THE EFFECTS OF PROJECTED AND PRINTED VIEWING GUIDES ON LEARNING IN TAPE-SLIDE INSTRUCTIONAL COMMUNICATION

by

Dominic G. L. Perri

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ABSTRACT

Dominic G. L. Perri

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A tape-slide presentation was produced by the investigator and administered in three conditions to a sample of 93 senior high school students. The first group viewed the presentation with the aid of a projected guide, the second group with the aid of a printed guide made up of exactly the same content material and format as the projected guide, and the third group viewed the presentation with no guide. The three groups were pretested for initial differences in prior knowledge. The groups were found to be equivalent on this dimension. A pretest-posttest control group design was used. Analysis of covariance, using the pretest as a predictor and the posttest as the dependent variable, revealed no significant interactions. Sex was not a significant factor. The main effect for viewing conditions was significant, $F(2,86) = 18.54$, $p < .01$. Scheffé analysis (.01) conducted across this factor revealed a significant difference between the projected guide condition and the other conditions. The control group and the printed guide condition were not different. Lastly, a questionnaire designed to measure viewers' attitude revealed that the majority of subjects were generally favourable to the projected guide. Thus, when a tape-slide presentation is used in instructional communication, a projected guide seems to be a more effective adjunct activity than a printed guide.

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CHAPTER 1

Introduction

With the ever-increasing budgetary restrictions placed on schools, tape-slide instructional aids have become increasingly popular as compared with videotapes or films. This new demand was soon felt by the various organizations in the education field and, as a result, there are now several topics on the market in different subject areas, commercially produced in the form of tape-slides. Radio-Québec, for example, developed a complete high school course in basic electricity in the form of tape-slides.

In an effort to maximize the amount of learning that can occur as a result of this viewing, researchers have attempted to determine the optimum conditions that should accompany the viewing of tape-slide presentations. Such knowledge is of prime importance to those who plan, produce, or experience instructional communication. Examples of the main areas of investigation are: multi-images (Allen & Cooney, 1963; Card, 1966; Perrin, 1969a; Brydon, 1971; Tam & Reeve, 1971; Trohanis, 1975; Riggs, 1978) and the use of adjunct activities which might accompany a tape-slide presentation in the form of a) behavioural objectives (Engel, 1968; Loh, 1972; Olsen, 1972; Booth, 1973; Taylor, 1973; Duchastel & Gonzalez, 1974; Travers, 1977; Wingard, 1977; Main, 1979), and b) viewing guides (Gropper, 1966; Howe, 1970; Beisenherz, 1971; Fields, 1971; Lavin, 1971; O'Meara, 1975; Lang, 1977; Dayton, 1977; Lukas, 1979).

Multi-Image

Definition. Multi-image communication is the technique of presenting simultaneously two or more images appearing on a screen or on different screens placed side by side. Many labels have been used to describe this technique: multi-media, multi-screen, multiple-image, and non-linear projection.

Holt (1968) refered to the multi-image communication technique as multi-screen. However, in many instances the several images are projected on the same screen, making this definition inaccurate. Perrin (1969a) did not use the term multi-image, itself, but instead defined multiple-image as the result of projecting two or more separate but related pictures simultaneously on a large screen, or on two or more screens. Reid (1970) used the term multi-image to designate a display format allowing simultaneous projection of multiple, integral visual images on a single screen or a combination of screens. Lawson (1971) suggested that multi-image is the most appropriate nomenclature because it can be considered to indicate the use of more than one type of medium -- slides, films, filmstrips, or other projections. This definition overlaps the McLuhan (1964) concept of mixed-media, which suggests the combination of two or more visual communication media to reach a certain objective. Kinder (1973) pointed out an important distinction between multi-image and multi-media. He argued that the multi-image may involve two or more images projected by the same type of medium, whereas multi-media may involve more than one medium, as for example a slide projector and an overhead projector. Owens' (1975) definition of multi-image was very similar to Perrin's definition, but he did not specify whether the several images need to be related.

However, from the context of the different studies treating the subject, and especially the work of Perrin and Owens, it seems that multiple-images and multi-images may be considered the most appropriate synonyms for the projection of two simultaneous images on one or two screens placed side by side.

Versatility. One of the important advantages of multi-image communication is the flexibility of the visuals (Benedict, 1964). For example, visuals may be slides, transparencies, opaque projections, films, or any other type of projection. The presentation may employ the same visual format for all screens or any combination of the above. The same visual may be replicated, projected side by side several times, or held in view while different images from other projectors accumulate. Presentations may be arranged to present a developmental process or the whole sequence simultaneously (Benedict, 1964).

Other uses would include presenting a general concept on one screen, and developing details on another screen (Benedict, 1964). Perrin (1969a) has added other dimensions to multi-image, such as making comparisons, presenting dichotomies, differences, likenesses, or related questions and answers, or actions and reactions. Visuals may be black and white, or colour. They may be photographs and maps, or they may be digital, i.e. words and numbers (Levie & Dickie, 1973). Projections can be front-screen or rear-screen and audio can be live or tape-recorded.

Multi-image presentations using slides exclusively are particularly useful in presenting examples of concrete realistic objects and diagrams (Levie, 1973). They are also well suited for promoting visual identification and when dealing with the difficult areas regarding attitudes, opinions and values (Atkins, 1974). Slides are available longer than the spoken word, or a frame of film, thereby enabling the instructor to control the amount of exposure for questions and discussion (Levie, 1973). Printed textual slides have a particular advantage for presenting outline material, emphasizing terminology, and classifying and inserting questions to act as stimulators and motivators (Kemp, 1968).

Theory. Upon what rationale, principle, or theory are multi-image presentations constructed? Perrin (1969b) reported that producers have designed multi-image presentations with remarkable skill but they have not verbalized an underlying theory. However, from the body of existing knowledge, he concluded that one of the three major factors which distinguishes multi-image from conventional use of media is the use of simultaneous images. The other two factors are screen size and information density. He expanded by saying that in sequential montage, or single-image presentation, the meaning of each new image is determined by the context of what preceded it, just as in verbal language the several elements in a series determine the total meaning. However, in multi-image presentations viewers make their own montage of the different image elements, allowing them not only to process larger amounts of information in a shorter period of time, but also increasing the probability of learning comparative elements. To that effect, he goes on to quote Millard (1964) to describe several classroom situations where comparisons using multi-images would be advantageous.

> The multiple-image technique enables the teacher to make comparisons, to illustrate the development of interrelated concepts, show relationships, and to otherwise combine the capability of several photographic aids either simultaneously or in some programmed pattern or sequence for instructional purposes.
>
> Using multi-images, we can effectively treat comparisons of physical, geographical, environmental, dimensional, and spatial characteristics of objects, and events. Dichotomies, alternatives, differences, likenesses, and many other forms of comparison can likewise be efficiently handled by this method (Perrin, 1969b, p. 369).

Other users of multi-images have claimed various advantages, including reduced time for the presentation of an idea, and significant increase in learning (Hubbard, 1961; Trohanis, 1971). Lawson (1971, p. 59) expressed the view that "we can learn many different things from many sources at the same time". But that viewpoint is empirically unsound (Goldstein, 1975). As Hartman (1961b) has demonstrated, interference may occur when multi-channel information is simultaneously presented: for example, a visual display with an unrelated aural description or explanation. Travers (1966) concluded from different studies that multi-sensory modality inputs are likely to succeed only when the information input is presented at such a low rate that the learner can switch from channel to channel. That is to say, a viewer may follow two distinct information inputs only if they are presented to him at such a slow pace that he can switch his attention from one input to the other without being confused. The combination of two or more images seems to increase the complexity, thus increasing the visual task. Apparently, the relevance of the selected images and sounds and the way in which they are organized is of crucial importance. As a result, the biggest difficulty in multi-image presentations is how to exploit its potential.

To help overcome this problem, Carpenter (1953) has suggested that the patterns of stimuli, pictures and sounds be arranged so that all the elements are integrated and mutually reinforcing for the intentional learning outcome. In doing so, one should make sure that interference between channels does not occur. Indeed, Twyford (1969) suggested that it may not be the visual format for the increased learning that some multi-image studies have demonstrated, but rather the careful organization and presentation of the instructional content may be the greatest contributing factors.

Finally, Jonassen (1979) pointed out quite clearly that multi-image is not a medium, but is just a communication technique which has the potential for manipulating visual perception and, consequently, concept acquisition. He suggested that rather than approaching a subject only in terms of single-image presentation versus multi-image presentation, one should consider how simultaneous images can best be structured to facilitate specific types of learning behaviour. Multi-image communication does not possess implicit symbolic codes and, for this reason, the structuring of multi-image presentations should be designed by using established cognitive strategies based on existing theory.

In summary, there seems to be little theory verbalized about multi-image presentations. Perrin (1969b) was the first investigator to determine some factors distinguishing multi-image presentations from the conventional use of media. One factor is simultaneous images, which allow the viewer to make his own montage; that, according to Perrin (1969b), increases the probability of learning comparative elements and processing larger amounts of information in a shorter period of time.

There are other claims favouring multi-images, but there is relatively little research to support these claims (Bollman, 1971; Brydon, 1971; Kilmartin, 1969; Lombard, 1969). There is evidence demonstrating that if the visuals are not carefully organized, multi-images may have a detrimental effect on learning. It is suggested, therefore, that multi-image presentations be constructed based on established learning theory and instructional strategies, since multi-images are a communication technique, and not a medium with implicit symbolic codes (Jonassen, 1979). One such strategy which has achieved attention is the use of adjunct activities to supplement and improve the effectiveness of multi-image presentations.

Adjunct Activities

The literature of instructional design (Carpenter, 1957; Dale, 1964; Gagné, 1970; Kemp, 1980) suggests that one way to promote learning is to increase the learner's participation. One means of achieving that in visual presentations is to provide an adjunct activity which encourages the viewer to interact with the presented material by having him answer questions or read supplemental material accompanying the visual presentation. In addition, Travers (1977) has suggested that this participation can be initiated by letting the viewer know in advance just what he is expected to look for or to attend to. This guidance can be provided by supplementing the visual presentation with an adjunct activity in the form of a viewing guide. The viewer may be told what to look for in the presentation either by behavioural objectives (Mager, 1962; Gronlund, 1970), or advance organizers (Ausubel, Novak & Hanesian, 1978; Ally, 1980).

Behavioural objectives tell the viewer what to do in order to reach a prescribed learning outcome or mastery level. The advance organizer relates the new material with existing cognitive structures. However, as Ally (1980) pointed out, advance organizers may not always be effective, as when, for example, the viewer uses his prior knowledge in the learning process.

The importance of active participation has also been underlined by Rothkopf (1966); he calls it mathemagenic behaviour, i.e. behaviour giving birth to learning. The theory here is that student behaviour during the learning process will determine what is learned.

> When that behaviour is relatively passive, learning will probably not be as high as when that behaviour is relatively active and interacting in a meaningful way with the presented material (O'Meara, 1975, p. 53).

The difference between passive and active behaviour is involvement, i.e. the number of conscious bridging experiences or connections that the viewer makes with the presented stimulus (Krugman, 1970).

In sum, eliciting the viewer's participation is a cognitive strategy of crucial importance for visual presentations. Learning is activity. Seeing is activity. Perception is an activity. Thus, they should involve some form of activity during the presentation for effective learning (Kemp, 1980).

<u>Alternate Adjunct Activities</u>

While the information content of a picture is the major determinant of where we look, the pattern of eye movements can be influenced by what the observer is told to look for (Goldstein, 1975). If attention is directed by particular instructions so that the observer has some idea of what will be shown to him, or what to look for, he will perceive it more quickly and more accurately than if he has no such expectation (Vernon, 1971). Our perceptual system demands that an object be fixated if it is to be seen in detail. The more fixation a picture receives, the higher the probability that the picture will be remembered (Loftus, 1972).

O'Meara (1975) found that students who view visual presentations with the aid of behavioural objectives and an adjunct activity in the form of a printed viewing guide tend to retain more of the content of a visual presentation than students who view the same presentation without these aids. These findings confirmed Lavin's (1971) findings about the use of adjunct activities with audio-visual material. However, O'Meara emphasized that students should not be asked to do other things while viewing the presentation, since they have constantly to switch their attention from the projected stimulus to the printed stimulus of the viewing guide. He reported that although a high percentage of the students in his study responded favourably to the idea of a printed guide, they nevertheless objected, on the grounds that the fill-in section, during the viewing of the presentation, definitely tended to interfere with the proper viewing of the presentation.

A more effective way to direct attention seems to be a guide projected on a screen side by side with the presentation. Besides offering better viewing conditions and promoting spatial cuing, this guide becomes an integral part of the presentation. For example, a question is asked on the projected guide and the answer may be provided on the next slide of the presentation. This guide format also seems to conform with the theory advanced by Hebb (1966), who argued that attention is associated with psychological arousal during learning and a high-level arousal leads to better retention than a low-level arousal. An explanatory note appearing on the screen at the right instance, while the rest of the time the single-image presentation goes on without changes, seems to do just that: be more psychologically arousing than a single-image, thus improving the instructional effectiveness of the tape-slide presentation.

With such a viewing guide, a single-image presentation becomes a multi-image presentation (Perrin, 1969a; Levie & Dickie, 1973), or, if the original presentation was already a multi-image, its basic characteristics remain unchanged.

The present study utilized a single-image presentation with a projected guide; thus, it is considered an alternate form of multi-images.

Statement of the Problem

The main purpose of this study was to determine whether differences exist in the relative effectiveness of three tape-slide formats: standard format (control condition), standard format plus printed viewing guide, and standard format plus projected viewing guide, when prior knowledge of the presentation content is controlled.

CHAPTER 2

Literature Review

Multi-Image

Formal Instruction. Several attempts have been undertaken in the classroom setting or in formal situations to explore the efficacy of multi-image presentations as an integral part of instruction. In general, the users of multi-image claim various advantages, including reduced time for the presentation of an idea, and significant increases in learning (Hubbard, 1961; Perrin, 1969a; Lawson, 1971; Trohanis, 1971b), but there is little evidence to support these claims (Lombard, 1969; Bollman, 1971; Brydon, 1971).

Allen and Cooney (1963) compared the relative effects of learning from visual images presented simultaneously and sequentially. The immediate test results showed that, for sixth graders, mixed factual-conceptual content is better presented simultaneously, while straight factual material is better presented sequentially. However, the delayed test produced results inconsistent with this finding. They revealed no significant difference between the multi-image presentation format and the single-image format on mixed or unmixed content.

In a similar classroom setting, Lombard (1969) conducted another study, the results of which suggest that multi-image instruction can effectively transmit information. The study compared three-image and single-image versions of an eleventh grade history lesson. Although multi-image proved to be effective in transmitting information, the results were inconclusive because the sound track for two versions were similar, but not identical. The difference in the audio stimulus may have contributed to the positive multi-image findings.

Along the same lines, Tam and Reeve (1971) compared five tape-slide presentation formats. One mode used single-image and four modes used the multi-image technique--sequential accumulation of two and three images, and programmed accumulation of two and three images. About 150 tenth-grade subjects, randomly assigned to treatment groups, participated in the experiment. A two-part test was administered by the researcher. The first part dealt with the visuals to measure the students' comprehension of a map, and the second part dealt with the comprehension of the individual images. The results showed no significant differences in the effectiveness of the five modes of visual formats. However, the data from the first part of the test tended to favour the multi-image presentation.

Didcoct (1972) conducted a similar comparative study with students at college level, comparing cognitive and affective responses of the students to single-image and multi-images. He concluded that students preferred multi-image presentations, but no evidence of differential cognitive gain was found.

In a different learning setting, but also in formal instruction, Brydon (1971) experimented on blueprint readings with trainees at the Lockheed Corporation Training Department. One group experienced a triple-image version and the other a single-image version. Both programs were designed to transmit knowledge to the learners. Brydon discovered that the multi-image presentation was extremely effective; mean differences were statistically significant at the .01 level of confidence. The study, however, suffered in internal validity because the two presentations differed in running time and number of slides.

The review of the literature also revealed that there were some studies in which multi-image was used to achieve affective objectives. The results seem to be contradictory at times, as do the cognitive studies. Some of the major studies are reported in the following section.

Kappler (1967) reported that multi-images are most effective when used to communicate affective learning: "it certainly drives hardest at sensations and emotions" (p. 28). The same conclusion was reached by Reid (1970, p. 22) "among certain church audiences". However, these results were not confirmed by Riggs (1978), who compared the effect of multi-images versus single-image format on attitude change and affective responses of high school seniors. He designed an 18-minute slide presentation to persuade subjects not to smoke by illustrating the relationship between smoking and health. The results indicated that the multi-image presentation was no more effective than the single-image for influencing behaviour change. Perhaps Riggs overestimated the persuasive potential of an 18-minute presentation for changing such strong habitual and social behaviour.

So far, the studies reported have employed picture illustration or other iconic material as the primary visual content. However, slides have the potential for conveying digital information, e.g. words, numbers, as well as pictorial information. Kemp (1968) maintained that printed textual slides have a particular advantage in presenting outline material, emphasizing terminology, and classifying and inserting questions to act as stimulators and motivators. Three studies using projected digital information are reported here. Although they differ from the previous multi-image studies, they are noteworthy because they laid the foundations for a new aspect of the multi-image presentation. They did not use multi-images, but simply single-image presentations. However, whatever principle or theory works for one channel of a visual presentation can possibly be adapted to the other channel(s) of a multi-image presentation.

The first study was conducted by Tanner (1975), who examined the difference in effectiveness between student performance on tests presented by means of slides and performance on standard print tests. The subjects participating in this study were all junior or senior elementary education majors enrolled in a basic instructional media course. The results showed that

> Projected slide tests appear to be effective in administering multiple-choice items without reducing student achievement scores when compared to conventional paper-pencil tests. In addition, the external pacing of projected slides did not have an adverse effect on student achievement scores (Tanner, 1975, p. 1457-A).

It seems possible, therefore, to test students viewing a visual presentation by the same means without adversely affecting their performance. It does not seem necessary to switch to paper-and-pencil tests to test the viewers of a tape-slide presentation. They can be tested by the same visual means without an adverse effect on achievement scores.

The second study recommended the use of questions in tape-slide presentations to increase intentional learning, and determined the following:

> If the intent of the designer of such presentations is to increase intentional learning, the use of such questions is recommended (Dayton, 1977, p. 4792-A).

The last study pursued Dayton's (1977) findings and concluded that "inserted post questions facilitated instructional learning without impairing intentional learning efficiency" (Schwier, 1980, p. 3714-A).

The results of these studies point to the possibility that digital information, interspersed or used in conjunction with iconic information, can enhance student learning from tape-slide productions. While these studies are not multi-image by design, they suggest an alternative multi-image format in which one screen is devoted to verbal accompaniments. The present study is designed to determine if such an arrangement can provide positive benefits over traditional tape-slide presentations.

Program Length. Allen (1970) suggested that instructional designers must somehow maximize student learning and retention for every minute of instructional programming. Previously, Hubbard (1961, p. 438) had reported that "a tape lecture of 50 minutes could be boiled down to 20 Telemation minutes with no loss of learning by students". Consequently, program length was further investigated by Lawson (1971), who suggested that the optimal length for multi-image instructional presentations should be between 20 and 25 minutes. Trohanis (1975) also pursued the topic of information learning and retention with multi-images and audio. In a classroom experiment he concluded that

> program length affects student subject matter learning and retention... the shorter instructional episodes were most efficient in retarding information loss which typically impairs the communication process (p. 411).

Following the recommendation of these investigators and, in particular, Lawson (1971), a 28-minute presentation was produced for this study.

Construction of Multi-Images. Jonassen (1979) pointed out that multi-image is not a medium and, therefore, presentations should be structured according to existing cognitive learning theory. He suggested that multi-image presentations have the potential for manipulating visual perception and, consequently, concept acquisition. In a study which Jonassen conducted to test whether a redundant instantiation format would improve concept attainment, he found that

> The mere addition of positive visual examples of class membership in a linear presentation sequence representing a summation of cues intrinsically does not improve concept acquisition despite the opportunity for simultaneous comparison of critical attributes. Evidently only a limited number of visual examples is required to form a class concept; it appears that most of the additional instantiation was redundant and therefore unnecessary for concept development.
> .... the suggestion by Perrin and others that comparison of like images is inherently advantageous needs to be questioned (Jonassen, 1979, p. 299).

Furthermore, the investigation showed that the multi-image presentation produced significant improvements in concept development over a simple-screen presentation when "each class of plants was assigned a single screen and examples of previously described classes were repeated simultaneously as a new class was illustrated" (Jonassen, 1979, p. 299). Jonassen attributed this improvement in memory to the use of spatial cuing. He presented each class of plants on a separate screen in a distinct position and spatial relationship to the other projected images. He concluded that viewers may have encoded this spatial information along with the concept, thus facilitating the retrieval of information. As a suggestion for further research, he recommended allocating one screen to a continuous presentation of the concept name, since associating the label with critical properties is an important principle of concept teaching.

The present study took into consideration the above findings and recommendation in the design of the multi-image presentation. First, the left screen always presented the projected guide. More specifically, the concept related to the adjacent iconic slide on the right screen was verbally codified, thus satisfying the spatial cuing as suggested by Jonassen (1979). Secondly, previously established concepts in the viewer's mind (Fleming & Levie, 1978) were used as analogies to explain some technical specifications more meaningfully. Thirdly, all technical specifications having similar characteristics were presented consecutively. Cahil and Hovland (1960) pointed out that the advantage of this form of presentation occurs because it reduces memory load. Forgetting apparently increases as the number of intervening instances increases.

Severin (1967) has proposed a theory of information transmission called cue summation, which "predicts that learning is increased as the number of available cues or stimuli is increased" (p. 237). He started out by considering the effects of redundant material and interference between channels. His findings agree with Travers (1964) that "there can be complete between-channel redundancy only when spoken and printed words are presented simultaneously" (Severin, 1967, p. 234). Similarly, van Mondfrans and Travers (1964) have argued that "the use of two sensory modalities has no advantage over one in the learning of material which is redundant across modalities" (p. 749). However, Card (1966) studied the learning of foreign vocabulary and found that learning could be facilitated by simultaneously displaying the word (digital) to be associated with the audio. Therefore, in certain specific instances of paired-associate tasks, redundancy between the audio channel and the digital display channel may be beneficial. On the other hand, when transmitting information simultaneously, if the cues of the second channel are not relevant to those in the first channel, there occurs an overall information loss. Travers (1964) pointed out that there has to be an optimal level between redundancy and interference. He went on to say that

> Redundancy can be cut to reduce the waste of time, cost, and effort in both teaching and learning. This will increase the information in a given channel within a specified time for maximum channel efficiency. On the other hand, when redundancy is reduced below some optimal

> level, depending upon noise conditions, it conversely increases errors (Travers, 1964, p. 242).

In the present study, redundancy and interference were controlled by reproducing in print a condensed summary of the most salient points in the narration and not the exact words of the audio. In addition, this guide format took into consideration the following conclusions reached by Severin (1967) on the basis of previous findings and existing theories. First,

> multichannel communications which combine words with related or relevant illustrations will provide the greatest gain because of summation of cues between channels (Severin, 1967, p. 243).

Secondly,

> multichannel communications which combine words in two channels (words aurally and visually in print) will not result in significantly greater gain than a single-channel communication since the added channel does not provide additional cues (Severin, 1967, p. 243).

However, he expanded this last conclusion by specifying that if the material presented is relatively difficult to the audience or exceeds the level of its literacy, a combined audio-print presentation would produce better results than a print presentation alone. That is precisely what Card (1966) found out.

Therefore, presenting a short statement as digital information in one channel and as audio in another channel seems to have some support. Furthermore, learning seems to be even more facilitated if a relevant illustration is simultaneously presented. The production should finally unfold by presenting the first idea or concept on the first slide, and as new ideas or concepts are developed, additional slides will add this information (McTeer, 1977).

Adjunct Activities

The bulk of research on adjunct activities emphasizes that initial orientation and interactive participation are two important factors in the viewing conditions needed for optimum learning from audio-visual material.

Initial Orientation. The initial orientation can be provided for the viewer either by behavioural objectives or by advance organizers (Ausubel, 1967, 1969; Duchastel & Merrill, 1973). Only selected literature from the extensive amount available will be reviewed in this section.

Behavioural objectives tell the viewer what to do in order to reach a specified learning outcome (Mager, 1962; Gronlund, 1970). Olsen (1972) designed an experiment to assess the effects of behavioural objectives on class achievement and retention. Eight experimental classes received instruction in physical science preceeded by stated behavioural objectives and six control classes received the same instruction without knowledge of the objectives. The results of the study indicated that

> providing classes and teachers with behavioural objectives prior to instruction can enhance the performance on achievement tests. Also the data strongly suggest that behavioural objectives and their accompanying assessment tests will cause a resistance to forgetting (Olsen, 1972, p. 224-A).

Similar results were obtained by Taylor (1973) and Wingard (1977), who concluded that providing objectives to students prior to presenting instructional material facilitated student performance. It also seems that the degree of precision stated in the behavioural objectives influences the learning outcome. Booth (1973) studied the effects of two types of instructional objectives on student achievement in a communication course and found that students provided with behavioural objectives scored higher on the achievement test than students provided with general objectives stated in non-behavioural terms.

Recently, Main (1979) investigated intentional and incidental learning resulting from the use of learning objectives with a selective audio-visual presentation and found that

> The use of learning objectives facilitated the learning of objective-relevant knowledge from a slide-tape presentation when the learning objectives were presented at the beginning of the program. Learning objectives used in this manner as "advance organizers" do not inhibit the acquisition of incidental (non-objective-relevant) information contained in the instructional program (Main, 1979, p. 4696-A).

In sum, the empirical evidence is quite clear about behavioural objectives: their use as introductory material enhances student performance on intentional learning without inhibiting incidental learning. The most important conclusion, perhaps, arising from the empirical studies is that behavioural objectives are not meant necessarily to be used by themselves, but rather might be used along with other stimuli or activities to help enhance learning (Sulzen, 1973).

Another way of providing initial organization is the use of advance organizers. (Ausubel, 1967, 1969) postulated that the presence of an advance organizer in an instructional unit will facilitate learning and retention. Many of his earlier findings have been confirmed in recent years, although there is also a body of studies indicating the ineffectiveness of advance organizers (Barnes & Clawson, 1975).

Kuhn and Novak (1971) compared an advance organizer with an introductory control passage. The advance organizer was an 800-word passage and an additional diagram on homeostasis, while the control introductory passage was of equal length, but treated the history of homeostasis. The results showed a significant difference in favour of the advance organizer. Similarly, West and Fensham (1976) used lessons on the principle of chemical equilibrium to investigate the advance organizer device. They reported the advance organizer as facilitating learning, especially for those students lacking prior knowledge.

Prior knowledge seems, in fact, to reduce the effect of the advance organizer. The same is true for the use of a spiral curriculum which presents and builds key concepts (Ally, 1980) one upon the other. Therefore, the use of advance organizers may be limited only to certain types of instruction. In the present study, the use of advance organizers may have proved of limited effectiveness because the experimental subjects may already have had some prior knowledge due to the popularity of the subject matter. Consequently, advanced organizers were not used like the behavioural objectives, but simply as introductory material for small concepts of the instructional unit.

Interactive Participation. Rothkopf (1970) has shown in his studies on mathemagenic behaviour that "what is learned depends largely on activities of the student" (p. 326). Numerous other studies have supported this underlying principle of learning. The following section will present some of them.

Howe (1970) conducted a study on note-taking strategies. He divided the subjects into three groups: summarizing professor, brief notes, and no notes at all. He found that those students who were allowed to review the material recalled significantly more items than those who were not allowed to review the material. Recall, however, was not affected by the instructions concerning note-taking strategy. On the other hand, Lavin (1971) indicated that the note-taking format does matter. He used three types of notes as adjunct study activities to film viewing. The viewers were exposed to blank outline notes, completed notes, and plain paper notes. This procedure was used for eight films. The results indicated that the first two types of notes were superior to the plain paper notes, and, interestingly enough, all three treatment groups were superior to the control group, which attended the film without the use of any aids. This study shows the importance of the learner's participation in an audio-visual presentation.

There are several other studies which underline the importance of the viewer's participation (Krugman, 1970; Beisenherz, 1971; Fields, 1971; O'Meara, 1975; Kemp, 1980) but most of them deal with film, not tape-slide presentations. There are no indications that this type of activity is more valid for the viewing of moving images than for still images. Lukas (1979) seemed to confirm this when he concluded that

> A well-designed and properly functioning multi-image projection system in conjunction with well-designed software and an independent student response system can be used as an effective instructional tool (p. 622-A).

One must take into account, however, the perception of images in the design of a multi-image presentation.

Perception and the Use of Adjunct Activities

The physical make-up of a picture is the major determinant of where we look in a picture; the pattern of the eye movements can be influenced by what the observer is told to look for (Goldstein, 1975). If the viewer is told to look for the ages of people in a picture, the pattern of the eye movements is different than if he is given no instruction.

Another factor determining where we look is motion and change. The nerve cells in the visual cortex respond weakly to steady light but respond with quick impulses to moving stimuli or stimuli that are turned on and off (Hubel & Wiesel, 1962). As a result, "a change in stimulation is one of the most effective ways of attracting attention" (Goldstein, 1975, p. 41).

> The potency of change as an attention getting device should be condensed when programming a multi-media show... while dissolves often result in beautiful visual effects, they may not attract attention as well as a simple slide change, since change itself is minimized in a dissolve (Goldstein, 1975, p. 41).

The emphasis has been on foveal vision, that is, upon what we can focus, but peripheral vision also plays a role in our perception of pictures. For example, two detailed visuals separated by a large visual angle cannot be focused simultaneously. However, it is possible to perceive distinct stimuli through peripheral vision if they are separated about two to four degrees of visual angle (Egeth, Vonides, & Wall, 1972). It is this part of the peripheral vision that allows us to respond very quickly to changes in illumination and movement around us (Edwards & Goolkasian, 1974).

Our memory for pictures is essentially perfect (Haber, 1970) but the memory depends largely on the number of fixations a picture receives (Loftus, 1972). It is important to note that it is the number of fixations, and not the exposure time of the visual stimuli, that determines how well a visual is remembered.

It can be concluded, therefore, that if special care is not taken in the organization and design of an adjunct activity in the form of a viewing guide, the observer's capacity to absorb information from a visual presentation may be reduced. A viewing guide may be constructed to help the observer fixate what is pertinent to intentional or instructional learning. Free-scanning is a long process, and unless the viewer is guided, he will take a long time to absorb all the details from a picture. Since in a multi-image presentation the observer may not have all the time he wishes for an in-depth free-scanning, a viewing guide becomes a necessity. The question is, what type of viewing guide is best suited to enhance the observer's capacity of perception?

Alternate Form of Multi-Images and the Use of Adjunct Activities

Thus far, multi-image presentations has consisted of iconic visuals only. An extensive search of the literature showed that only a few studies deviated from this traditional pattern, mainly by "inserting questions" in the presentation (Kemp, 1968; Tanner, 1975; Dayton, 1977; Schwier, 1980). Yet, the majority of the research on adjunct activities and human perception seems to allow alternate forms of multi-image presentations for instructional use.

We perceive pictures by scanning them. Only certain parts are fixated, either voluntarily or by the directed attention of an adjunct guide. This area of the picture falls on the fovea of the eye, and can be seen clearly. Goldstein (1975) reported that our major emphasis has been this foveal vision, but in doing so we have ignored 99 percent of the visual field.

> There is increasing evidence that peripheral vision plays a role in our perception of pictures even though fine detailed vision is not possible in the periphery (Goldstein, 1975, p. 41).

In addition, Loftus (1972) concluded that for improved memory, the number of fixations, and not the exposure time, is the crucial variable. Therefore, if the viewer is given a printed guide, such as a booklet, to follow while the visual presentation is in progress, he will certainly have fewer fixations on the projected visuals than if he did not have to read the guide. As a result, the recognition memory for the visuals may be reduced, counteracting the effects of the printed guide, whose objective is to direct attention for better memory. It may be argued that increased exposure time would solve the problem. However, another factor which directs the learner's attention is motion and change (Goldstein, 1975). Consequently, a longer exposure of the visual may not necessarily attract more attention or more fixations.

Therefore, it seems that a projected guide is a more effective way to direct attention and elicit the viewer's participation in the presentation. If the projected guide and the visual presentation are covered by two to four degrees of visual angle, the projected guide and the visual presentation can even by processed simultaneously (Egeth, Vonides, & Wall, 1972). Furthermore, because many nerve cells in the visual cortex respond with a burst of nerve impulses to moving stimuli or to stimuli that are turned on and off (Hubel & Wiesel, 1962), the viewer is practically forced to read the projected guide flashed before his eyes. A printed guide does not offer the same probability.

With this type of viewing guide, a single-image visual presentation becomes a multi-image presentation according to the accepted definition (Perrin, 1969a; Owens, 1975). Furthermore, Levie and Dickie (1973), in describing the versatility of multi-images, wrote that the visual of a multi-image presentation may be iconic (pictures) or digital (words and numbers).

Summary of Key Features

The review of the literature shows that several key attributes of multi-images and adjunct activities have been investigated. Based on this review, the following major features were built into the present study:

1. A pilot test was used to determine the difficulty of each test item.
2. A pretest was used to control for prior knowledge.
3. History, maturation, and experimental mortality were controlled better than most previous studies. A control group was used to establish base-lines.
4. Behavioural objectives were used as introductory material, and, in some sections, advance organizers.
5. A printed and a projected viewing guide were designed containing exactly the same material in form and content.
6. The viewing guide allowed the viewer to participate in the presentation (Gagné, 1970).
7. The viewing guide and the audio directed attention to visuals (Goldstein, 1975).
8. The viewing guide pointed out the most salient points of the presentation (Hartman, 1961a; Travers, 1964; Card, 1966; Severin, 1967).
9. The projected viewing guide always presented the concept related to the presentation, favouring in this way spatial cuing while reducing interference (Hartman, 1961b; Jonassen, 1979).
10. As many new concepts as possible were related to previously established concepts in the viewer's mind (Fleming & Levie, 1978).
11. Content material with the same characteristics was presented consecutively to favour association and reduce memory load

(Cahil & Hovland, 1979).

12. The viewing guide included a review section (Perrin, 1969b; Howe, 1970).

13. A questionnaire was developed to determine the viewer's attitude.

14. Three treatment groups were used: printed guide group, projected guide group, and no guide (control) group.

Hypotheses

This research examined the use of adjunct activities, in the form of a viewing guide, in a tape-slide presentation. The review of the related literature generated the following hypotheses:

H_1: Students who view tape-slide presentations with the aid of a printed list of behavioural objectives and detailed viewing guide will perform better on an immediate cognitive test than students who view the same tape-slide presentation without these aids. The justification of this hypothesis came from the studies on adjunct activities, in particular, Lavin (1971), who has shown that adjunct activities result in improved learning, and Rothkopf (1970), who has argued that effective learning is a function of relevant response modes that accompany learning.

H_2: Students who view tape-slide presentations with the aid of projected behavioural objectives and projected viewing guide on a screen side by side with the single-image presentation will perform better on an immediate cognitive test than students who view the same tape-slide presentation without these aids. The formulation of this hypothesis was derived from: a) the studies on perception concerning directed attention, peripheral vision, fixations of visual stimuli, and motion and change of stimulus; b) the studies on cognition and adjunct activities such as spatial cuing, pair-associate tasks, viewer's participation, and use of introductory material; and c) the studies on multi-images that investigated the use of digital studies in multi-image, either as inserted questions or as tests.

H_3: Students who view tape-slide presentations with the aid of projected behavioural objectives and projected viewing guide on a screen side by side with the single-image presentation will perform better on an immediate cognitive test than students who view the same tape-slide presentation with the aid of a printed list of behavioural objectives and viewing guide. The position endorsed by this hypothesis follows logically from the several potential advantages of the projected guide that are directly or indirectly advocated by the review of the literature. In particular, O'Meara (1975) reported that the printed stimulus may interfere with the normal learning process of a visual presentation.

H_4: Tape-slide presentations (multi-image and single-image) for large group instruction at secondary IV and V levels are equally effective with male and female students. The findings of Allen and Cooney (1963), and Tam and Reeve (1971), justified this fourth hypothesis. Dwyer (1972) reported that boys and girls in the same grade level learn equally well from identical types of visual illustrations when they are complemented with oral instruction. Owens (1975), however, found that males learn more than females from tape-slide presentations. Therefore, this moderator variable was introduced to help clarify the present literature.

H_5: Students exposed to projected and printed behavioural objectives and viewing guide will indicate via a questionnaire that, at minimum, they were not distracted by this form of tape-slide presentation. The attitude of the viewers was considered important in helping to analyze the results of the experiment more meaningfully.

CHAPTER 3

Method

Experimental Sample

The subjects selected for this study consisted of senior high school students registered at Marymount Comprehensive High School in Montreal. The school is located in the south-west end of the city, and its student population comes from a low-middle class background. The curriculum followed by these students is the one set by the Ministry of Education for secondary schools.

The sample consisted of 93 senior high school students from regular classes (see Table 1). The sample for the pilot test was comprised of another 46 students registered in classes very similar to those of the subjects involved in the experiment; they were rated by their teachers as average achievers.

Experimental Design

A pretest-posttest control group design (Tuckman, 1978) was used. There were three levels of the independent variable (presentation format: no guide, printed guide, projected guide), and two levels of moderator variables (sex: male and female). The design is illustrated in Figure 1.

Instrumentation

Pilot Test. A pool of 28 questions was constructed and subjected to pilot testing. These were administered to 46 students enrolled in classes that were similar to the sample of the study. High achievers and low achievers were excluded and instructions and testing conditions were the same as those supplied to all subjects in the final stage of the experiment.

Table 1

Distribution of Subjects by Treatment and Sex

Treatment	Females	Males	Total/Group
Control	14	17	31
Printed	16	16	32
Projected	16	14	30

GROUP I		01	X_c	Y_1 Y_2	02
	R				
GROUP II		03	X_{prt}	Y_1 Y_2	04
GROUP III		05	X_{prj}	Y_1 Y_2	06

Key

R - Randomization of classes to treatments

01, 03, 05 - Pretest

02, 04, 06 - Posttest

X_c - Single image and no guide

X_{prt} - Single image and printed guide

X_{prj} - Multi-image: Single image and projected guide

Y_1 - Male subjects

Y_2 - Female subjects

------ - Intact groups

All high and low achievers were removed and only part of the group was randomly assigned to the experiment.

Figure 1. Research Design.

Students were asked to complete the test without having viewed the presentation in order to determine which questions could be answered based on prior knowledge alone. The results of the pilot testing were analyzed and 17 questions were retained out of the initial 28 in the pool.

Pretest - Posttest. These 17 four-option multiple-choice questions were used to make up the pretest and the posttest (see Appendices D and F). In addition to these questions, both tests included an interpolated task of three simple mathematical questions to reduce the effects of short-term memory. These were located at the end of the pretest and at the beginning of the posttest.

Both pretest and posttest were norm-referenced tests at the group level because the result of one group were compared with the results of another group rather than related to performance criteria established in advance.

> When we use test results to compare Jack with his peers, we refer to this as "norm-referenced testing". The distribution of scores made by the group gives us a yardstick against which we can assess a given child's performance (Chase, 1974, p. 93).

Had it been desirable, the test could have been interpreted as a criterion-referenced test because the stated behavioural objectives indicated the level of performance. The questions included several levels of Bloom's taxonomy (1956). Primarily, the questions were at the knowledge, comprehension, and evaluation levels. The content validity was controlled by asking questions based strictly on the material presented and by basing all distractors on the same presentation (Chase, 1974). A reliability estimate (coefficient alpha) of .61 was obtained on the posttest.

Materials

Tape-Slide Presentation. The audio-visual presentation used in this study was entitled "Guide to Stereo High Fidelity". It was a 28-minute production composed of 86 slides (see Appendix A). Twenty-seven were iconic, 19 were digital (Levie & Dickie, 1972), 27 were iconic but with added printed characters, six were simple graphs, and seven were mainly cartoons.

The artwork for the iconic slides was obtained by cutting out pictures of Hi-Fi components found in brochures or pamphlets distributed by Hi-Fi dealers and posting the figure of interest on cardboard. These slides were made as colourful as possible. Flashly combinations of colours were at times used to stimulate interest on the part of the students. The digital slides were produced by transferring block letters onto light-green cardboard (Kodak, 1978; Page, 1974).

Legibility is always a prime concern for these types of slides. Kodak (1978) suggested that:

> the maximum viewing distance should be about 8 times the height of the projected image. To put it another way, if the projected material is legible for the farthest viewer, who is seated 8 times the projected image height from the screen, it will be legible for all other members of the audience (p. 36).

No risks were taken concerning legibility. The above requirement was by far exceeded in this production. The slides and graphs used could be read over twice the distance of the farthest viewer in the auditorium.

Finally, the last type of slide was primarily cartoons, to illustrate situations not easily obtainable in real life or to enlighten the presentation by introducing some humour from time to time.

Preparation of Tape-Slide Presentation. The purpose of this tape-slide show was to acquaint the student with the basic components of a Hi-Fi system. A behavioural objective was developed in order to plan the final sequence of the presentation. Also, Mager (1961) emphasized the need for including in the objective statement an indication of minimally acceptable performance in order to measure "how much" and "how well". The objective was in the cognitive domain and could be classified under Bloom's (1956) general headings of knowledge, comprehension, and, mainly, evaluation (Gronlund, 1970).

The presentation was designed to achieve this objective: following the audio-visual presentation "Guide to Stereo High Fidelity", the student would be able to select the best tuner or pair of speakers by comparing their respective corresponding technical specifications. Right after the presentation, the student would also answer, within 30 minutes, 17 multiple-choice (four options) questions with an accuracy of at least 70 percent.

The presentation emphasized the contention that:

> much more can be apprehended and retained if the learner is required to assimilate only the substance of ideas rather than the verbatim language used in expressing them (Ausubel, 1967, p. 20).

More specifically, the presentation was aimed at enabling the student to remember whether or not the value of a certain technical specification had to be high or low, rather than remembering, for example, its definition. In addition to that, new information was associated to extant prior knowledge (Gagné, 1974) to help bridge the gap between the new material and the established ideas in cognitive structure (Ausubel, Novak, & Hanesian, 1978).

The technique used to review the technical specifications presented in the show was progressive disclosure, the first specification being the content of the first slide, and all technical specifications presented being the content of the last slide (McTeer, 1977).

The empirical justification for the questions in the review can be drawn from Anderson and Biddle (1975), who were reported by Rickards (1980) as saying that

> adjunct postquestions produce more recall than adjunct prequestions or no questions at all (p. 7)

Subject Matter. This tape-slide production was a basic guide to Stereo High Fidelity. It introduced the viewer to High Fidelity and dealt particularly with the specifications supplied by manufacturers for tuners and speakers. Amplifiers, turntables, and other general information about Hi-Fi systems were proposed to be the subject of a second presentation. The production attempted to enable the viewer to select a tuner and pair of speakers from the technical specifications.

Relevancy of Subject Matter. Since the investigator has taught radio technology at the secondary level for a number of years, he has noticed that many students buy quite expensive sound systems, but their only guide in the process of selection is advertising, physical look, superfluous gadgets, and "recommendation" by a friend. They seem to have very little knowledge about the technical performance of the system. It was decided, therefore, that an audio-visual production on Stereo High Fidelity would be a worthwhile educational experience for senior high school students.

Audio. The commentary accompanying the visuals was narrated by a male announcer who had previous experience with this type of work at Radio

Sir George and the National Film Board. The narration was essentially non-redundant. Despite the difficult subject matter, the narration was kept as simple as possible, with concrete analogies.

The original and final productions were recorded on a TDK sound recording tape, professional studio quality (L-1800), 1.0 mil polyester base, at 7½ in/s (19cm/s). The final tape had the narration recorded on the right channel and audio pulses to advance the projectors, (both presentation and projected guide), recorded on the left channel, making the tape compatible with both the projected and printed guides (the latter simply does not use the left channel).

The music played at the different intervals was chosen with the audience in mind, i.e. senior high school students. However, the background music used for the ending of the presentation, i.e. the summary, was not "disco", but less distracting, taken from Frank Mills' "Sunday Morning Suite".

Printed and Projected Viewing Guides. The viewing guide for this presentation consisted of 40 brief statements highlighting the essence of the narration, i.e. summarizing the most important points and not the exact words of the audio. These statements were presented in two formats: printed and projected; the statements themselves were exactly the same in both guide formats. The printed guide (see Appendix C) had 40 statements printed in a small booklet. Beside each one was a small circle to be checked by the viewer after reading the corresponding statement. The projected guide (see Appendix B) had each statement projected on a screen placed at the left-hand side adjacent to the presentation screen. It is important to note that, regardless of the viewing format, any given statement was paired with the same set of slides. Both guides started by providing the viewer with some initial orientation in the form of behavioural objectives and concluded the presentation with a built-in review section.

Questionnaire. A questionnaire consisting of ten questions was constructed to determine the subjects' opinion of the printed and projected guides. A five-point Likert scale was used to rate their responses (see Appendix F).

Procedure

Selection of Experimental Sample. Eight senior classes were chosen in agreement with the school administration and the class teachers. The students registered in these classes were at the end of the previous year indentified as regular students, i.e. neither high achievers nor low ones. However, since the experiment took place after the first term mark, teachers were asked to identify those students whose first term mark showed an average performance. They were then asked to give a ticket to each student in the class, marking on it a small dot for the student who was a high or low achiever. Only the students who showed the ticket were allowed to enter the auditorium of the school where the treatments were administered. Students were asked to sit in every alternate seat. Those with a dot on their tickets were to sit only in certain rows. The whole seating process was done without letting any student suspect that they were about to participate in an experiment. In fact, all classes were told by their teachers that the purpose of the tape-slide show was only to aid them in buying a Hi-Fi system.

Three treatment groups were formed with the eight intact classes by randomly assigning two or three of these classes to the groups. Also, all students designated by their teachers as either high achievers or low achievers were not included in the experiment (those with a dot on their ticket). Among the remaining students (minimum 40 in each group), only about 30 were randomly picked to participate in the experiment. That was done simply by distributing about 30 copies of the pretest at random. The others were told that "unfortunately" there were no more papers left for them but they were welcome to view the presentation anyway. Of course, only those students who received the pretest were later provided with the posttest, and the questionnaire. This process was chosen to increase further the chance of random selection in the experimental sample.

Physical Study Setting. In order to control environmental variables, all treatment groups were exposed to the stimulus materials under very similar viewing conditions. The study took place in the school auditorium. All groups were asked to sit in the center-front section of the auditorium in order better to face the single 9' x 12' (2.7m x 3.7m) projection screen. The projection equipment was placed about 12 feet (3.7m) behind the last row of students. Testing took place during the same day as follows: control group 8:45 a.m. to 10:45 a.m.; printed guide group 11:45 a.m. to 1:15 p.m.; and projected guide group 1:45 p.m. to 3:00 p.m. Each group was randomly assigned to the treatment and each student was sitting in every alternate seat in order to avoid any temptation to copy or to talk (standard high school precautions). Finally, the viewing distance exceeded the legibility requirements recommended by Kodak (1978).

Equipment. Before each presentation, the projection equipment was set up and ready to go. Both projectors were focused and adjusted so that the two images in the multi-image presentation appeared parallel to each other and separated by about 2 inches (5 cm). The set-up of the equipment is illustrated in Appendix G.

The equipment used for this experiment consisted of one TC-270 Sony stereo tape-recorder, one Hi-Fi speaker box, two Kodak Carousel 850-H 35mm slide projectors with zoom lenses, and one Media Master 5-Channel Multimedia Programmer, model 375R. The 9' x 12' projection screen used was already installed on the auditorium stage and all lights in the back-stage were turned off in order to have maximum colour brightness on the screen, and also to reduce any viewing disturbance. The two projectors and the tape-recorder were mounted on a 5 foot (1.5m) high desk installed at the center and in the rear of the auditorium.

Lighting conditions are always of primary concern for this type of presentation. In this study, lighting was controlled to be almost ideal. During the single-image presentation without any viewing guide (control group) all lights were turned off. During the single-image presentation with the printed guide, all lights were also turned off, but some reflector lamps installed on top of the stage were turned on to shine on the viewers. Special attention was taken to make sure that no light would shine on the screen, to ensure maximum brightness and also not to have the lamp itself fall within the viewer's field of view.

Tryout of Presentation. Before the actual presentation, the tape-slide show was monitored several times to established correct program synchronization and operation. The greatest difficulty encountered in producing the audio-tape was with the Multimedia Programmer used to record pulses on the tape. After numerous trials, it was found that a tone frequency of 800 Hz (Channel 3) and a tone frequency of 3200 Hz (Channel 5) were the most reliable. The 800 Hz tone was used to advance the projected guide while the 3200 Hz tone was used to advance the slides in synchronization with the narration (see Appendix G).

Presentation. After the seating was arranged as described earlier, the investigator instructed each group as follows:

> For the next half hour, you will be viewing a tape-slide show on High-Fidelity, that is, tuners, speakers, amplifiers and stereos.
>
> I hope you'll find the show very interesting because it will teach you how to select a tuner or a speaker from the technical specifications supplied by the manufacturers. Just the name like Sansui, Pioneer, or Marantz is not enough to tell you the quality of the stereo. To be exact, one has to be a little bit more scientific. And that's what this tape-slide presentation is all about. Now, I'm sure that there are some of you who may already know a lot about technical specifications but others may know nothing about it. Frankly, I expect the majority of you not to know very much about it. But just to see how much each one of you knows before viewing the show, I will give you a small test before the show. Once you finish this test, I'll turn on the projector(s). Again, don't be discouraged if you find out that you don't know much at this point.
>
> (CONTROL AND PROJECTED GROUP ONLY)
>
> When you watch the show, please don't take down notes, but just pay attention.
>
> (FOR PRINTED GROUP ONLY)
>
> When you watch the show, I'll also give you a guide to help you. Please follow it carefully. Read the first line when a red circle appears on the left-hand corner of the screen or when a

slide at the left side tells you "Look at your Guide". At the first signal to read the guide, read the first statement and check the circle next to it. At the second signal, read the second statement on the guide and so on. Please don't go back and forth.

(FOR ALL GROUPS)

Immediately after the show, you will have another small test to see how much you have learned. I expect you to be able to answer correctly at least seven questions out of each 10. At the end of this test, there will also be a questionnaire to allow us to know how you felt about this show. Please don't cheat on this final test. Marks will not count for a grade, but they will just indicate to us how much a student can learn when taught by a tape-slide show of this type. If you wish, I will give you the mark privately. To do well on this test, all you have to do is to look carefully at the slides, listen to the commentary, and follow directions. Please don't talk during the show or test period. OK? Let's begin.

After these instructions, the pretest was distributed, and it was picked up by some teachers helping the investigator as soon as it was completed. About 15 minutes later all the copies of the pretest were handed in. At this point, the projector was turned on for the control group to view the single-image presentation. The printed guide group, instead, just before the projector was turned on, was supplied with the viewing guide and reminded to look at the guide and read the corresponding statement only when cued by the show. For the last treatment group, the projected guide group, after the collection of all the pretest booklets, the investigator turned on the two projectors, i.e. single-image presentation and projected guide.

At the end of the presentation, 28 minutes later, the printed viewing guide was collected for the printed guide group, and to this group, as well as the other two groups, the posttest was administered. It was also picked up as soon as it was completed. All copies of the posttest were handed in to the investigator about 20 minutes later.

The experiment terminated here for the control group; however, the printed guide group and the projected guide groups were finally asked to complete a questionnaire before they were dismissed. All questionnaires were completed in less than 10 minutes, and were returned to the investigator.

CHAPTER 4

Results

Analysis of Prior Knowledge

To determine whether subjects were randomly distributed in equivalent groups, one-way analysis of variance was performaed across the three treatment groups on the pretest scores. Also, since the subject matter might have been of greater interest to males than to females, resulting possibly in greater prior knowledge for males, all groups were further tested across sex on the recognition pretest. Means and standard deviations for all groups by sex for the measure of prior knowledge are shown in Table 2.

The analysis of variance presented in Table 3 shows that a) the interaction of the sex of students by groups was not significant, $F(2,87) = .523$, $p > .50$; b) the main effects for sex were also not significant, $F(1,87) = .461$, $p > .40$; and c) the main effects for groups were equally not significant, $F(2,87) = .147$, $p > .80$. Therefore, the three treatment groups were assumed to be equivalent on the dimension of prior knowledge. Also, it was assumed that males and females performed in a similar fashion on the pretest.

Primary Analysis

Hypotheses. The purpose of this study was to determine the relative effectiveness of printed and projected viewing guides as adjunct activities to a tape-slide presentation. The following hypotheses were tested relative to the purpose of this study:

H_1 - The printed guide treatment group (X_{prt}) will perform better than the control group (X_c).

Table 2

Means and Standard Deviations for Groups by Sex on Recognition Pretest

Groups	Male $\overline{X}$	Female $\overline{X}$	Combined $\overline{X}$	Combined SD
Control Group (X_c)	3.35	3.43	3.39	1.08
	(17)	(14)	(31)	
Printed Guide Group (X_{prt})	3.44	3.38	3.41	1.50
	(16)	(16)	(32)	
Projected Guide Group (X_{prj})	3.93	3.25	3.57	1.87
	(14)	(16)	(30)	

Table 3

Analysis of Variance - Pretest Score by Group and Sex

Source of Variation	ss	df	F
Main Effects	1.666	3	.238
Groups	.686	2	.147
Sex	1.074	1	.461
2-way Interaction			
Groups by Sex	2.439	2	.523

H_2 - The projected guide group (X_{prj}) will perform better than the control group (X_c).

H_3 - The projected guide group (X_{prj}) will perform better than the printed guide group (X_{prt}).

H_4 - Males and females will perform in an equal fashion in each treatment group.

Test for Overall Effects. To test a general hypothesis for significant effects, a two-way analysis of covariance was conducted using posttest scores as the dependent measure and pretest scores as the predictor variable. Regression analysis showed that the pretest scores were a significant predictor of the dependent variable, $F(1,92)=9.85$, $p < .002$, with a regression coefficient of .55. Since this squared coefficient (r^2) represents the ratio of the explained variance to the total variance (Hamburg, 1974), the value of .30 can be interpreted as meaning that 30% of the total variance of the posttest was explained by the relationship existing between the pretest and the posttest. Consequently, the posttest scores were adjusted for this percentage of the total variance before the F-ratio was calculated. In addition, the lack of significant effects on the pretest across treatment conditions satisfies the condition of homogeneity of regression.

Table 4 presents the means and standard deviations of each of the treatment conditions divided by sex. Two-way analysis of covariance (see Table 5) produced a significant main effect for treatment conditions, $F(2,86)=18.54$, $p < .001$, no significant main effect for sex and no significant interaction. The overall significant main effect indicated the need for further analysis, so post hoc comparisons were run to determine the locus of the treatment effect.

Table 4

Means and Standard Deviation for Groups by Sex on Posttest

Group	Males $\overline{X}$	Females $\overline{X}$	Combined $\overline{X}$	SD
X_c	6.06	6.79	6.39	2.667
	(17)	(14)	(31)	
X_{prt}	6.88	7.81	7.34	2.350
	(16)	(16)	(32)	
X_{prj}	10.79	9.88	10.30	2.794
	(14)	(16)	(30)	
Total	7.74	8.22		
	N=47	N=46		
	SD=3.47	SD=2.61		

Table 5

Analysis of Covariance - Posttest Score by Groups and Sex with Pretest Score as a Covariate

Source	SS	df	F
Covariates			
Pretest	62.666	1	9.852
Main Effects			
Sex	3.317	1	.521
Groups	235.907	2	18.544 *
2-way Interactions			
Groups by Sex	10.353	2	.814
Explained	316.940	6	8.305
Residual	547.017	86	

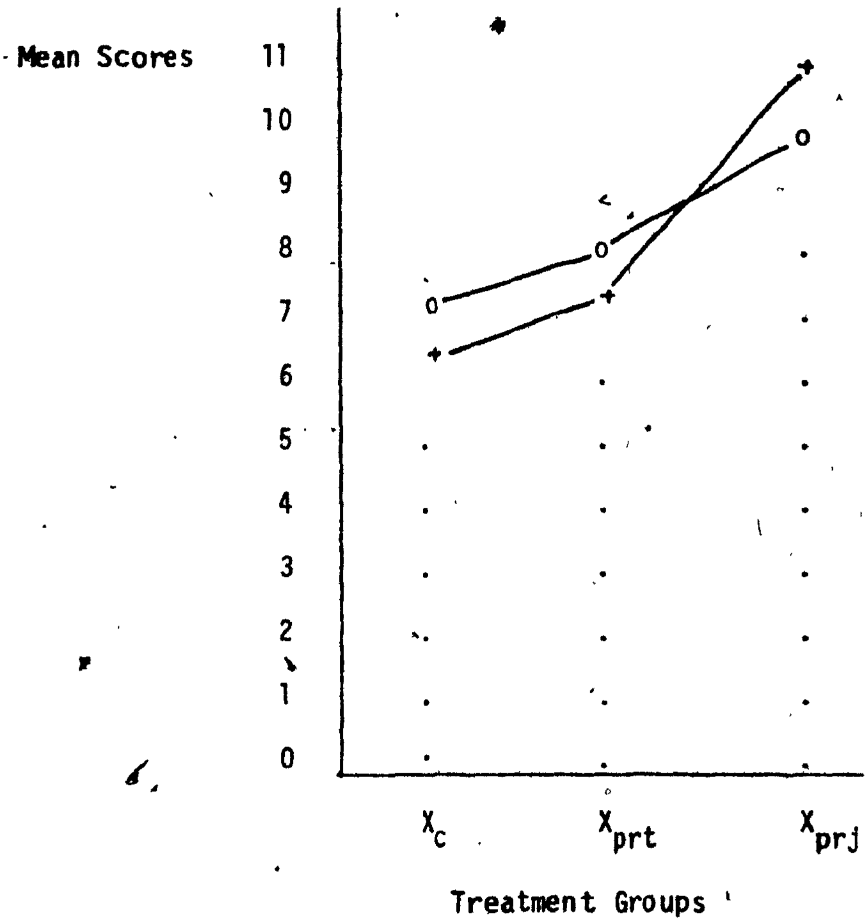
* $p < .001$

Post Hoc Comparisons

A Scheffé test ($p < .01$) was conducted to determine which treatment group was significantly different than the others. The results of this test indicated that the projected guide group performed significantly better than both the printed guide and the control conditions (Projected > Printed = Control). Figure 2 graphically illustrates these differences across treatment conditions as well as the relatively stable results obtained when the groups are separated by sex. The results of this analysis strongly favoured the projected condition over the other two treatments when prior knowledge of the content is controlled. As a consequence, the first hypothesis was rejected and the other three were accepted.

Questionnaire

The questionnaire indicated that those students exposed to the printed viewing guide were not repelled by it; on the contrary, they expressed a liking for it (see Appendix F). In Question 3, when students were asked whether the viewing guide helped them recall the subject matter, a X^2 (chi square) analysis of the data revealed that the responses between the printed and the projected guide treatment groups was significantly different ($p < .05$). Also, in Question 7, when the students were asked whether the viewing guide interfered with the actual viewing of the presentation, they expressed opinions clearly indicating that the projected guide interfered significantly less ($p < .005$) than the printed guide.



Key

X_c - Control group (no guide at all)

X_{prt} - Printed guide group

X_{prj} - Projected guide group (multi-image)

+ ——— - Males

o ——— - Females

Figure 2. Treatment groups by mean scores and sex on posttest

CHAPTER 5

Conclusions, Discussion, and Recommendations

Conclusions and Discussion

The purpose of this study was to assess the effectiveness of a printed and of a projected guide format in tape-slide presentations for large group instruction at the senior high school level. A recognition multiple-choice test was developed to measure learning achievement. Presentation format was the manipulated variable in the study. A tape-slide presentation on High Fidelity was produced by the investigator and a viewing guide was designed to go with it. One group was administered the viewing guide in a printed format, while the other group was administered the same guide in a projected format on the left side of the screen. The control group had no guide at all. The discussion and conclusions in this chapter are organized under the re-examination of each hypothesis in light of the obtained results.

Initial Characteristics of Groups. Initially, the three treatment groups were compared on the pretest measure to determine if they possessed equivalent prior knowledge of the program content. The test revealed that the groups were similar in this respect. It also showed that males and females were equivalent for prior knowledge before the treatments were administered. Tuckman (1972) has suggested that whenever the treatment groups cannot be randomly assigned, a pretest should be administered and its score used as a statistical covariate in the analysis to control for initial group differences. It can be concluded from these results that a) the three treatment groups were indeed equivalent on the dimension of prior knowledge, and b) that males and females performed in a similar fashion on the recognition pretest.

Hypothesis 1.

> Students who view tape-slide presentations with the aid of a printed list of behavioural objectives and detailed viewing guide will perform better on an immediate cognitive test than students who view the same tape-slide presentation without these aids.

The results show that students viewing the tape-slide presentation with the aid of the printed guide did not perform better on the posttest than those students who viewed the same tape-slide presentation without any aid. Therefore, hypothesis 1 cannot be accepted.

By examining the questionnaire, a possible explanation emerges which explains these results. When the treatment group viewing the tape-slide presentation with the aid of the printed guide was asked whether the printed guide interfered with the viewing of the main tape-slide show, 15.6% Strongly Agreed, 28.1% Agreed, 9.4% marked Undecided. About half the group, therefore, expressed some concern about interference. Although interference may occur with simultaneously transmitted information, this only occurs when the cues of the second channel are not relevant to those in the first (Travers, 1964). That, however, did not occur in the case of those viewing the presentation with the aid of the printed guide. Firstly, the printed guide was exactly the same as the projected guide, which proved to be quite effective. Secondly, the printed guide summarized the most salient points of the audio, as did the projected guide. Severin (1967) specified that when the material presented is relatively difficult for the audience, or exceeds its level of literacy, a combined audio-print presentation may produce significantly better results than a print presentation alone. However, the problem cannot be dismissed. There is one other type of interference that could have occurred. It involves the visual modality. Since the printed guide and the Hi-Fi presentation were not both within the viewer's field of vision, the visual modality was divided into two distinct tasks which might have interfered with each other (Fleming & Levie, 1978).

Different studies have demonstrated the advantages of adjunct activities in the form of a printed viewing guide (Gropper, 1966; McKeachie, 1967; Rothkopf, 1970; Lavin, 1971; O'Meara, 1975), but the results of this particular study do not wholly confirm these past findings. The discrepancy may be due to the guide format. There are several types of printed viewing guides. Some require the viewer to fill in words, others to summarize the audio, and others to check off a given sentence or choose the right response in a multiple-choice format. In addition, some printed viewing guides are designed for interaction, while viewing the presentation, while others are to be completed only at pauses. It is possible to explain the results found in this study by examining the style of viewing guide. O'Meara (1975), although confirming Lavin's (1971) findings concerning the use of adjunct activities with audio-visual material, concluded that

> Viewing guides should be designed such that they do not interfere with actually viewing the tape. Students should not be asked to do other things while the tape is running. Rather, the tape should be stopped at strategic points where the student can be asked questions about the material he has just seen (p. 50).

That, perhaps, was the single most important explanation for the no significant difference found in the comparison of the printed guide and the control group. As mentioned earlier, the students' response on the questionnaire also gave that indication.

Despite the lack of significant results found for this hypothesis, it is important to note that the mean for the control group on the posttest was 6.39 as compared to 7.34 for the mean of the printed guide group. Therefore, the treatment group with the printed viewing guide performed relatively better than the control group. This finding is in line with other research on adjunct activities. It is possible that the efficiency of the printed viewing guide was limited because it had to be read while the presentation progressed. Since the printed viewing guide and projected slides were not within the viewer's field of perception (watching both required a head movement) the viewer had constantly to switch his attention from the slides to the printed guide. Moreover, Fleming and Levie (1978) pointed out that

> ... the spatial character of vision permits parallel (simultaneous) processing in different parts of the field, thus increasing the capacity for pictorial information (p. 61).

In other words, since the viewer was required to perceive the printed guide and the presentation as two separate identities, he derived no benefit from pictorial and spatial cuing which might have enabled him to encode the pictorial information with the concept (Jonassen, 1979).

Hypothesis 2.

> Students who view tape-slide presentation with the aid of projected behavioural objectives and projected viewing guide on a screen side by side with the single-image presentation will perform better on the immediate cognitive test than students who view the same tape-slide presentation without these aids.

The results indicating a significant difference between the performance of the projected guide group and the control group affirm this hypothesis. Unlike the printed guide format, the identical content material when projected on the left side of the screen produced a remarkable difference.

This significant difference may be attributable to several factors.

First, by projecting the viewing guide on the left side of the screen, the single tape-slide presentation became a multi-image presentation, even though the left screen always presented a digital image (words and phrases) at intermittent intervals. The advantages of multi-image presentations over single-image presentations have been demonstrated by several studies (Allen & Cooney, 1963; Card, 1966; Brydon, 1971; Trohanis, 1975). Perrin (1969b) theorized that

> On large screens (or screens side-by-side), the viewer makes his own montage of different comparative information. The immediacy of this type of communication allows the viewer to process large amounts of information in a very short time. Thus information density is effectively increased, and certain kinds of information are more efficiently learned (p. 369).

Furthermore, Tam and Reeve (1971) found evidence to suggest that when some images are accumulated for a longer period and others are shown sequentially, learning is enhanced. In this study, the viewing guide was projected at intermittent instances. The same image remained in view while others were shown sequentially on the right screen. Therefore, the presentation format may have contributed to the superiority of the projected guide condition. Even though the same procedure was used for the printed guide, it did not produce the same positive results. It is possible that the viewer read the indicated line only once, thereby losing the effect of image accumulation.

Secondly, Goldstein (1975) has pointed out that a slide change is more effective than dissolves for maintaining visual attention. Fleming and Levie (1978) added that one way to maintain global control of visual attention is to change the level of stimulation, i.e. movement or brightness, in the sensitive areas of peripheral vision. Since the projected guide appeared on the left screen at irregular intervals and was often preceded by a black slide, it may have contributed to maintaining the viewer's attention, resulting in superior performance on the posttest.

Thirdly, Fleming and Levie (1978) stated that

> An effective combination of iconic and digital signs appears to be pictorial stimulus and a verbal response, e.g. label or description (p. iii).

In other words, studies of paired-associate learning have shown pictures to be most effective in the stimulus position and words most effective in the response position (Fleming & Levie, 1978). The projected guide presentation solved the digital versus iconic dilemma by using both. The projected guide was always digital and the Hi-Fi presentation was always iconic, with the exception of titles and review slides. Therefore, that also may have contributed to the efficiency of the projected guide presentation.

Fourthly, Jonassen (1979), in discussing multi-images and concept acquisition, suggested that when used appropriately, spatial cuing may act to improve retention. He conducted a study in which each class of plants was presented on a separate screen which had a distinct position and spatial relationship to the other projected images. He attributed the significant performance of his subjects to a possible encoding of spatial information into memory along with the concept. A similar process may have occurred when viewing the presentation along with the projected guide. The left screen always presented the concept relative to the adjacent iconic slide. The viewer may have associated the information of the projected guide with the corresponding properties presented by the right screen, thus reducing the memory load.

Fifthly, the review of the presentation section was designed to establish a dialogue between the projected guide and the single-image presentation. This form of presentation may have encouraged the viewer's participation, thereby contributing to the superior results (Gropper, 1966; Rothkopf, 1966; McKeachie, 1967; Howe, 1970; Fields, 1971; O'Meara, 1975; Dayton, 1977).

Hypothesis 3.

> Students who view tape-slide presentations with the aid of projected behavioural objectives and projected viewing guide on a screen side by side with the single-image presentation will perform better on an immediate cognitive test than students who view the same tape-slide presentation with the aid of a printed list of behavioural objectives and viewing guide.

This study revealed that students who view a tape-slide presentation with the aid of a projected guide learn significantly more than students with either a printed guide or not guide at all. Consequently, this hypothesis is accepted.

In discussing the first two hypotheses, several arguments were presented that also helped to explain these results. The following attributes of the projected guide were discussed: 1) multi-image; 2) image accumulation; 3) attention gain by changes in peripheral vision; 4) association between digital and iconic images; 5) spatial cuing; and 6) involvement in the review section of presentation. In addition, Fleming and Levie (1978), discussing two-channel capacity in relation to audio-visual presentations, pointed out that

> Capacity appears to be larger where two modalities are utilized (audition and vision) rather than one. Two tasks involving the visual modalities for instance, will interfere more than where one involves the visual and one the auditory modality (p. 67).

The projected guide and the Hi-Fi presentation were always within the viewer's field of perception, becoming for the viewer a single global visual.

The audio constituted the other modality. The viewers who received the printed guide, however, were not able to treat the printed guide and the Hi-█ presentation as one global visual because all elements were not within their field of perception. Therefore, they had two visual modalities and one auditory. It is probable that the two visual tasks interfered with each other, hence the concern expressed in the questionnaire when viewers were asked whether the printed guide interfered with the viewing of the main tape-slide show. The significant X^2 for this question further indicates that the printed guide was not entirely successful.

Another possible explanation for the observed difference between the printed and projected guide formats is that students may not have followed the printed guide as designed. A cue was given to indicate when to read the printed guide, but in fact viewers may not have conscientiously followed this instruction. The projected guide did not pose that problem because it forced the viewers to attend to it. In fact, a viewer would have had consciously to avoid reading it because of its placement relative to the presentation.

It was also pointed out by Goldstein (1975) and further explained by Fleming and Levie (1978, p. 21) that

> ... if the screen is dark, gain attention by brightening it; if it is static, gain attention by adding movement. "Popping on" of overprint titles directs attention to them and what they label.

It is possible that the "popping on" of the several slides of the projected guide helped the viewers to engage in a more active and purposive behaviour, resulting in a positive learning benefit (Krugman & Hartley, 1970).

Howe (1970) found that those students who were allowed to review the material recalled significantly more items than those who were not allowed to review the material. The review section of this presentation was designed to involve the viewers. A question was asked on the projected guide and the correct answer was found on the next slide of the single-image presentation. The viewer became a liaison between the projected guide and the single-image presentation. It is presumed that this process produced its intended effect in the projected guide presentation because the action was always within the viewer's field of perception. Although this same device was used in the printed condition, it may not have unfolded in the same manner because it required an extra effort from the viewer to look up to the single-image presentation and down to the guide at regular intervals. This speculation finds some additional support when the results of the questionnaire are scrutinized. The overall involvement in the projected guide came across much closer to the "Strongly Agree" choice of the Likert scale.

Hypothesis 4.

> Tape-slide presentations (multi-image and single-image) for large group instruction at Secondary IV and V levels are equally effective with male and female students.

The results support this hypothesis, showing that males and females learn equally well from tape-slide presentations (multi-image and single-image) at the Secondary IV and V level. No main effect for sex or interaction between sex and the presentation format was observed. The moderator variable of sex was introduced because the subject matter was thought to be more attractive and hence, more familiar to males than to females. However, the results do not confirm this suspicion. The results of this finding support the majority of past studies involving audio-visual presentations (Allen & Cooney, 1963; Tam & Reeve, 1971;

Dwyer, 1972, p. 90).

Hypothesis 5.

> Students exposed to projected and printed behavioural objectives and viewing guide will indicate via a questionnaire that, at minimum, they are not distracted by this form of tape-slide presentation.

The objective of this hypothesis was to find the viewers' attitude concerning the printed and projected guides. The response was excellent. All students completed the questionnaire. In general, the students with the projected guide showed a greater appreciation than the students with the printed guide for this type of adjunct activity. On some specific points, like facilitation of recall and interference, the results were statistically significant (see Appendix F). Therefore, from the reaction on the questionnaire, it can be concluded that the projected guide is more appealing than the printed guide as an adjunct activity to audio-visual presentations.

Recommendations for Future Research

The results of this study suggest that a projected viewing guide, as an adjunct to an audio-visual presentation, produces superior short-term learning compared with either a standard tape-slide presentation or one utilizing a printed viewing guide. However, the present study also showed that a printed viewing guide is not significantly more effective than no guide at all. The latter finding contradicts several earlier studies. Although the results of this comparison did not yield significant differences, the mean of the printed guide treatment group was noticeably higher than the control group. Therefore, there is need for further research.

First, it is suggested that this study be replicated at all age levels to determine the precise conditions under which the technique functions most effectively. Future research studies should incorporate both an immediate and a delayed posttest into the design to compare short- and long-term retention. Snow (1974, p. 281) stated that "generalizations about school learning need to be built on research using substantial samples of learning time".

Secondly, there is a need to conduct a longitudinal study. The research should involve a complete series of tape-slide presentations over a whole term, with one group exposed to a projected guide, another group exposed to a printed guide, and a control group viewing the same presentation without any adjunct material. Of course, these three experimental groups should be selected as much as possible on a random basis. This experiment was conducted as an extra-curricular activity, or as a general interest activity, and consequently students were told that the final score would not be counted towards their term mark. It would be interesting, however, to monitor the performance of students in a real classroom situation where this particular task would influence their term mark. A long-term naturalistic study would also reduce the novelty effects which often plague "one-off" studies. The easier the flow of events, the more representative the research will be.

Thirdly, the viewing guide format itself needs additional research. The fact that the printed guide and the single-image presentation are not within the viewer's field of perception may cause some interference because it involves two distinct visual tasks (Fleming & Levie, 1978). Some viewing guides include fill-in sections, some others multiple choice items, and others a combination of several types to be completed either at pauses or while the presentation is being viewed. This study established that the viewing guide format may be a significant factor in terms of learning outcomes. It is necessary, therefore, to investigate this factor further, along with its relationship to other adjunct activity formats.

Fourthly, there is a need to expand the use of printed and projected viewing guides in subject areas other than science. It would be interesting for future studies to apply this treatment in the arts and social science sectors in order, ultimately, to determine the generalizability of this type of presentation format.

Several other research suggestions are also worthy of mention:

1) Further research is needed in the area of redundancy and between-channel interference. Hartman (1961b) stated that the level of difficulty in each channel must be such that it permits the learner to switch attention between an auditory message, a visual-pictorial message, and a visual printed message, and then to assess the optimal redundancy level between channels.

2) Spatial cuing and image accumulation seem to be two important factors to be investigated further in instructional tape-slide presentations especially in regard to the use of a projected guide in the multi-image format.

3) The practicality of multi-image instructional presentations and the cost effectiveness of projected guide formats, as compared with alternative production and presentation methods are also recommended for further investigation.

4) Finally, Fleming and Levie (1978, p. 61) have pointed out that there is evidence that for right-handed people the left hemisphere appears specialized for serial information, especially languages (speech), and the right hemisphere for simultaneous information, especially spatial stimuli

(pictures). It would be very interesting to conduct a study to investigate the effects of projected viewing guides on right-handed and left-handed subjects.

In sum, although projected viewing guides need to be researched further, the results of this study indicate that they may have considerable value in education. An additional variety of visual formats, such as the combination of digital and iconic stimuli, may produce even more interesting results. The flexibility of the visual combinations enabled by multi-image communication may provide novel capabilities for exploratory research.

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APPENDIX A

Tape-Slide Script

Note

Although the objective of this presentation states that four audio components will be covered, the script which follows represents only half the content. Since this was only Part I, only one test was given.

SINGLE-IMAGE PRESENTATION

SLIDES	TAPE
1. CU speaker	FU MUSIC
2. MS receiver. Digital: Guide to Stereo High Fidelity	Music
3. MS receiver. Digital: ... helping you select a hi-fi system	Music
4. MS tuner. Digital: Produced by D. Perri	Music
5. MS table radio	FU NARRATOR/F-UNDER MUSIC NARRATOR: The term High Fidelity has become a commercial catchphrase that may be found on just about anything that produces sound.
6. MS speakers and trumpet slightly overlapping	Almost all manufacturers claim total faithfulness to the original sound but the ability to judge the clarity of sound requires long training.
7. LS sound system in display	FO MUSIC NARRATOR: The purpose of this tape-slide show is to acquaint you with the basic components of a Hi-Fi system,
8. MS speakers, turntable, tuner, and amplifier	that is: tuner, amplifier, speakers, and turntable.

By the end of this show, you should be able to select a sound system by comparing the corresponding specifications of two or more Hi-Fi components and choosing the one with the highest or lowest value depending, of course, on which one is more appropriate.

9. MS first page of test. Instructions

The show is divided into two parts. Right after each part, you will be asked to complete a short test to determine how much you have learned. You should be able to answer correctly at least 7 questions out of each 10.

10. CU headings of presentation

What is High Fidelity?

Choosing the Hi-Fi components

Speakers

Tuner

Amplifier

Record Player

Do's and Don't's for Hi-Fi

FU MUSIC/FO NARRATOR

11. Digital: What is High Fidelity?	CROSSFADE MUSIC TO NARRATOR NARRATOR: High Fidelity or Hi-Fi means that sound is reproduced as it was recorded in the studio. The sound picked up by a Hi-Fi receiver should be reproduced without changes.
12. LS person playing guitar at center of speakers	One way to test this would be to compare a live musician with the original tune reproduced by a sound system.
13. MS drummer and speakers	In an ideal situation, you shouldn't be able to distinguish whether the tune comes from the musician or from the speakers. When this happens, we say that the sound system has zero distortion or no distortion at all.
14. LS drawing of orchestra	But in practice it is very difficult to set up a test like that because, number one, you would need a musician every time you wanted to test a system;
15. MS piano	and number two, most of the instruments that can reproduce the

	wide range of human hearing are not portable. Therefore, this method is obviously impractical.
16. CU screen of oscilloscope	Manufacturers use a more practical method, electronic instruments, to measure distortion.
17. CU ear. Digital: 20-20,000 Hz	For example, the human hearing ranges from about 20 to 20 thousand vibrations per second or, in technical terms, from 20 to 20 thousand hertz.
18. Graph of uniform frequency response	This wide range of frequencies should be reproduced by any Hi-Fi component with the same intensity of loudness as it was recorded in the studio. If the reproduction is faithful to the original sound, a Distortion Analyzer would display is as a straight line which is called Flat Frequency Response.
19. Graph of deviation from Flat Frequency Response	If instead, the reproduced note sounds louder or different than the original note, the Distortion Analyzer would display the change

	as deviations from the Flat Frequency Response line and measures them in DB's.
20. Digital: Family Name: Distortion Given Name: __________?	There are different types of distortion but they all reduce the clarity of the reproduced sound.
21. CU trumpet and clarinet	For example, when two similar musical instruments like a trumpet and a clarinet are reproduced sounding almost the same, the distortion is called Harmonic Distortion.
22. CU telephone set	An extreme case of Harmonic Distortion occurs in the telephone, when frequently a person's voice is so drastically changed that it's difficult to recognize.
23. Graph. Deviation from Flat Frequency Response	When, instead, some instruments are reproduced either louder or softer than the way they should really sound, the distortion is called Poor Frequency Response, or Deviation from the Flat Frequency Response.
24. CU volume control	This has the same effect as increasing or decreasing the volume every time a specific instrument

plays. Of course, that certainly doesn't add any pleasure to your listening.

25. MS receiver specifications

All these measurements are called technical specifications and they are provided by the manufacturer on the pamphlets which come with the Hi-Fi component. In the rest of this show, we will compare the corresponding specifications of two or three Hi-Fi components and learn to choose the best.

26. Digital: Choosing Hi-Fi Components

FO NARRATOR/FU MUSIC

27. LS Tuner, Pre-Amp., Power-Amp., Receiver

CROSSFADE MUSIC TO NARRATOR

NARRATOR: Once you have decided that you want to buy a Hi-Fi system, there are many options available to you. If you visit an audio shop, you'll see displays of components called receivers, tuners, pre-amplifiers, or power amplifiers. To understand what choice is best for you, let's consider the function of each of these components.

28. MS tuner	A tuner picks up the radio signals transmitted in the air from a radio station and converts them into electronic signals which are finally converted into sound by the speaker.
29. MS Pre-amplifier	The pre-amplifier is the component is the component which comes after the tuner or turntable. It allows you to change the volume and the tone of the program. It is the component which has the most controls, switches, and pushbuttons.
30. MS power amplifier	The power amplifier further amplifies the electrical signals and raises them to a level necessary to drive the speakers at the volume of your choice.
31. Graph of receiver showing its components; tuner, pre-amp and and power-amp	A receiver is a combination of a tuner, a pre-amplifier, and a power amplifier in one single cabinet; but, it never includes the speakers.
32. CU receiver	Most Hi-Fi systems use a receiver. There are two good reasons for

this choice.

33. MS man in home environment enjoying music

The first reason is simplicity. If all you want is to sit down and listen to the radio, then all you have to do is to connect the receiver to a pair of speakers, plug it in and enjoy the music.

34. MS back of receiver showing connections for turntable

If you want to listen to a record, that's simple too. But the main reason is savings.

35. Graph showing tuner, pre- and power-amp as part of receiver, resulting in savings

By combining all the units in one, there is bound to be a large cost saving. So if your budget is limited, it is best for you to concentrate on receivers than on separate components.

36. Order is which Hi-Fi components are connected (digital)

If, however, you desire more sophisticated equipment, and can afford it, a three-part system is the answer. Generally, this system offers greater power output and the absolute ultimate in performance.

37. LS different speakers

However, the choice of the electronic part for your sound system is very

	much related to your choice of speakers. Therefore, it is logical to buy the speakers first, and later the electrical components.
38. Digital: speakers	FO NARRATOR/FU MUSIC
39. MS person in audio shop	Music
40. LS receivers in display in audio shop	Music
41. MS different speakers with question mark (?)	FU NARRATOR/FADE UNDER MUSIC NARRATOR: The choice of the speakers is certainly the hardest to make when you shop for a sound system because no standard specifications are available to which a particular speaker can be compared.
42. MS speaker. Digital: selection of speaker	The following hints, however, will prove to be of great help to you when shopping for a pair of speakers.
43. LS speaker with specifications	FO MUSIC NARRATOR: Don't be concerned with the specifications of frequency response published by the manufacturer.

44. MS male announcer speaking into microphone

First, listen to the voice of your favorite male announcer. The sound should come out as if the announcer is sitting exactly halfway between the speakers.

45. MS various speakers

If the voice sounds like an old record, far away or too sharp, reject this speaker immediately. If you're not sure, ask the dealer himself to go halfway between the speakers and repeat the same words of the announcer. You can then compare the two sounds. Any speaker failing this test cannot pass a music test, and should be immediately rejected.

46. MS Test record

FU MUSIC AND UNDER NARRATOR

Music

NARRATOR: After the speaker passes the voice test, try another test. Play some selected classical records or special music recorded purposely to test a speaker.

47. MS turntable with record

Listen to the music for a while. See if the individual instruments can be picked up sharply.

<u>FU MUSIC/FO NARRATOR</u>

Music

48. CU bird and MS brass band

<u>CROSSFADE MUSIC TO NARRATOR</u>

<u>NARRATOR</u>: Check the dynamic range of the speaker; that is, if it can reproduce sound from soft levels to very loud ones. Listen....

<u>FU MUSIC</u>

49. Graphic of window on real background

<u>CROSSFADE MUSIC TO NARRATOR</u>

<u>NARRATOR</u>: Surprised? You're not the only one. When I tried this test at home, my wife rushed upstairs to look for the broken window.

50. MS speaker with sound waves

Anyway, many popular speakers require a substantial amount of amplifier power, called RMS power, before they start producing sound. At the other end of the scale, all speakers have physical limitations that determine the maximum amount of power they can handle before they are damaged or produce distortion.

51. MS speaker with Min and Max power specifications

Therefore, find out the minimum and maximum power recommended for that speaker. Generally, the greater,

		the Dynamic Range, that is, the difference between the maximum and minimum power, the better the speakers can reproduce changes in sound.
52.	LS different types of speakers	<u>FU MUSIC AND UNDER NARRATOR</u> Music <u>NARRATOR</u>: Once you have made your choice by following these tips, you will be in a better position to judge how much amplifier power you really need.
53.	Print: tuner	<u>FU MUSIC</u> Music
54.	CU tuner	Music
55.	CU tuner	Music
56.	MS tuner picking up radio waves	<u>CROSSFADE MUSIC TO NARRATOR</u> <u>NARRATOR</u>: The function of the tuner is to pick up both AM and FM radio waves transmitted by the radio station.
57.	LS park with trees	The main difference between AM and FM is the quality of reception. FM is known to be clear and not as

	noisy as AM. There are two reasons for that.
58. Graph of audio range showing AM and FM range	First of all the FM transmission allows music up to 15 thousand hertz. Although that's not quite as high as the 20 thousand hertz which is considered to be the highest frequency that people can hear, it is far better than AM.
59. Cartoon showing weight-lifter in front of a tuner. In print: "strong on static, but gentle on music".	The second reason is that the FM tuner does not pick up static or other electrical bugs and that qualifies it as Hi-Fi.
60. LS tuner with specifications	These are the tuner's specifications. Are you frightened, perhaps? Don't worry. You'll be surprised how well you will make sense out of them.
61. LS three tuners with respective specifications	These specifications are different from the specifications associated with speaker boxes because electronic specifications are more refined and that makes it easier for you to compare one tuner with another tuner or one amplifier with another amplifier.

62. MS tuner with Sensitivity specification

The Sensitivity specification indicates the ability of the tuner to pick up very weak or distant signals and turn them into clear sound. For example, a tuner with a sensitivity specification of 1.9 microvolts may pick up a radio station about 30 miles away but one with a sensitivity of 1.7 microvolts may pick up a station 50 miles away and produce a comparably clear sound.

63. LS three tuners showing Sensitivity specification for each

The lower the value, the more sensitive the tuner is because it can pick up smaller signals from stations located at greater distances. Therefore, the third tuner is in this case the tuner with the best Sensitivity specification.

64. MS tuner with S/N ratio specification

The Signal-to-Noise ratio indicates how clear the sound is picked up by the tuner.

65. LS CBC transmitting antenna

As the sound travels from the radio station to your receiver, it picks up static electricity along the way,

		and other unwanted noises. The Signal-to-Noise ratio specification indicates how well the tuner can distinguish between the true sound and other electrical interferences picked up over the distance. If the tuner doesn't filter out the sound from the unwanted noises, we hear a background hiss.
66.	MS cartoon of reporter interviewing someone in the street.	You can remember this specification by making an analogy with a reporter interviewing someone in the street, where the sound of the interviewee would correspond to the sound from the radio station and the noise of the cars would be the background hiss.
67.	LS three tuners showing S/N ratio specification	The Signal-to-Noise ratio tells you, in fact, how strong the sound is as compared to the background noise. Obviously, the higher the Signal-to-Noise ratio, the clearer the reception. In this case, the second tuner is the best.
68.	MS tuner. In digital: Harmonic Distortion	Harmonic Distortion is the specification indicating the changes

introduced in sound that did not exist in the studio when the original recording was made.

69. LS three tuners with respective Harmonic Distortion specifications

This specification is measured as a percentage, because it expresses the degree of change from the original recording. So, the lower this specification, the more natural the sound. For example, an ideal tuner with zero percent Harmonic Distortion would reproduce sound as if the orchestra was playing right in your living-room. But in practice, there is always a bit of distortion. It is important, though, to keep it as low as possible. So, the first tuner is the best in this case.

70. MS tuner with Selectivity specification

Selectivity, as the word implies, refers to the ability of the tuner to select a desired station among several present in the air at any time. A good tuner should open the door to just the station that you tune without letting some other station squeeze in too.

71.	Cartoon representing strength	A high Selectivity specification indicates the strength of the tuner to fight back the stations that want to squeeze in when they are not supposed to go through. So, the higher the better.
72.	LS three tuners with Selectivity specification	Therefore, the third tuner has the best Selectivity specification.
73.	MS tuner with Frequency Response specification	In High Fidelity, not only should the sound be reproduced without changes from the original studio recording, but also each instrument should sound with the same loudness as recorded. In other words, we don't want the drum to sound louder than the piano unless it was recorded that way. The specification describing this deviation from the original musical tune is called Frequency Response, and a typical Frequency Response specification might read: Frequency Response from 30 hertz to 15 thousand hertz plus or minus 1 DB.

74. Graph of Frequency Response

That means that no frequency within that range will be boosted of decreased by more than 1 DB as compared to the original sound. The greater the deviation, the less uniform is the Frequency Response. Therefore, the plus or minus number should be as close as possible to zero.

75. MS tuner with graph indicating left and right speakers

Finally, Stereo Separation is the last important specification of our concern. In stereophonic recordings, some instruments are meant to be reproduced by the left speaker, and some others by the right speaker.

76. LS traffic agent directing traffic

The tuner must therefore also act as a traffic agent directing each instrument to the left or to the right speaker as recorded in the studio. And just as a traffic agent keeps the cars spaced apart to avoid a collision, similarly, the tuner keeps the left and right channels separated to avoid mixing them up.

77. LS three tuners with Stereo Separation specification

The Separation to be maintained between the two stereo channels should be as high as possible. Therefore, the third tuner is again the best.

78. MS tuner specifications

FU MUSIC AND UNDER NARRATION

NARRATOR: There are other specifications, but those that we have seen are the most important ones to consider when selecting a tuner, whether as a unit by itself or integrated in a receiver.

79. Digital: Sensitivity, S/N Ratio, Selectivity, Stereo Separation, Harmonic Distortion, Frequency Response.

Here are in summary the six specifications that we have just seen.

FU MUSIC/FO NARRATOR

80. Digital: Sensitivity - Greater is Better

Music

81. Digital: S/N Ratio - Greater is Better

Music

82. Digital: Selectivity - Greater is Better

Music

83. Digital: Stereo Separation - Greater is Better

Music

84. Digital; Harmonic Distortion - Music
Lower is Better

85. Digital: Frequency Response - Music
Greater is Better

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86. Digital: End of Part I <u>FO MUSIC</u>

APPENDIX B

Projected Guide

PROJECTED GUIDE (Left Side)	PRESENTATION (Right Side)
1. Black	1. CU speaker
	2. MS receiver. Digital: Guide to Stereo High Fidelity
2. Instructions: 1. Listen to the tape, 2. Don't take down notes	3. MS receiver. Digital: ... helping you select a hi-fi system.
3. This side of the screen will indicate to you the most important points	4. MS tuner. Digital: produced by D. Perri
4. Black	5. MS table radio
	6. MS speakers and trumpet slightly overlapping.
5. This show will acquaint you with the components of a Hi-Fi system	7. LS sound system in display
6. By the end of the show, you should be able to select a sound system from the technical specifications	8. MS speakers, turntable, tuner and amplifier
7. After the show, you're expected to answer correctly 7 questions out of each 10	9. MS first page of test. Instructions
8. Black	10. CU headings of presentation "What is High Fidelity? Choosing the Hi-Fi Components Speakers Tuner Amplifier Record-Player Do's and Don't's for Hi-Fi"
9. High Fidelity means reproducing sound without changes	11. Digital: What is High Fidelity?
10. Black	12. LS person playing guitar at center of speakers

PROJECTED GUIDE (Left Side)	PRESENTATION (Right Side)
11. If the sound coming out from the speaker can't be distinguished from the live sound, we have zero distortion	13. MS drummer and speakers 14. LS drawing of orchestra
12. Black	15. MS piano
13. Distortion is measured by electronic instruments and specified by manufacturers	16. CU screen of oscilloscope
14. Audio Range: 20 to 20,000 Hz	17. CU ear. Digital: 20-20,000 Hz
15. Perfect sound reproduction is displayed by Distortion Analyzer as a straight line	18. Graph of uniform frequency response
16. Deviations from the straight line indicate bad reproduction	19. Graph of deviations from Flat Frequency Response
17. Black	20. Print: "Family Name: Distortion Given Name: ? "
18. Harmonic Distortion reduces the clarity of the reproduced sound	21. CU trumpet and clarinet 22. CU telephone set
19. Poor Frequency Response causes some instruments to be reproduced louder or softer than recorded	23. Graph-Deviation from Flat Frequency Response 24. CU volume control
20. Black	25. MS receiver specifications 26. Print: Choosing Hi-Fi Components 27. LS Tuner, Pre-amp, Power-amp, Receiver
21. Tuner picks up radio signals	28. MS Tuner
22. Pre-amplifier allows you to control sound	29. MS Pre-amplifier
23. Power-amplifier raises sound to the desired volume	30. MS Power-amplifier
24. The receiver combines in one cabinet tuner, pre-amplifier, and power-amp	31. Graph of receiver showing its components: tuner, pre-amp and power-amp

PROJECTED GUIDE (Left Side)	PRESENTATION (Right Side)
	32. CU receiver
25. Black	33. MS Man in home environment enjoying music
	34. MS Back of receiver showing connections for turntable
26. By combining in one cabinet the tuner, pre-amp, and power-amp there is a cost saving	35. Graph showing tuner, pre-amp, and power-amp as part of receiver resulting in savings
27. Black	36. Order in which Hi-Fi components are connected (digital)
28. Speakers determine the power required from receiver	37. LS Different speakers
	38. Digital: Speakers
	39. MS Person in audio shop
	40. LS Receivers in display in audio shop
29. Black	41. MS Different speakers with question mark (?)
	42. MS Speakers. Digital: Selection of Speaker
30. Disregard the speaker's frequency response specification	43. LS Speaker with specifications
31. Listen to the voice of your favourite male announcer. It should sound real.	44. MS Male announcer speaking into mic.
32. Reject any speaker failing the male-voice test	45. MS Various speakers
33. Black	46. MS Test record
34. All instruments should be reproduced sharply	47. MS Turntable with record
35. Can the speaker reproduce very soft passages and thundering loud volumes?	48. CU Bird and MS Brass band

PROJECTED GUIDE (Left Side)	PRESENTATION (Right Side)
36. Black	49. Graphic of window on real background
	50. MS Speaker with sound waves
37. Dynamic Range = (Max power - Min power) Greater is better.	51. MS Speaker with min and max power specifications
38. Black	52. LS Different types of speaker
	53. Print: Tuner
	54. CU Tuner
	55. CU Tuner
39. Tuner picks up transmitted radio waves	56. MS Tuner picking up radio waves
40. Black	57. LS Park with trees
41. FM is clearer than AM because:	58. Graph of audio range showing AM and FM range
	59. Cartoon showing weight-lifter in front of a tuner. In print: "Strong on static, but gentle on music."
42. Black	60. LS Tuner with specifications
	61. LS Three tuners with respective specifications
43. Sensitivity: ability to pick up weak signals	62. MS Tuner with Sensitivity specifications
	63. LS Three tuners showing Sensitivity specification for each
44. Signal-to-Noise Ratio: specifies the strength of sound as compared to unwanted noise. Higher is better.	64. MS Tuner with S/N ratio specifications
	65. LS CBC transmitting antenna
	66. MS Cartoon of reporter interviewing someone in the street
	67. LS Three tuners showing S/N ratio of each

PROJECTED GUIDE (Left Side)	PRESENTATION (Right Side)
45. Harmonic Distortion: indicates how much the original sound is changed by the tuner. Lower is better.	68. MS Tuner. In digital: "Harmonic Distortion"
	69. LS Three tuners with respective Harmonic Distortion specifications
46. Selectivity: ability to select one station among hundreds of others. Higher is better.	70. MS Tuner with Selectivity specifications.
	71. Cartoon representing strength
	72. LS Three tuners with Selectivity specifications
47. Frequency Response: deviation from original musical tune. Smaller deviation is better.	73. MS Tuner with Frequency Response specification
	74. Graph of Frequency Response
48. Stereo Separation: ability to prevent the left and right channel from mixing together. Higher is better.	75. MS Tuner with graphic indicating Left and Right speaker
	76. LS Traffic agent directing traffic
	77. LS Three tuners with Stereo Separation specification
49. Black	78. MS Tuner specifications
50. Sensitivity should be high or low?	79. Digital: Sensitivity, S/N ratio, Selectivity, Stereo Separation, Harmonic Distortion, Frequency Response.
51. Sensitivity: greater is better. Signal-to-Noise ratio: High or Low?	80. Digital: Sensitivity - greater is better
52. Sensitivity: greater is better. Signal-to-Noise ratio: greater is better. Selectivity: High or Low?	81. Digital: S/N ratio - greater is better
53. Sensitivity: greater is better Signal-to-Noise ratio: greater is better Selectivity: greater is better Stereo Separation: High or Low?	82. Digital: Selectivity - greater is better

PROJECTED GUIDE (Left Side)	PRESENTATION (Right Side)
54. Sensitivity: greater is better Signal-to-Noise ratio: greater is better Stereo Separation: greater is better Harmonic Distortion: High or Low?	83. Digital: Stereo Separation -- greater is better
55. Sensitivity: greater is better Signal-to-Noise ratio: greater is better. Selectivity: greater is better Stereo Separation: greater is better Harmonic Distortion: lower is better Frequency Response: High or Low?	84. Digital: Harmonic Distortion - lower is better
56. Sensitivity: greater is better Signal-to-Noise Ratio: greater is better Selectivity: greater is better Stereo Separation: greater is better Harmonic Distortion: lower is better Frequency Response: ± 1 DB	85. Digital: Frequency Response ±1 DB small deviation is better
57. Black	86. Digital: End of Part I
	87. Black

APPENDIX C

Printed Guide

GUIDE TO STEREO HIGH FIDELITY

PRINTED GUIDE

INSTRUCTIONS:

1. Watch the show.

2. Every time you see a red circle on the left side of the slide, and/or a specific slide indicating LOOK AT YOUR GUIDE, read this Guide.

3. At the first signal, i.e. red circle and/or LOOK AT YOUR GUIDE, read the first sentence and check circle next to it.
   At the second signal, read the second sentence, and so on.

4. Do not go back to a sentence that you have already read.

○ Instructions:
1. Listen to the tape.
2. Don't take down notes.
3. Check the circle next to each sentence after you have read it.

○ This Guide will indicate to you the most important points.

○ This show will acquaint you with the components of a Hi-Fi system.

○ By the end of the show, you should be able to select a sound system from the technical specifications.

○ After the show, you're expected to answer correctly 7 questions out of each 10.

○ High Fidelity means reproducing sound without changes.

○ If the sound coming out from the speaker can't be distinguished from the live sound, we have zero distortion.

○ Distortion is measured by electronic instruments and specified by manufacturers.

○ Audio Range: 20 to 20,000 Hz

○ Perfect sound reproduction is displayed by Distortion Analyzer as a straight line.

○ Deviations from the straight line indicate bad reproduction.

○ Harmonic Distortion reduces the clarity of the reproduced sound.

○ Poor Frequency Response causes some instruments to be reproduced louder or softer than recorded.

○ Tuner picks up radio signals.

- Pre-amplifier allows you to control sound.
- Power-amplifier raises sound to the desired volume.
- The receiver combines in one cabinet tuner, pre-amplifier, and power-amp.
- By combining in one cabinet the tuner, pre-amp, and power-amp, there is a cost saving.
- Speakers determine the required electronic components.
- Disregard the speakers' Frequency Response specifications.
- Listen to the voice of your favorite male announcer. It should sound real.
- Reject any speaker failing the male-voice test.
- All instruments should be reproduced sharply.
- Can the speaker reproduce very soft passages and thundering loud volumes?
- Dynamic Range = (Max power - Min power) Greater is better.
- Tuner picks up transmitted radio waves.
- FM is clearer than AM because:
  - a) higher audio range
  - b) no static picked up
- Sensitivity: ability to pick up weak signals.
- Signal-to-Noise ratio: specifies the strength of sound as compared to unwanted noise.
  Higher is better.

○ Harmonic Distortion: indicates how much the original sound is changed by the tuner.
Lower is better.

○ Selectivity: ability to select one station among hundreds of others.
Higher is better.

○ Frequency Response: deviation from original musical tune.
Smaller deviation is better.

○ Stereo Separation: ability to prevent the left and right channel from mixing together.
Higher is better.

○ Sensitivity should be high or low?

○ Sensitivity: Greater is better.
Signal-to-Noise Ratio: High or Low?

○ Sensitivity: Greater is better.
Signal-to-Noise Ratio: Greater is better.
Selectivity: High or Low?

○ Sensitivity: Greater is better.
Signal-to-Noise Ratio: Greater is better.
Selectivity: Greater is better.
Stereo Separation: High or Low?

○ Sensitivity: Greater is better.
Signal-to-Noise Ratio: Greater is better.
Selectivity: Greater is better.
Stereo Separation: Greater is better.
Harmonic Distortion: High or Low?

○ Sensitivity: Greater is better.
Signal-to-Noise Ratio: Greater is better.
Selectivity: Greater is better.
Stereo Separation: Greater is better.
Harmonic Distortion: Lower is better.
Frequency Response: High or Low?

Sensitivity: Greater is better.
Signal-to-Noise Ratio: Greater is better.
Selectivity: Greater is better.
Stereo Separation: Greater is better.
Harmonic Distortion: Lower is better.
Frequency Response: + or - 1 DB
(small deviation is better)

APPENDIX D

Pretest

GUIDE TO STEREO HIGH-FIDELITY

LEARNING MEASUREMENT

NAME: ____________________

H/R: ____________________

MALE: ____________________

FEMALE: ____________________

INSTRUCTIONS:

1. TAKE UP TO 30 MINUTES TO COMPLETE THIS TEST.

2. ANSWER ALL QUESTIONS. IF YOU DO NOT KNOW ANSWER, PLEASE TAKE A GUESS.

3. MARKS FOR THIS TEST WILL NOT COUNT FOR A GRADE, BUT WILL BE USED TO DETERMINE HOW MUCH YOU CAN LEARN WHEN TAUGHT BY A TAPE-SLIDE SHOW.

4. DARKEN THE LETTER CORRESPONDING TO BEST GIVEN CHOICE ON THE ANSWER SHEET.

1. Poor frequency response causes some instruments to be reproduced

   a) softer or louder than originally recorded
   b) with a background
   c) with static electricity
   d) faster or slower than originally recorded in the studio

2. The main reason for combining two or three Hi-Fi components in one cabinet is

   a) better sound reproduction
   b) more power output
   c) less distortion
   d) cost saving

3. When the sound coming out from a speaker cannot be distinguished from the same live sound, we have

   a) a good speaker but with small dynamic range
   b) a bad speaker
   c) zero distortion
   d) high distortion

4. Before buying a pair of speakers, you should listen to the voice of your favorite male announcer. If it does not sound real (almost live)

   a) listen to some classical records and accept that speaker only if instruments sound clear
   b) reject that speaker immediately
   c) check if the speaker can reproduce sound ranging from soft levels to loud ones
   d) check the speaker with a better amplifier and try a different male announcer

5. High Fidelity means

   a) reproducing loud sound
   b) reproducing sound without changes
   c) reproducing FM sound
   d) perfect tuning

6. The sensitivity of a tuner specifies

   a) the ability to distinguish between electrical noise, such as static electricity, and the transmitted sound signal, and turn it into clear sound

   b) the radius of the circular path in which the tuner is sensitive to a transmitted signal

   c) the ability to pick up weak signals

   d) the ability to pick up the selected station (even when far away) among the hundreds of stations presented in the air at any given time

7. The Dynamic Range of a speaker

   a) indicates how perfect the sound is reproduced

   b) indicates the ability of the speaker to reproduce clear sound at loud volumes

   c) is equal to the maximum power minus the minimum power that the speaker can handle

   d) should ideally be zero for proper balance

8. The Signal-to-Noise ratio specification indicates

   a) the strength of sound as compared to unwanted noise such as FM background hiss

   b) the amount of noise introduced by the transmitting station in the process of transmission

   c) the ratio between the sound of the selected station and that of a station that squeezes in the background

   d) the ratio obtained when a 1000 Hz signal and 20,000 Hz signal are introduced in the tuner for the test

9. Which tuner has the best <u>Sensitivity</u> specification?

   a) 1.8 mV

   b) 1.8 DB

   c) 1.8 %

   d) 2.5 mV

10. Which tuner has the best Signal-to-Noise ratio specification?

a) 50 DB
b) 50 mV
c) 0 %
d) 90 DB

11. The Harmonic Distortion specification indicates

a) the amount of background noise or hiss
b) how much the original sound is changed in the process of reproduction
c) the ability to prevent the left and right channel from mixing together
d) the ability to keep instruments at the same level of recording (neither louder nor softer)

12. Which tuner has the best Stereo Separation specification?

a) 99 DB
b) 99 %
c) 3.33 m
d) 3.33 DB

13. Which tuner has the best Selectivity specification?

a) 1 DB
b) 50 %
c) 88 MHz to 108 MHz
d) 100 DB

14. Which tuner has the best Harmonic Distortion specification?

a) 90 DB
b) 0.1 %
c) 90 mV
d) 0.9 %

15. Which tuner is best?

a) Harmonic Distortion: 0.9 %
   Sensitivity: 1.3 mV

b) Harmonic Distortion: 0.1 %
   Sensitivity: 1.8 mV

c) Harmonic Distortion: 90 mV
   Sensitivity: 1.8 %

d) Harmonic Distortion: 90 DB
   Sensitivity: 1.7 DB

16. Which tuner is best?

a) Sensitivity: 1.5 mV
   Stereo Separation: 99 DB
   Selectivity: 100 DB

b) Sensitivity: 1.5 %
   Stereo Separation: 99 %
   Selectivity: 1 DB

c) Sensitivity: 2.5 DB
   Stereo Separation: 100 m
   Selectivity: 88 MHz to 108 MHz

d) Sensitivity: 1.8 mV
   Stereo Separation: 3.33 DB
   Selectivity: 50 %

17. Which tuner has the best Frequency Response specifications?

a) 30 to 15,000 Hz + or - 4 DB

b) 30 to 15,000 Hz + or - 3 DB

c) 30 to 15,000 Hz + or - 1 DB

d) 30 to 20,000 Hz + or - 1 DB

18. Multiply 6.52 x 0.25 =

19. Divide 9.75 by 0.15 =

20. Add 3.45 + 0.16 + 0.008 =

21. How much of this material did you know before watching the show? Please be honest. Your co-operation will help us determine how effective the show was.

a) none

b) less than 3 questions

c) from 3 to 5 questions

d) from 5 to 10 questions

e) over 10 questions

22. Did you ever buy a sound system?

a) No, I did not buy a sound system

b) Yes, over 6 months ago

c) Yes, from 2 to 6 months ago

d) Yes, less than 1 month ago

23. Have you compared the technical specifications of two or more receivers sometimes in the past month?

a) Never

b) Yes, 1 to 5 times

c) Yes, over 5 times

d) Yes, but I do not remember them

APPENDIX E

Posttest

GUIDE TO STEREO HIGH-FIDELITY

LEARNING MEASUREMENT

NAME: ________________

H/R: ________________

MALE: ________________

FEMALE: ________________

1. TAKE UP TO 30 MINUTES TO COMPLETE THIS TEST.
2. YOU MAY NOT USE ANY NOTES.
3. MARKS FOR THIS TEST WILL NOT COUNT FOR A GRADE, BUT WILL BE USED TO DETERMINE HOW MUCH A STUDENT CAN LEARN WHEN TAUGHT BY A TAPE-SLIDE SHOW OF THIS TYPE.
4. PLEASE ANSWER ALL QUESTIONS ON THE PROVIDED ANSWER SHEET. DARKEN THE LETTER CORRESPONDING TO THE BEST GIVEN CHOICE.

1. Multiply 2.65 x 1.3 =

   a) 2.95
   b) 3.445
   c) 1.798
   d) 34.45

2. Divide 2.25 by 0.25 =

   a) 9
   b) 0.9
   c) 0.09
   d) 0.86

3. Add 1.25 + 0.69 + 0.005 =

   a) 1.945
   b) 1.90
   c) 1.55
   d) 6.955

4. High Fidelity means

   a) reproducing loud sound
   b) reproducing sound without changes
   c) reproducing FM sound
   d) perfect tuning

5. When the sound coming out from a speaker cannot be distinguished from the same live sound, we have

   a) a good speaker, but with small dynamic range
   b) a bad speaker
   c) zero distortion
   d) high distortion

6. Poor frequency response causes some instruments to be reproduced

   a) softer or louder than originally recorded
   b) with a background hiss
   c) with static electricity
   d) faster or slower than originally recorded in the studio

7. The main reason for combining two or three Hi-Fi components in one cabinet is

   a) better sound reproduction
   b) more power output
   c) less distortion
   d) cost saving

8. Before buying a pair of speakers, you should listen to the voice of your favourite male announcer. If it does not sound real (almost live)

   a) listen to some classical records and accept that speaker only if instruments sound clear
   b) reject that speaker immediately
   c) check if the speaker can reproduce sound ranging from soft levels to loud ones
   d) check the speaker with a better amplifier and try a different male announcer

9. The Dynamic Range of a speaker

   a) indicates how perfect the sound is reproduced
   b) indicates the ability of the speaker to reproduce clear sound at loud volumes
   c) is equal to the maximum power minus the minimum power that the speaker can handle
   d) should ideally be zero for proper balance

10. The Signal-to-Noise ratio specification indicates

   a) the strength of sound as compared to unwanted noise such as FM background hiss
   b) the amount of noise introduced by the transmitting station in the process of transmission
   c) the ratio between the sound of the selected station and that of a station that squeezes in the background
   d) the ratio obtained when a 1000 Hz signal and a 20,000 Hz signal are introduced in the tuner for the test

11. The Harmonic Distortion specification indicates

   a) the amount of background noise or hiss
   b) how much the original sound is changed in the process of reproduction
   c) the ability to prevent the left and right channel from mixing together
   d) the ability to keep instruments at the same level of recording (neither louder nor softer)

12. The Sensitivity of a tuner specifies

    a) the ability to distinguish between electrical noise, such as static electricity, and the transmitted sound signal and turn it into clear sound
    b) the radius of the circular path in which the tuner is sensitive to a transmitted signal
    c) the ability to pick up weak signals
    d) the ability to pick up the selected station (even when far away) among the hundreds of stations present in the air at any given time

13. Which tuner has the best Sensitivity specification?

    a) 1.8 mV
    b) 1.8 DB
    c) 1.8 %
    d) 2.5 mV

14. Which tuner has the best Signal-to-Noise ratio specification?

    a) 50 DB
    b) 50 mV
    c) 0 %
    d) 90 DB

15. Which tuner has the best Harmonic Distortion specification?

    a) 90 DB
    b) 0.1 %
    c) 90 mV
    d) 0.9 %

16. Which tuner has the best Frequency Response specification?

    a) 30 to 15000 Hz + or - 4 DB
    b) 30 to 15000 Hz + or - 3 DB
    c) 30 to 15000 Hz + or - 1 DB
    d) 30 to 20000 Hz + or - 4 DB

17. Which tuner has the best Stereo Separation specification?

    a) 99 DB
    b) 99 %
    c) 3.33 m
    d) 3.33 DB

18. Which tuner has the best Selectivity specification?

a) 1 DB
b) 50 %
c) 88 MHz to 109 MHz
d) 100 DB

19. Which tuner is best?

a) Sensitivity: 1.5 mV
Stereo Separation: 99 DB
Selectivity: 100 DB
b) Sensitivity: 1.5 %
Stereo Separation: 99 %
Selectivity: 1 DB
c) Sensitivity: 2.5 DB
Stereo Separation: 100 m
Selectivity: 88 MHz to 108 MHz
d) Sensitivity: 1.8 mV
Stereo Separation: 3.33 DB
Selectivity: 50 %

20. Which tuner is best?

a) Harmonic Distortion: 0.9 %
Sensitivity: 1.3 mV
b) Harmonic Distortion: 0.1 %
Sensitivity: 1.8 mV
c) Harmonic Distortion: 90 mV
Sensitivity: 1.8 %
d) Harmonic Distortion: 90 DB
Sensitivity: 1.7 DB

21. How much of this material did you know before watching the show? Please be honest. Your co-operation will help us determine how effective the show was.

a) none
b) less than 3 questions
c) from 3 to 5 questions
d) from 5 to 10 questions
e) over 10 questions

22. Did you ever buy a sound system?

a) No, I did not buy a sound system
b) Yes, over 6 months ago
c) Yes, from 2 to 6 months ago
d) Yes, less than 1 month ago

23. Have you compared the technical specifications of two or more receivers sometimes in the past month?

a) never
b) Yes, 1 to 5 times
c) Yes, over 5 times
d) Yes, but I do not remember them

APPENDIX F

Questionnaire

Means Results and Chi Square Test for each Statement of Questionnaire:

Key
1. Strongly Agree, SA
2. Agree, A
3. Undecided, U
4. Disagree, D
5. Strongly Disagree, SD

1. This tape-slide show was a good means of presenting the subject.

	SA	A	U	D	SD
Printed	9	20	2	0	1
Projected	12	16	2	0	0

Raw Chi Square = 1.81 with 3df. (N.S.D.)

2. The fact that you were made aware that at the end of the show there was a test and that you had to compare two or more technical specifications was helpful in letting you know just what to remember from this show.

	SA	A	U	D	SD
Printed	3	19	9	1	0
Projected	16	13	1	0	0

Raw Chi Square = 17.37 with 3df. (p = .001)

3. (Projected guide group only)
The projected guide on the left side of the screen facilitated the recall of the subject matter presented by this show.
(Printed guide group only)
The printed guide facilitated the recall of the subject matter presented by this show.

	SA	A	U	D	SD
Printed	8	21	0	3	0
Projected	13	12	4	0	1

Raw Chi Square = 11.59 with 4df. (p =.05)

4. (Projected guide group only)
   All tape-slide shows should have a projected guide like the one in this show.
   (Printed guide group only)
   All tape-slide shows should have a printed guide like the one in this show.

	SA	A	U	D	SD
Printed	5	17	8	2	0
Projected	10	14	4	2	0

Raw Chi Square = 3.23 with 3df. (N.S.D.)

5. (Projected guide group only)
   Having the viewing guide projected on the left side of the screen was better than having the same material printed on a stencil which had to be read while the show was going on.
   (Printed guide group only)
   Having the viewing guide printed on a stencil was better than having the same guide projected on the left side of the screen which you had to read while the show was going on.

	SA	A	U	D	SD
Printed	3	17	9	3	0
Projected	16	12	2	0	0

Raw Chi Square = 17.16 with 3df. (p =.001)

6. (Projected guide group only)

Having the projected viewing guide and letting you know in advance just what was expected of you by the end of the show is a better way to learn than using the tape-slide show alone.

(Printed guide group only)

Having the printed viewing guide and letting you know in advance just what was expected of you by the end of the show is a better way to learn than using the tape-slide show alone.

	SA	A	U	D	SD
Printed	6	22	3	1	0
Projected	11	13	5	1	0

Raw Chi Square = 4.22 with 3df. (N.S.D.).

7. (Projected guide group only)

The projected guide interfered with the viewing of the main tape-slide show.

(Printed guide group only)

The printed guide interfered with the viewing of the main tape-slide show.

	SA	A	U	D	SD
Printed	5	9	3	15	0
Projected	0	3	3	15	9

Raw Chi Square = 16.95 with 4df. ($\underline{p}$ = .005)

8. You could have learned as much from this show without a viewing guide.

	SA	A	U	D	SD
Printed	2	8	11	10	1
Projected	1	5	4	11	9

Raw Chi Square = 10.7 with 4 df (p =.03)

9. The review part of this show got you involved.

	SA	A	U	D	SD
Printed	3	17	7	3	2
Projected	11	14	4	1	0

Raw Chi Square = 8.62 with 4 df. (N.S.D.)

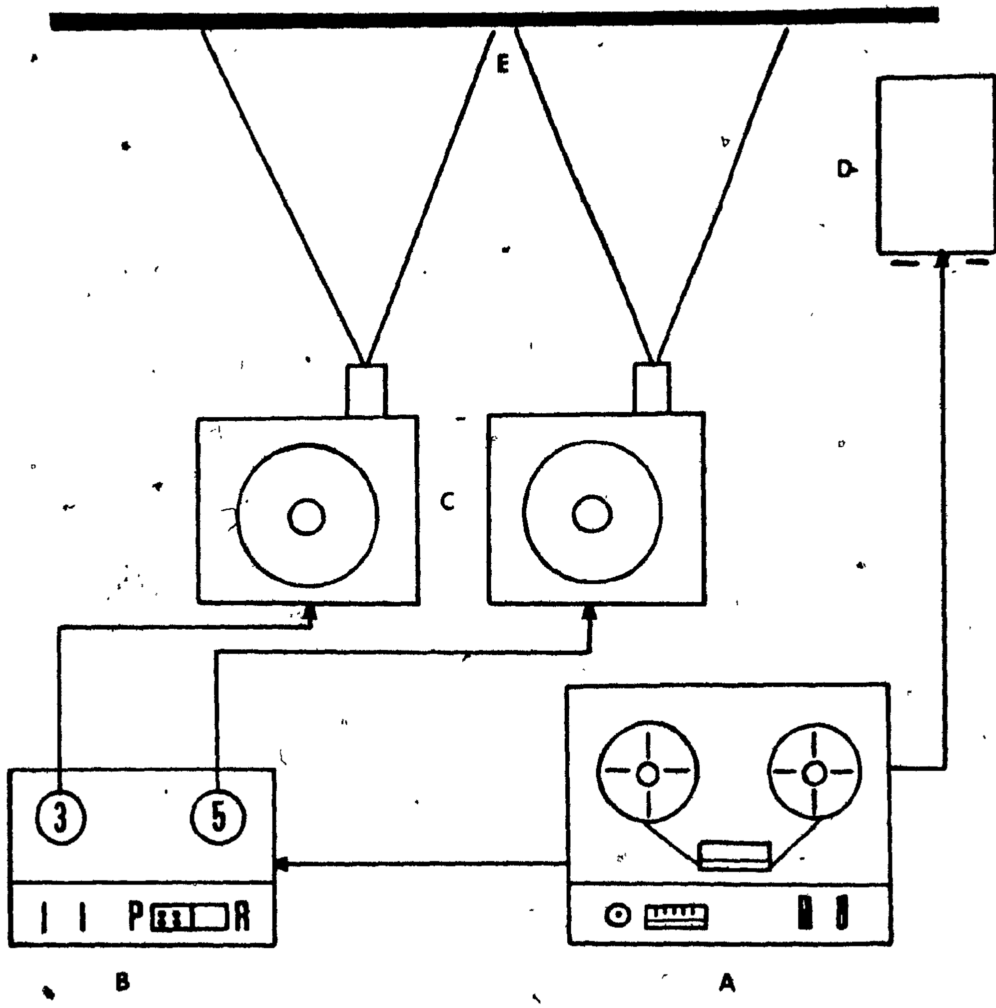
10. You wish to see Part II of this show at some later time.

	SA	A	U	D	SD
Printed	9	12	6	2	3
Projected	14	14	1	0	1

Raw Chi Square = 7.75 with 4 df. (N.S.D.)

APPENDIX G

Projection Equipment



A. TC-270 Sony stereo tape-recorder

B. Media Master 5-channel Multimedia Programmer, model 375R

C. Kodak Carousel 850-H 35mm slide projectors

D. Hi-Fi speaker

E. 9 by 12 foot projector screen