (based on $s_w^2 = 23.31$) in Table 4.

TABLE 4

Newman-Keuls Test on Means between Programs and Control

Ordered means	Differences between ordered Means				
	8.09, $\bar{X}_1$	13.61, $\bar{X}_2$	15.71, $\bar{X}_3$	16.93, $\bar{X}_4$	17.11, $\bar{X}_5$
CONTROL, 8.09, $\bar{X}_1$	--	5.52	7.62	8.84	9.02
I, 13.61, $\bar{X}_2$	--	--	2.10	3.32	3.50
II, 15.71, $\bar{X}_3$	--	--	--	1.22	1.40
III, 16.93, $\bar{X}_4$	--	--	--	--	0.18
IV, 17.11, $\bar{X}_5$	--	--	--	--	--

Studentized Ranges (Difference/$s_{\bar{X}}$)

Group	CONTROL	I	II	III	IV
CONTROL	--	11.27**	15.55**	18.04**	18.41**
I	--	--	4.28**	6.77**	7.14**
II	--	--	--	2.49	2.86
III	--	--	--	--	0.37
IV	--	--	--	--	--

Note.--$s_{\bar{X}} = \sqrt{s_w^2/n} = \sqrt{23.31/97} = 0.49$.

*p less than .05, $Q_2 = 2.77$, $Q_3 = 3.31$, $Q_4 = 3.63$, $Q_5 = 3.86$.

**p less than .01, $Q_2 = 3.64$, $Q_3 = 4.12$, $Q_4 = 4.40$, $Q_5 = 4.60$.

Scores for subjects viewing programs with mixed repetitions were significantly higher (p less than .01) than scores for subjects viewing the program without repetitions. All groups achieved significantly higher scores (p less than .01) than the control group. Differences between repetition programs did not even approach significance. These results support the first hypothesis: repetition of internally structured and conceptually related repetitions of instructional units is more effective than a single instructional communication in increasing learning.

COMBINED REPETITION BLOCKS, SIMPLE, AND CONTROL GROUPS

Scores for each repetition block in programs II, III, and IV were computed and combined according to repetition type to permit: comparison of massed repetition (MR), summary (SUM), and spaced repetition (SR) against each other and against both simple and control programs; and comparison of simple and control against each other based on a different variance estimate.

Using the analysis of variance for combined repetition blocks and for simple and control groups (Table 5), the overall F was calculated as 93.91, which was significant at better than .01.

Both .05 and .01 criterion values for the Newman-Keuls test (df = 480) were listed for comparison against studentized ranges (based on $s_w^2 = 14.36$) in Table 6.

TABLE 5

ANOVA for combined Repetition Blocks and Simple and Control Groups

Source	Statistical Unit		
	Sum of Squares	df	Variance Estimate
Between	5393.64	4	$1348.41 = s_b^2$
Within	6892.67	480	$14.36 = s_w^2$
Total	12286.31	484	F = 93.91

TABLE 6

Newman-Keuls Test on Means between

Repetition Blocks, Simple, and Control

Ordered means	Differences between ordered Means				
	8.09, $\bar{X}_1$	13.61, $\bar{X}_2$	16.10, $\bar{X}_3$	16.38, $\bar{X}_4$	17.37, $\bar{X}_5$
CONTROL, 8.09, $\bar{X}_1$	--	5.52	8.01	8.19	9.28
SIMPLE, 13.61, $\bar{X}_2$	--	--	2.49	2.67	3.76
MR, 16.10, $\bar{X}_3$	--	--	--	0.18	1.27
SUM, 16.28, $\bar{X}_4$	--	--	--	--	1.09
SR, 17.37, X_5	--	--	--	--	--

Table 6--Continued.

Studentized Ranges (Difference/$s_{\bar{x}}$)

Group	CONTROL	SIMPLE	MR	SUM	SR
CONTROL	--	14.15**	20.54**	21.00**	23.80**
SIMPLE	--	--	6.38**	6.85**	9.64**
MR	--	--	--	0.46	3.26[a]
SUM	--	--	--	--	2.80[b]
SR	--	--	--	--	--

Note.--$s_{\bar{x}} = \sqrt{s_w^2/n} = \sqrt{14.36/97} = 0.39$.

*p less than .05, $Q_2 = 2.77$, $Q_3 = 3.31$, $Q_4 = 3.63$, $Q_5 = 3.86$.

**p less than .01, $Q_2 = 3.64$, $Q_3 = 4.12$, $Q_4 = 4.40$, $Q_5 = 4.60$.

[a]This value approaches significance at .05 ($Q_3 = 3.31$).

[b]This value would normally be considered significant at .05, but the significance is not indicated in the Newman-Keuls test when the previous value (3.26) is not significant.

Combined scores for subjects viewing designated repetition blocks were all significantly higher (p less than .01) than scores for SIMPLE and CONTROL groups. Scores tabulated for spaced repetition blocks were significantly higher (p less than .05) than scores for summary blocks and approached significance (p less than .05) over massed repetition blocks. The difference between summary and massed repetition blocks did not even approach significance. Again, the results clearly support the first hypothesis, but only tentatively support the second hypothesis: spacing is more effective than massing of internally structured and conceptually related instructional units in increasing learning.

COMBINED REPETITION BLOCKS

Using the analysis of variance for combined repetition blocks (Table 7), the overall F was calculated as 3.40, which was significant at better than the .05 level.

Both .05 and .01 criterion values for the Newman-Keuls test (df = 290) were listed for comparison against studentized ranges (based on s_w^2 = 13.46) in Table 8.

TABLE 7

ANOVA for combined Repetition Blocks

Source	Statistical Unit		
	Sum of Squares	df	Variance Estimate
Between	91.59	2	45.80 = s_b^2
Within	3877.09	288	13.46 = s_w^2
Total	3968.09	290	F = 3.40

The variance estimate for within groups from Table 7, thus, provided the basis for a second comparison of repetition blocks against each other. Scores tabulated for spaced repetition blocks were significantly higher (p less than .05) than scores for massed repetition and for summary blocks. Again the difference between massed repetition and summary blocks did not even approach significance.

TABLE 8

Newman-Keuls Test on Means between Repetition Blocks

Ordered means	Differences between ordered Means		
	16.10, $\bar{X}_1$	16.28, $\bar{X}_2$	17.37, $\bar{X}_3$
MR, 16.10, $\bar{X}_1$	--	0.18	1.27
SUM, 16.28, $\bar{X}_2$	--	--	1.09
SR, 17.37, $\bar{X}_3$	--	--	--

Studentized Ranges (Difference/$s_{\bar{x}}$)

Group	MR	SUM	SR
MR	--	0.49	3.43*
SUM	--	--	2.95*
SR	--	--	--

Note.--$s_{\bar{x}} = \sqrt{s_W^2/n} = \sqrt{13.46/97} = 0.37.$

*p less than .05, $Q_2 = 2.77$, $Q_3 = 3.31$.

**p less than .01, $Q_2 = 3.64$, $Q_3 = 4.12$.

The results reaffirm the second hypothesis and do not in any way challenge the assumption that a summary is simply another form of massed repetition.

DEMOGRAPHIC AND MEDIA ACCESSIBILITY DATA

No correlations between demographic and media accessibility data and scores on questionnaires was expected. As comparison across groups on the solicited data indicated no substantial differences between groups, no correlations were run. However, the overall percentile comparisons are shown in Table 12 in Appendix D to provide a more detailed profile of the total sample used in this study. Only 0.2% of the sample had no television set in the home, 52.8% had black and white sets, 24.9% had colour, and 22.1% had both black and white and colour. Students ranged in age from 11 to 14 years with 78.8% at 12 years and 14.2% at 13 years. The sex composition was 48.2% male and 51.8% female. Of the possible classifications for home environment, 50.7% were professional, 26.0% were white collar, and 21.2% were blue collar. The basis for classification of home environment is footnoted in Table 12, Appendix D.

Discussion

LIMITATIONS OF CONCLUSIONS

In the strictest sense, the results support the hypotheses set forth in this study only for retention (short-term) of relatively novel information, only for groups of subjects with the characteristics of the sample (including the in-class environment), and only for instructional communications conveyed via the video tape (television) medium under the conditions maintained in this study. Certainly because of the experimental and program design, it would seem safe to conclude that in educational television productions, it is better (for short-term retention at least) to have spaced repetitions of instructional communications described by intervals of silence between repetitions. It should be remembered that although audio silence was maintained for 7 seconds between spaced repetitions, a static visual signal (a relevant slide) was kept on the monitor. It may be that audio signals could also be maintained without detracting from the impact of the repetitions.

It is important to remember that all programs were carefully organized and programs with internally structured and conceptually related instructional units repeated only once (but in clusters of three) may be improved by spacing, while programs with differently structured units may not. It is also important to remember that all repetitions were verbalized in both the video and audio channels.

It is probable that within an instructional communication with limited number of repetitions (less than or equal to three) and short program duration (less than 25 minutes), repetition time substantially compensates for time "lost" in repeating units for those who may have initially learned the material (Karp, 1972). Intervals of silence for spaced repetitions consumed 70 seconds per program section or a total of 210 seconds--three minutes and thirty seconds within a program of about 20 minutes. Learning increments were significant with spaced repetitions, but this was for a massed media program which normally precludes individualization of instructional sequences. In the case of days or weeks of instruction, the use of spaced repetitions for individuals who have not reached a specified criterion level would still be recommended based on the results of this particular "televised" repetition study.

Certainly it would not be difficult to incorporate pauses between repetitions in a face-to-face lecture-discussion situation, and computer assisted programs and other reproducible presentations are amenable to the structuring of intervals between repetitions. The question of optimum spacing of repetitions is still unanswered, e. g., would intervals of 8 or 10 seconds be better or worse than intervals of 7 seconds or does the number of seconds matter as long as at least 5 seconds intervene. Also, can the results be extended beyond instruction mediated by television?

RESULTS COMPARED WITH ACCEPTED VIEWS

There may be no such thing as "accepted views" in this area, but with the results of this study and others reviewed earlier, there should be little doubt that internally structured repetitions of instructional units substantially and significantly add to a student's measured ability to recall information. Within the array of studies on repetitions cited in literature reviews, the general support for the effectiveness of repetitions from 1913 to the present investigated subject areas of poetry, general science, composition skills, patterned mazes, connected discourse, reading of micrometers, mathematics, biology and these studies used a maze of mediums for presentation. None, however, supporting the effectiveness of repetitions, had used the video tape medium (educational television) for presentation. A group of studies (though fewer in number) with equally diverse subject areas generally supported the claim that repetitions did not aid learning. Many of the studies on both sides have been criticized either for lack of control or use of nonsense subject matter.

The most credible opponent to the argument that repetitions aid learning is Gagné (1971) and his arguments apply only to hierarchically ordered learning tasks. Even within hierarchies, however, the major substance of his arguments was based on a study in which repetitions (although limited) were required:

> When she had worked down to the point where these subordinate capabilities were present, Wiegand turned around and went the other way. She now made sure that all the prerequisite skills were present, right up to, but not including the final inclined plane problem (Gagné, 1971, p. 29).

And in the same article, Gagné seemed to favor spaced repetitions specifically:

> Periodic and spaced reviews, however, are another matter, and it seems likely that these have an important role to play in retention. Notice that when a review is given, the student has to exercise his strategies of retrieval (Gagné, 1971, p. 30).

It seems that more of a learner's capabilities are stimulated with spaced repetitions--not only is the instructional communication stored, but the learner is given time to code the information, to organize, to internalize. Few studies have examined the differential effects of massed vs. spaced repetitions and none have maintained the conditions specified in this study. The significance of spaced repetitions is generally consistent, however, with the results reported by Reynolds and Glaser (1964), by Sassenrath and Spartz (1972), and by Gay (1973) --all of whom focused on meaningfully related material although days provided the unit for intervals between repetitions. Indeed, the temporal conditions may be more important than the structure of the repetitions or the initial instruction.

As the measure of retention from the television programs was administered under a short-term recall condition, the results would seem to contradict the conclusions of earlier studies on massed vs. spaced practice:

> Massed practice is more effective for the <u>immediate</u> retention of meaningfully learned materials (probably because of reminiscence), but distributed practice is superior when <u>delayed</u> tests of retention are administered... (Ausubel, 1968, p. 292).

But spaced repetition within an instructional communication allows for 1) increased <u>covert practice</u> between repetitions--a "rehearsal buffer" for coding and retrieval (Gagné, 1971, p. 28), a longer time for the memory trace of information to be in storage (Murdock, 1971); and 2) increased mediation between repetitions--"to integrate the changes which learning brings about," (Friedman, 1969, p. 448), more "inspection behaviors," (Reid, 1971, p. 186), "superior consolidating and sensitizing," (Gay, 1973, p. 172), "elaboration and transformation of stimulus inputs," (Labouvie, Frohring, Baltes, and Goulet, 1973, p. 196).

IMPLICATIONS FOR EDUCATIONAL TECHNOLOGY: NATURAL ORGANIZATION AND EDUCATIONAL SIMULATION

In the blossoming (or burgeoning) field of educational technology which generates reproducible instructional materials that can be tightly structured for repetitions to optimize learning, the use of repetitions would seem in order. The use of spacing between repetitions would seem to be better for short-term retention than the use of massing.

The theoretical explanation for the benefit of spaced repetitions is in harmony with the model of natural organization developed by Braham (1971). Braham's model may parallel the stages of learning as "learning is the operative means for the 'complexification' of human consciousness " (Braham, 1971, p. 180). Education and educational technology as the "intentional organization of learning " should be optimized with intentionally structured repetitions and with intentionally structured intervals between repetitions. The process of education--the teaching and the learning--proceed from initiation (such as initial communication), to differentiation (giving meaning to a message or communication), to relation (coding--"ideas cannot even be utilized, tested or thrown into fresh combinations until they have become part of his cognitive organization " (Braham, 1971, p. 202), to investigation (processing of information), to the higher phases of concentration and transformation, to transition to another cycle. The focus of spaced repetitions would seem to be after initiation and before transition--in the processes of relating and integrating primarily.

Retreating to the initiation phase, the EDSIM conceptual model (Mitchell, 1972) charts motivation, attention, and self-management as factors influencing instructional impact, but for any instructional unit, specified probabilities of student activities may be altered by the set of instructional communications received. Thus, it is understood that the "student has differential motivation for the mathemata" (from Greek to denote things learned), but that "he must also attend and respond before instructional communications can induce a change in his capability." (Mitchell, 1972, pp. 4, 5). It is further claimed that such attention is a linear function of the number of repetitions of instructional communications. The results of this study suggest that such attention may be influenced by temporal conditions of repetitions. Although a single instructional unit may succeed in teaching a certain mathematom, an "unlearned mathematom may undergo a transition to the learned state " (Mitchell, 1972, p. 8) if intentionally structured repetitions are spaced within the instructional communications executed by the teacher. The incorporation of such repetitions would seem to increase the possibility of learning a specified mathematom. It is also possible that spacing of repetitions may decrease the number of repetitions required in order to reach the "learned state...at the end of an instructional unit" (Mitchell, 1972, p. 8).

Conclusion and Summary

The ANOVA and Newman-Keuls analysis of experimental data yielded the following results based on measures of retention: spaced repetitions of instructional units produced superior results to massed repetitions or summaries; all repetitions produced superior results to an instructional communication without repetitions and to no instruction at all (classic control).

For program and control groups, df = 484, s_w^2 = 23.31, F = 55.94 (p less than .01), $s_{\bar{x}}$ = 0.49, and all repetition means were significantly greater (p less than .01) than CONTROL or SIMPLE means. For combined repetition blocks, SIMPLE, and CONTROL groups, df = 484, s_w^2 = 14.36, F = 93.91 (p less than .01), $s_{\bar{x}}$ = 0.39, all repetitions were significantly greater (p less than .01) than CONTROL or SIMPLE means, spaced repetition means were significantly greater (p less than .05) than summary means, and approached significance over massed repetitions. For combined repetition blocks, df = 290, s_w^2 = 13.46, F = 3.40 (p less than .05), $s_{\bar{x}}$ = 0.37, and spaced repetition means were significantly greater (p less than .05) than massed repetition means and summary means.

The results indicate no significant or substantial difference between the type of repetition designated as summary and that designated as massed repetition. By operationalizing spaced repetitions with inter-repetition intervals of seven seconds, a clear divergence from the domain of massed repetitions was achieved, and a significant increment in measured learning was achieved.

Appendix A

Program Scripts

REPETITIONS OF INSTRUCTIONAL UNITS

There were a total of fifteen repetition groups or related concepts with the first five (1-5) appearing in section I of each program, the second five (6-10) in section II of each program, and the third five (11-15) in section III of each program. Each concept was composed of three related instructional statements or units, each unit constituting a single repetition of information contained within each program. The repetitions numbered and lettered below are written in the form corresponding to the actual lettering used in the information keying techniques; e.g., "2 1/2" instead of "two and a half" may begin a sentence. The numbers and letters assigned to each repetition group did not appear on the graphics used for keying. Each instructional group, though conceptually identified below after the group number, was not identified per se 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 to 8,000 forest fires yearly in Canada.
   b. Forest fires burn more than 2 million acres of 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 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 water bombing.
   c. Prevention is the most effective method of fighting fires.

6. Characteristics of lighting 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 shot number for both video and audio portions; if the shot number is level with a blank audio portion, then there was no sound for the duration of the corresponding video portion. Shots were sequentially numbered in program 1, but in programs II, III, and IV, 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 repetition groups. In the particular case of spaced repetitions, a lower case letter following the treatment number was used to designate a change in video shots. However, the number and lower case letter used in conjunction with the letters "SR" indicate the repetition group number and the particular instructional statement that was repeated. For example, T1c, the shot following shot number T1b in the script for program IV, means the treatment was still the first one for the program and the repetitions were from group one; but SR1b specifies further that the particular statement that was repeated came from statement "b" in group "1".

The letter "C" followed by an arabic numeral designates the camera number; e.g., C1 is read as camera one. The conventional symbols 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 causes the image of one camera to cut into the image of another. In production of programs II, III and IV 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" described by Zettl (1961, p. 200). 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; video images for treatments are identified by numbers and letters to designate the repetition(s) which appeared over the image described in parentheses after TC. In program II, for example, shot number five of graphic number one identified as MR1 keyed into the telecine image, means that the repetitions from group 1 appeared over the image of a crowded forest while the presenter read the corresponding audio passage.

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 repetition considered as experimental treatments. Specific content and phraseology for video and audio portions were constant throughout programs II, III, and IV. Program I differed substantially from programs II, III, and IV to the extent that experimental repetitions present in the latter were absent from the former.

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

PROGRAM I: 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 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

Video.	Audio.
	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, 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

Video.	Audio.
	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.
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 look-out towers, bulldozers, and water-bombing airplanes, and thousands of men risk their lives fighting forest fires.

	Video	Audio
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 of 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) ZOOM IN TO CU (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 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 dead-fall. This is the litter caused by dead leaves, branches, plants and trees. Then there's underbrush caused by the growth of small plants,

Video.	Audio.
	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
27. C2 MS (presenter) KEYED INTO TC (bark beetle)	insects, such as the bark beetle, attack the big 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

Video	Audio
	after a small fire.
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, 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

Video.	Audio.
	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) ZOOM IN TO CU (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. 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.
43. C3 CU (presenter)	Nowadays, we're beginning to follow the experience of the Indians. We know that the forest's 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.

	Video	Audio
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's 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
47.	C1 (graphic, man and drip torch)	embers, the most modern method is to use the 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.
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

Video.	Audio.
	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. 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 simply that 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.

Video.	Audio.
58. VTR (boy walking through forest)	MUSIC
59. C1 (production credit) KEYED INTO TC (forest and sunlight)	

PROGRAM II: MR-SUM-SR

	Video.	Audio.
1.	Same	Same
2.	Same	Same
3.	Same	Same
4.	Same	Same
T1.	C1 (graphic, MR1) 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, MR2) KEYED INTO TC (burned forest)	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 (burned forest)	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, MR3) KEYED INTO TC (burned forest)	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, MR4)	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, MR5) 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
22.	Same	Same
23.	C1 (graphic, lightning)	Same
24.	C2 CU (presenter)	Same
25.	Same	Same
26.	Same	Same

	Video.	Audio.
27.	Same	Same
28.	Same	Same
29.	Same	Same
30.	Same	Same
31.	C3 MS (presenter)	Same
32	C3 MS (presenter)	Same
33.	TC (forest and sunlight)	Same
34.	Same	Same
35.	Same	Same
36.	Same	Same
37.	TC (birds on shore)	Same
T6.	C1 (graphic, SUM6) KEYED INTO TC (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.
T7.	C3 (graphic, SUM7) KEYED INTO TC (forest)	Deadfall and underbrush serve as fuel for fires. Underbrush robs large trees of nourishment. Insects attack and weaken large trees.
T8.	C1 (graphic, SUM8) KEYED INTO TC (forest)	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.
T9.	C3 (graphic, SUM9) KEYED INTO TC (forest)	The mineral content of the soil increases after small fires. Small fires create open spaces. Small fires clear off litter from the surface floor.

	Video.	Audio.
T10.	C1 (graphic, SUM10) KEYED INTO TC (forest)	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
T11a.	C1 (graphic, SR11a) KEYED INTO TC (jungle forest)	Early man used fires to clear lands for hunting and grazing.
T11b.	TC (jungle forest)	PAUSE FOR SEVEN SECONDS
T11c.	C3 (graphic, SR11b) KEYED INTO TC (jungle forest)	Early man used fires to clear areas for home building.
T11d.	TC (jungle forest)	PAUSE FOR SEVEN SECONDS
T11e.	C1 (graphic, SR11c) KEYED INTO TC (jungle forest)	Early man used fires to create fields for planting.
41.	Same	Same
T12a.	C1 (graphic, SR12a) KEYED INTO TC (jungle forest)	Ashes from fire served as fertilizer.
T12b.	TC (jungle forest)	PAUSE FOR SEVEN SECONDS
T12c.	C3 (graphic, SR12b) KEYED INTO TC (jungle forest)	Fire eliminated weeds and competing plants.
T12d.	TC (jungle forest)	PAUSE FOR SEVEN SECONDS
T12e.	C1 (graphic, SR12c) KEYED INTO TC (jungle forest)	Fire promoted the flowering of chia a seed producing plant.
42.	TC (jungle forest)	Same
43.	Same	Same

	Video.	Audio.
44.	Same	Same
45.	Same	Same
T13a.	C1 (graphic, SR13a) KEYED INTO TC (forest)	The area should be damp when starting a controlled burn.
T13b.	TC (forest)	PAUSE FOR SEVEN SECONDS
T13c.	C3 (graphic, SR13b) KEYED INTO TC (forest)	For controlled burning the wind should be calm.
T13d.	TC (forest)	PAUSE FOR SEVEN SECONDS
T13e.	C1 (graphic, SR13c) KEYED INTO TC (forest)	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
51.	Same	Same
52.	Same	Same
53.	Same	Same
T14a.	C1 (graphic, SR14a) KEYED INTO TC (forest and litter)	Valleys and hills are burned from the top down.
T14b.	TC (forest and litter)	PAUSE FOR SEVEN SECONDS
T14c.	C3 (graphic, SR14b) KEYED INTO TC (forest and litter)	Open areas are burned from natural boundaries such as roads and streams
T14d.	TC (forest and litter)	PAUSE FOR SEVEN SECONDS
T14e.	C1 (graphic, SR14c) KEYED INTO TC (forest and litter)	The drip torch method, using a mixture of gas and oil which sticks to vegetation, makes burning more effective.

	Video.	Audio.
54.	TC (forest and litter)	Same
55.	C3 CU (presenter)	Same
T15a.	C1 (graphic, SR15a) KEYED INTO TC (dark forest)	Controlled burning restricts build up of deadfall and underbrush.
T15b.	TC (dark forest)	PAUSE FOR SEVEN SECONDS
T15c.	C3 (graphic, SR15b) KEYED INTO TC (dark forest)	Controlled burning clears areas for birds and animals to live in.
T15d.	TC (dark forest)	PAUSE FOR SEVEN SECONDS
T15e.	C1 (graphic, SR15c) KEYED INTO TC (dark forest)	Controlled burning increases the mineral content of the soil.
56.	Same	Same
57.	Same	Same
58.	Same	Same
59.	Same	Same

PROGRAM III - SUM-SR-MR

	Video.	Audio.
1.	Same	Same
2.	Same	Same
3.	Same	Same
4.	Same	Same
5.	Same	Same
6.	TC (burned forest)	Same
7.	Same	Same
8.	Same	Same

	Video.	Audio.
9.	Same	Same
10.	Same	Same
11.	Same	Same
12.	C3 CU (presenter)	Same
13.	Same	Same
14.	Same	Same
15.	C1 (graphic, carelessness)	Same
16.	C3 CU (presenter)	Same
17.	Same	Same
18.	Same	Same
19.	Same	Same
20.	C3 CU (presenter)	Same
T1.	C1 (graphic, SUM1) KEYED INTO TC (burned 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.
T2.	C3 (graphic, SUM2) KEYED INTO TC (burned forest)	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.
T3.	C1 (graphic, SUM3) KEYED INTO TC (burned forest)	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.
T4.	C3 (graphic, SUM4) KEYED INTO TC (burned forest)	Over seventy-five percent of all forest fires are started by man. Thirty-four percent of man caused

Video.	Audio.
	fires result from carlessness. Some man caused fires result from railway and forest industry accidents; others are set for wilful destruction.
T5. C1 (graphic, SUM5) 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
22. Same	Same
23. C1 (graphic, lightning)	Same
T6a. C3 (graphic, SR6a) KEYED INTO TC (forest)	Twenty-five percent of all forest fires are started by lightning.
T6b. TC (forest)	PAUSE FOR SEVEN SECONDS
T6c. C1 (graphic, SR6b) KEYED INTO TC (forest)	Lightning fires usually occur during the presence of rain.
T6d. TC (forest)	PAUSE FOR SEVEN SECONDS
T6e. C3 (graphic, SR6c) KEYED INTO TC (forest)	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
T7a. C1 (graphic, SR7a) KEYED INTO TC (forest and litter)	Deadfall and underbrush serve as fuel for fires.

	Video	Audio
T7b.	TC (forest and litter)	PAUSE FOR SEVEN SECONDS
T7c.	C3 (graphic, SR7b) KEYED INTO TC (forest and litter)	Underbrush robs large trees of nourishment
T7d.	TC (forest and litter)	PAUSE FOR SEVEN SECONDS
T7e.	C1 (graphic, SR7c) KEYED INTO TC (forest and litter)	Insects attack and weaken large trees.
29.	Same	Same
30.	Same	Same
T8a.	C1 (graphic, SR8a) KEYED INTO TC (forest and sunlight)	Litter and underbrush accumulate less in a regularly burned forest.
T8b.	TC (forest and sunlight)	PAUSE FOR SEVEN SECONDS
T8c.	C3 (graphic, SR8b) KEYED INTO TC (forest and sunlight)	Insects that attack trees are killed off in a regularly burned forest.
T8d.	TC (forest and sunlight)	PAUSE FOR SEVEN SECONDS
T8e.	C1 (graphic, SR8c) KEYED INTO TC (forest and sunlight)	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
T9a.	C1 (graphic, SR9a) KEYED INTO TC (forest and sunlight)	The mineral content of the soil increases after small fires.
T9b.	TC (forest and sunlight)	PAUSE FOR SEVEN SECONDS
T9c.	C3 (graphic, SR9b) KEYED INTO TC (forest and sunlight)	Small fires create open spaces.
T9d.	TC (forest and sunlight)	PAUSE FOR SEVEN SECONDS

	Video	Audio
T9e.	C1 (graphic, SR9c) KEYED INTO TC (forest and sunlight)	Small fires clear off litter from the surface floor.
34.	Same	Same
35.	Same	Same
36.	Same	Same
37.	TC (birds on shore)	Same
T10a.	C1 (graphic, SR10a) KEYED INTO TC (birds on shore)	Two and a half times as many deer live in a regularly burned area.
T10b.	TC (birds on shore)	PAUSE FOR SEVEN SECONDS
T10c.	C3 (graphic, SR10b) KEYED INTO TC (birds on shore)	Game birds are unable to find when litter is deeper than six inches.
T10d.	TC (birds on shore)	PAUSE FOR SEVEN SECONDS
T10e.	C1 (graphic, SR10c) KEYED INTO TC (birds on shore)	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, MR11) KEYED INTO TC (jungle forest)	Early man used fires to clear land 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, MR12) KEYED INTO TC (jungle forest)	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

	Video	Audio
43.	Same	Same
44.	Same	Same
45.	Same	Same
T13.	C1 (graphic, MR13) KEYED INTO TC (forest)	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
51.	Same	Same
52.	Same	Same
53.	Same	Same
T14.	C1 (graphic, MR14) 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, MR15) KEYED INTO TC (dark 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

Video.	Audio.
58. Same	Same
59. Same	Same

PROGRAM IV: SR-MR-SUM

Video.	Audio.
1. Same	Same
2. Same	Same
3. Same	Same
4. Same	Same
T1a. C1 (graphic, SR1a) KEYED INTO TC (crowded forest)	The forest industry employs over three hundred thousand people.
T1b. TC (crowded forest)	PAUSE FOR SEVEN SECONDS
T1c. C3 (graphic, SR1b) KEYED INTO TC (crowded forest)	Twenty percent of Canada's exports are forest products.
T1d. TC (crowded forest)	PAUSE FOR SEVEN SECONDS
T1e. C1 (graphic, SR1c) KEYED INTO TC (crowded forest)	Fifty percent of Canada's land mass is covered by forests.
5. Same	Same
T2a. C1 (graphic, SR2a) KEYED INTO TC (burned forest)	There are six to eight thousand forest fires yearly in Canada.
T2b. TC (burned forest)	PAUSE FOR SEVEN SECONDS
T2c. C3 (graphic, SR2b) KEYED INTO TC (burned forest)	Forest fires burn more than two million acres or ten percent of all productive land.
T2d. TC (burned forest)	PAUSE FOR SEVEN SECONDS

	Video.	Audio.
T2e.	C1 (graphic, SR2c) KEYED INTO TC (burned forest)	Over eighteen million dollars worth of trees are lost yearly through forest fires.
6.	TC (burned forest)	Same
7.	Same	Same
8.	Same	Same
9.	Same	Same
10.	Same	Same
11.	Same	Same
12.	C3 CU (presenter)	Same
T3a.	C1 (graphic, SR3a) KEYED INTO TC (burned forest)	A ground fire smoulders and burns beneath the surface.
T3b.	TC (burned forest)	PAUSE FOR SEVEN SECONDS
T3c.	C3 (graphic, SR3b) KEYED INTO TC (burned forest)	A surface fire starts and burns on the surface.
T3d.	TC (burned forest)	PAUSE FOR SEVEN SECONDS
T3e.	C1 (graphic, SR3c) KEYED INTO TC (burned forest)	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
T4a.	C1 (graphic, SR4a) KEYED INTO TC (burned forest)	Over seventy-five percent of all forest fires are started by man.
T4b.	TC (burned forest)	PAUSE FOR SEVEN SECONDS

	Video.	Audio.
T4c.	C3 (graphic, SR4b) KEYED INTO TC (burned forest)	Thirty-four percent of man caused fires result from carelessness.
T4d.	TC (burned forest)	PAUSE FOR SEVEN SECONDS
T4e.	C1 (graphic, SR4c) KEYED INTO TC (burned forest)	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
T5a.	C1 (graphic, SR5a) KEYED INTO TC (burned forest)	Canada spends over eighteen million dollars a year to fight fires.
T5b.	TC (burned forest)	PAUSE FOR SEVEN SECONDS
T5c.	C3 (graphic, SR5b) KEYED INTO TC (burned forest)	Money is spent on lookout towers, bulldozers, and water bombing.
T5d.	TC (burned forest)	PAUSE FOR SEVEN SECONDS.
T5e.	C1 (graphic, SR5c) KEYED INTO TC (burned forest)	Prevention is the most effective method of fighting fires.
21.	Same	Same
22.	Same	Same
23.	C1 (graphic, lighting)	Same
T6.	C3 (graphic, MR6) KEYED INTO TC (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.

	Video.	Audio.
24.	C2 CU (presenter)	Same
25.	Same	Same
26.	Same	Same
27.	Same	Same
28.	Same	Same
T7.	C1 (graphic, MR7) KEYED INTO TC (forest and litter)	Deadfall and underbrush serve as fuel for fires. Underbrush robs large trees of nourishment. Insects attack and weaken large trees.
29.	Same	Same
30.	Same	Same
T8.	C1 (graphic, MR8) KEYED INTO TC (forest and sunlight)	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 strenghened in a regularly burned forest.
31.	C3 MS (presenter)	Same
32.	C3 MS (presenter)	Same
33.	TC (forest and sunlight)	Same
T9.	C1 (graphic, MR9) KEYED INTO TC TC (forest with light)	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.	Same	Same

	Video.	Audio.
37.	TC (birds on shore)	Same
T10.	C1 (graphic, NR10) 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.	C4 MS (presenter)	Same
41.	Same	Same
42.	TC (jungle forest)	Same
43.	Same	Same
44.	Same	Same
45.	Same	Same
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
54.	TC (forest and litter)	Same
55.	C3 CU (presenter)	Same
T11.	C1 (graphic, SUN11) KEYED INTO TC (forest and sunlight)	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.

	Video.	Audio.
T12.	C3 (graphic, SUM12) KEYED INTO TC (forest and sunlight)	Ashes from fire served as fertilizer. Fire eliminated weeds and competing plants. Fire promoted the flowering of chia, a seed producing plant.
T13.	C1 (graphic, SUM13) KEYED INTO TC (forest and sunlight)	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.
T14.	C3 (graphic, SUM14) KEYED INTO TC (forest and sunlight)	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.
T15.	C1 (graphic, SUM15) 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

APPENDIX B

TABLE 9

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).

Appendix C

Final Questionnaire

SAMPLE 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 forests 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 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. lighting
_____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 it destroyed at least 30 homes. The area the fire was started in was timber try. 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

HOW OLD ARE YOU ? ______________

WHAT GRADE ARE YOU IN? __________

SEX: __________ MALE

__________ FEMALE

WHAT IS YOUR FATHER'S OCCUPATION OR THE OCCUPATION OF THE HEAD OF YOUR HOUSEHOLD?

____

DO YOU HAVE A TELEVISION SET IN YOUR HOME?

NO _____

YES _____ BLACK & WHITE __________

COLOUR? __________

THE END

TABLE 10

Item Analysis for Final Questionnaire

Item[a]	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	11.00
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 program; items 9-16 and 26 to section II; and items 17-24 and 27 to section III.

TABLE 11

K-R Reliability for Final Questionnaire

S^{a}	Variance Unit Score (X)	$X-\bar{X}$	$(X-\bar{X})^2$	S	Variance Unit Score (X)	$X-\bar{X}$	$(X-\bar{X})^2$	Item[b]	K-R Unit p_i[c]	q_i[d]	$(p_i)(q_i)$	Item	K-R Unit p_i	q_i	$(p_i)(q_i)$
1	21	9.167	84.034	16	13	1.167	1.362	1	.533	.466	.249	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	23.358	19	18	6.167	38.032	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:

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

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

$= \sigma^2 =$ unbiased estimate

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

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

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

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

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

[a]Subjects were randomly numbered.

[b]Items 1-8 and 25 related to section I of program; 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.

TABLE 12

Demographic and Media Accessibility Data[a]

Response	Group					
	I	II	III	IV	CONTROL	TOTAL
			Age			
11	3.1	9.3	6.2	6.2	4.1	5.8
12	74.2	78.4	85.6	77.3	78.4	78.8
13	20.6	12.4	7.2	14.4	16.6	14.2
14	2.1	0.0	1.0	2.1	1.0	1.2
			Sex			
Male	50.5	48.5	47.4	35.1	59.8	48.2
Female	49.5	51.5	52.6	64.9	40.2	51.8
			Home Environment[b]			
NR	6.2	3.1	0.0	0.0	1.0	2.1
Prof	29.9	58.8	56.7	61.9	46.4	50.7
W Collar	24.7	21.6	32.0	26.8	24.7	26.0
B Collar	39.2	16.5	11.3	11.3	27.8	21.2
			Type of Television set in home[c]			
NA	0.0	0.0	0.0	1.0	0.0	0.2%
B and W	56.7	51.5	51.5	50.5	53.6	52.8
Colour	17.5	19.6	34.0	32.0	21.6	24.9
Both	25.8	28.9	14.4	16.5	24.7	22.1

[a]The reported indices are in percentiles for each group (I, II, III, IV, and CONTROL) with n equal to 97 (100%) and for the total group of subjects with N equal to 485 (100%).

[b]Responses to the question about occupation of the head of the household were categorized as follows: NR, no response; Prof, professional, managerial, and technical occupations; W Collar, clerical, sales, and service; B Collar, farming, fishing, forestry, processing, machine, trades, bench work, structural work, miners, loggers, craftsmen, production process, labourers, etc.

[c]Only one subject indicated there was no television set in the home. Responses were coded as follows: NA, not applicable; B and W, black and white television; Colour, colour television; Both, black and white and colour televisions in the home.

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