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Kamran Moghbel

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CHAPTER 1

INTRODUCTION

Greek philosophers of early ages dealt with the question whether words really embody the nature of things and whether the structure of language reflects the structure of the world (Dember & Jenkins, 1970). The ancients recognized the problem of giving meaning through some kind of sign writing, pictograms, ideograms and so on. With a few exceptions (Chinese, Japanese), ideograms are not currently used to represent both concrete objects and abstracts; alphabetic representation of speech sounds predominates. Every child seems to discover that "things" have names and goes through a period in which "what-is-it" is a constant question and a name (a word) is the standard response (cf Farnham-Diggory, 1972). Through such a system of labelling and explanation we give some meaning to the environment. To association theorists the meaning of an object, a picture or a word is just the overt or covert response one makes to that stimulus. In this view, the stimuli that elicit many responses are called more meaningful and those which elicit few responses are less meaningful.

Common practice in the presentation of visual teaching materials seems to be based on the adage that a picture is worth a thousand words. Some relationship between the picture and verbal material is

assumed to exist once the two types of stimuli are simultaneously presented. This may be theoretically sound with regard to S-R learning theories; one may be asked to remember the labeled "house", or he may be asked to show a house when given the label. This is not, however, a very good way to observe the process of memory for pictures or words. Psychological investigation of the effect of labeling a visual display on subsequent change in the stored trace has shown that when ambigious figures are given meaningful labels, on later attempts to produce the figures subjects tend to produce figures which fit the labels rather than the original figures (Hall, 1950). Similar experiments to elaborate on the function of memory and stimulus meaningfulness have been carried out with verbal materials; an unusual story is told to a subject, this subject repeats the story to another and so on. In the retelling of the story the material is changed to fit a more reasonable pattern (in F. Diogory, 1972).

Both types of studies reveal the role of human cognition in reproduction of visual or aural materials. In terms of Shannon-Weaver communication theory, among other necessary factors for an effective communication; the decoder and encoder of the system must use a common system of symbols (e.g. same language) so that the receiver of the message understands the information. Additionally, words may be an integral part of the passage of pictorial information and conveyance of ideas. It is not, therefore, surprising that as Ebel (1965) stated "the kind of knowledge that schools and colleges are most concerned with is verbal knowledge. To the degree that a person's experiences of external affairs and internal thoughts can be expressed in words, they become a part of his verbal knowledge" (p. 40).

Many, if not all, audio-visual teaching materials are so produced as to show an object or a phenomenon through the visual channel and give its name or some description through the auditory channel (Van Mondfrans & Travers, 1963). On the auditory side, the storage process has been studied with relative success. However, there seems to be less agreement about the fate of pictorial stimuli in the human memory system. The problem arises if we ask to what extent the subsequent recall of information may be attributed to either, or both sense modalities through which information is delivered. An experiment by Carmichael and Walter (cited by Dember & Jenkins, 1970, p. 419) examined the coding aspect of memory by giving distorted figures along with verbal "memory aids" that suggested particular coding; they found that subsequent recall (by drawing) tended to reflect the memory aids.

The experimental findings refered to so far imply that unfamiliar stimuli tend to be given some meaning during their subsequent recall from the memory system. It is conceivable that the "meaning" of given pictorial stimuli heavily rely upon verbal labeling and verbal coding (Norman, 1969). The present paper attempts to measure the effect of aurally or pictorially repeated materials upon their retrieval from short-term memory.

Context of the Problem

The simplest audio-visual instructional program necessarily consists of the association of pictorial and auditory material. Oftentime, the task of associating the two types of materials is a difficult one; the right auditory message may not accompany the right pictorial stimuli.

Nevertheless, it is said that multimodality communication results in the reception of more information than does single modality communication (Travers, 1966). One may reasonably examine the relative effectiveness of each channel of communication on the retention of information following the repetition of either verbal or visual materials. Through the wealth of theories that the information-processing and communication approaches provide to the technology of education, this research will seek to shed some light on manipulation of auditory and visual information presented via a slide-tape program.

Statement of the Problem

It is generally accepted that information received by means of audio-visual stimuli is processed and stored in short-term memory (STM) as an early stage in human information processing (Haber, 1969; Lindley & Brown, 1971; Norman & Lindsay, 1973). Repetition of material in an instructional program is well established as a procedure to facilitate retention (Lumsdaine, 1963; Reynolds and Glaser, 1964). However, it is not clear whether repetition of the audio portion or extension of the visual portion of an audio-visual presentation is a more effective means of facilitating retention.

The present study was designed to examine whether auditory repetition (called AR) or extended pictorial exposure (called VR) may yield superior retention on a post-test administered to Grade 8 and 9 students.

CHAPTER 2

REVIEW OF THE RELATED LITERATURE

COMPARATIVE MEMORY STUDIES

Sperling (1960) has suggested that "remembering" may occur in separate visual and auditory stores. Further, he postulates that visual material is immediately encoded into a verbal presentation of stimuli and proceeds to the auditory store. The idea that all material is stored auditorily is supported by Conrad's (1964) studies of acoustic confusion in immediate recall of visually presented letters. He found a significant correlation between letters which were confused in listening and letters which were confused in recall, suggesting that errors occurring after visual presentation substantially involve acoustic (auditory) confusion.

Sperling (1963) noticed when asking the subject to wait (e.g. 20 secs) after the stimulus exposure before writing down the letter that Ss repeat (rehearse) the entire letter sequence during the interval. At the time of writing each letter, they also may speak it simultaneously. He assumes that Ss who do not voice the material, rehearse subvocally (inner speech).

Norman (1969) stated that rehearsal may aid retention in exactly the same way that repeated presentation of an item may facilitate

its retention (p. 68). Brenner, Walter and Kurtz (1970) reported better learning as a result of repetition in delayed and immediate retention task (Ausubel, 1968).

Neisser (1967) elaborated on Conrad's findings and asserted that the information stored in short-term memory (STM) is still very much auditory information. Waugh and Norman's (1965) research on memory is consistent with earlier findings of Sperling and Conrad; and they maintain that there are separate memory storage compartments for pictorial items, and verbal items.

One version of this notion is that with either visual or aural presentation, verbal items are first coded acoustically and stored in primary memory systems. Short-term retention improves (as does long-term retention) when the material to be recalled is repeated before a test of retention (Hebb, 1961; Hellyer, 1962); long-term memory in the terminology of Lindley and Brown (1971), is refered to as semantic memory. However, Paivio (1969) and Bower (1967) have proposed that semantic memory is divisible into two systems, one specified for representation of language, and the other for representation of objects and scenes. The verbal code is a description of graphemic, phonemic and semantic features of words, whereas the pictorial code is a description of the appearance of objects and combination of objects (Seymour, 1974).

Many recent reports on memory have indicated that memory for pictures is better than memory for words, e.g. Standing (1973); in his study the task was learning 10,000 pictures; he found that picture memory exceeds verbal memory in terms of verbal recall. Pictures of objects are recognized significantly better than their names (Paivio

et al, 1968). In comparing a sequence of 612 pictures and performing a similar task with long sentences, Shepard's (1967) Ss reported more correct answers in picture recall than sentence recall. More general supportive data are available in findings of Allik & Siegel (1974), in which pictures are remembered better than words.

Testing the memory of the pictures vs memory for verbal description of pictures by recognition task, Nelson, Reed and Metzler (1974), showed better recognition of pictures than of verbal descriptions. And free recall was also better for pictures than for their descriptions (Dallet & Wilcox, 1968).

Modern psychological theories of learning and memory have attempted to resolve this phenomenon by multicomponent assumptions about the memory mechanism. Some of these approaches to non-verbal imagery and verbal symbolic processes are considered to involve independent but partially interconnected systems for encoding, storage, organization and retrieval of stimulus information (Paivio and Csapo, 1973). Sperling (1963), refers to the same systems as Visual Information Store (VIS) and Auditory Information Store (AIS). This class of theory accounts for superiority of pictures in memory by the "dual encoding hypothesis". Among others who advocate dual-memory systems (e.g. Ellis, 1969; Davis et al, 1973), Paivio (1968, 1973) and his colleagues, delivered the most supportive evidence for such a concept. According to this theory of the two memory components, the <u>imagery system</u> is specialized for dealing with non-linguistic information stored in the form of images, that is, memory representations corresponding to concrete things; linguistic information may be handled solely by the <u>verbal system</u>, but words may also evoke mental images. Thus the visual superiority of pictures is best

explained a) by "additive effect" of the two codes in pictorial recall, and b) by the greater contribution of pictorial code than verbal code in recall (Paivio & Csapo, 1973).

Comparing memory for sentences with memory for pictures, Clark and Chase (1972) criticized the traditional conclusion that retrieval may be said to be verbal or visual. They seem to be convinced that both sentences and pictures are encoded in terms of their interpretive common propositions composed of names of objects along with names of their properties. In other words, cognitive processing is happening during audio-visual perception; knowledge, even that derived from a picture, is always presented in the form of abstract propositions. The question of Ss' modality preference is studied by Ingersell (1970), Ingersell and Di Vasta (1974), in which they found an interaction between the presentation modality and modality preference in terms of ease of response from auditory or visual modalities.

Atwood (1971) presented a theoretical model in which a "pictorial" and a "verbal-auditory" system are distinguished. The two systems are responsible for visual-pictorial and verbal-auditory perception accordingly. He asserted that the visual-pictorial and verbal-auditory systems are functionally linked by information recoding operations. In fact this notion has received major support by various investigators, e.g. Sperling (1969), Standing & Smith (1975). Superior retention of information following AV presentation of material over auditory presentation alone (Day and Beach, 1950), may be attributed to the information recoding operations. Repetition of audio message or prolonging pictorial portion may serve to maintain material in immediate memory and help transfer it

to a more permanent store. Studies by Lumsdaine (1963); Ausubel (1963); Edwards (1974) and Coldevin (1975), support this notion. Prolonging a slide for 7 seconds in the former and 5 seconds in the latter experiment (while maintaining audio silence) in spaced repetition had significant impact on the retention of audio-visual instruction presented via television. "The provision of repetition or review of instructional sequences appears to be more effective than single exposure to a given unit" (C.F. Coldevin, 1975, p. 292); spacing repetition leads to a better retention than massing them. "Thus massed rehearsal may be of less value than well spaced trials" (Peterson, cited in Haber, 1969, p. 55). (Note the confusion between repetition and rehearsal!).

It is difficult to draw a distinct line to separate free-recall and recognition. Very often the two terms are used to refer to the same process in memory. However, it seems appropriate to delve into the literature investigating the recognition aspects of the two types of stimuli. Nelson, Reed and Metzler (1974), conducted a brief experiment to study role of detail in the recognition of pictures and verbal descriptions. Their finding indicated that the advantage for pictures over verbal descriptions in recognition is not due to the extra detail that pictures contain. Further, they argue that if a picture contains relatively few details, then S will store relatively more information about each detail and vice-versa. Travers et al (1966) and Broadbent (1958) have much to offer on the issue. Travers et al (1966) explained the phenomenon by the "compression processing" of incoming information . This, in the typical educational situation, involves the retention of that part of information which is more critical to the receiver and discarding of less critical details; it is exemplified by the use of black and white

line drawings representing full-coloured natural phenomena which have a wealth of detail that line drawing omits. In their view the information is doomed to go through various stages of compression during its transmission from the environment to the receiver. By "various stages" he means that information may be compressed by the instructor prior to the impact on the sense organs; it could also be compressed after it has activated the receptors: "precompressed information appears to have considerable advantages in promoting information". This is a rather neat explanation of the finding of Nelson et al (1974).

Travers' view seems to have stemmed from earlier works of Broadbent (1958), in which he originated his famous filter theory. Some anology may be found in Travers' compression process of visually transmitted information to Broadbent's filter theory of auditory messages. Points that Broadbent suggested deserve mentioning: information handling of memory has a limited capacity in dealing with given stimuli; irrelevant audio messages tend to be discarded; and two messages which convey little information stand a better chance of being dealt with simultaneously than two messages each conveying much information. When no material is to be discarded there is comparatively little advantage in using two or more sensory channels for presenting information (Broadbent, 1958, pp. 34, 211). Furthermore, he discussed the division of attention in multi-channel communication and stated that the information system may pay attention to only one channel at a time and that is the channel that consequently produces a response.

Cohen and Granstorm (1970) conducted a series of studies to test memory for verbal and non-verbal material by the recognition para-

digm. In their earlier study clear evidence was given that reproduction from short-term visual memory (STVM) has a strong verbal component while recognition from STVM is mainly non-verbal. Later they showed that the ability to describe a picture positively correlates with the individual's performance on a STVM task involving the reproduction of briefly presented figures. They concluded that this correlation is a result of the subjects' verbal coding process.

The verbal loop hypothesis put forward by Glanzer and Clark (1964) makes a similar contention. According to this hypothesis in a perceptual task Ss translate input information into words; their subsequent usage of the stored words is the basis of their final response. Cohen's and Glanzer's points of view are common in the assumption that a S's verbalization (or translation in Clark's terminology) for a stimulus object is critical in determining the efficiency of response.

Goldberg et al (1974) experiments on recognition memory confirmed that in order to remember simple pictorial information, Ss verbally encode the pictures and retain both their verbal and visual codes in a dual encoding system.

PSYCHOPHYSIOLOGICAL FACTORS

The existence of two storage systems is also supported by neurophysiological evidence indicating that the right and left cerebral hemispheres function differently with respect to verbal and visual process; supposedly the left hemisphere dominates for tasks involving abstract thinking and linguistic processes, while the right hemisphere dominates

for perceptual and non-verbal functions (Travers, 1969; Lindsay & Norman, 1973; Levie and Levie, 1975).

Gazzaiga (1967) experiments with split-brain patients showed that information presented to the left hemisphere (through the right eye) can be read out or written down, but when the same information is presented to the right hemisphere, it cannot be spoken or written down. He explains the result as due to lack of communication between the two halves, and that only the left hemisphere contains language properties. The left hemisphere is responsible for verbalizing or writing the information perceived. Gazzaniga further states that some conceptualization takes place when response is made in the non-linguistic half (right hemisphere). Carey and Blake (1974) showed evidence for the linguistic coding hypothesis in their experiment with deaf and hearing subjects and found that memory skills may be related to verbal ability. Norman (1972, p. 438) stated that memory for simple perceptual experience is directly related to the ease with which the language can communicate that experience, and agreed that incoming information is often encoded into its acoustic labels, which in turn can have a considerable effect on the retention of sensory information. This is consistent with evidence, previously reviewed, that input information is encoded in terms of its verbal-acoustic representation (e.g. Lindley et al, 1971; Shaffer & Shiffrin, 1072); that ability to reproduce visual information is linked to the ability to describe the visual information (Cohen et al, 1968), and reproduction of figural information has a strong verbal component which is lacking in the recognition response (Cohen et al, 1970).

In regard to studies by Lumsdaine (1963), Reynolds and Glaser (1964), Coldevin (1975), it can be said that with repetition, AV inform-

ation may be further sustained in memory system. However, whether extended visual (pictorial) information, repeated verbal (auditory) information, or the usual mode of AV presentation would result in better performance is the question that the present study attempted to answer.

CHAPTER 3

OBJECTIVES OF THE PRODUCTION

The experimental objective of the production was to determine the effectiveness of audio-repetition and secondly, to examine the relative effectiveness of visual repetition. The instructional objective was to present some information about early human settlement in Iran and about the way of thinking and living as revealed by archeological excavation. Subjects could be expected to be relatively free from previous experience with the content.

Specific goals and objectives of the program may be set out as follows:

- To introduce 48 students of Grade 8 and 9 to early human settlement in Iran and its way of thinking and dealing with various aspects of social and political organization, through a 20-minute slide-tape presentation.

- After the presentation, students should be able to:

  1) correctly recognize ten pictures, representing ten specific historical relics among other pictures simultaneously presented to them on the screen;

  2) correctly recognize 20 verbal descriptions of 20 histori-

cal themes, presented to them among other verbal descriptions on the post-test.

HYPOTHESES

The three experimental hypotheses are put forward as follows:

- H1 Performance on auditory repetition items in the recognition post-test will be superior to performance on non-repeated items.
- H2 Performance on the auditory repetition items in the recognition post-test will be superior to performance on visual repetition items.
- H3 Performance on the visual repetition items in the recognition post-test will be superior to performance on non-repeated items.

Hypotheses will be accepted or rejected at .01 level of confidence.

RATIONALE FOR THE HYPOTHESES

Auditory repetition (AR) is expected to result in a better retention than no repetition. Explicit or implicit justification for this speculation comes from various studies of memory previously reviewed. Auditory repetition may in fact present an opportunity to rehearse information already encoded. Further, if one assumes that pictorial

stimuli are first represented in a verbal form (Sperling, 1969; Shaffer & Shiffrin, 1972), then one may expect better recall where auditory repetition is interposed, due to the more direct and shorter encoding in input processes and decoding in output processes. As Posner and Konick have pointed out, it would be more appropriate to consider pictorial "repetition" as an opportunity for concentrating attention (in Haber, 1969).

Busche (1962) reported that approximately 17% more of repeated auditory items than repeated visual items were recognized. Additional justification for the hypotheses lies in investigation of a situation in which pictures lack labels (Paivio & Csapo, 1969); in this study, exclusion of verbal indicators caused decrement in observers' performance. Unfamiliar visuals which may not be readily "termed" are also difficult to remember (Murdack, 1967).

In a recent study by Coldevin (1975), it has been found that insertion of review strategies, namely, massed, spaced and summary had a marked effect on cognitive acquisition of a television presentation as compared to a simple program. Allowing the related slide to remain on the screen during a 5-second pause as a part of spaced review, produced the highest mean of the treatments.

It is possible to think of audio-repetition as a form of reinforcer of the intended message already transmitted to the students through the auditory channel, making it less likely that the message will be ignored. Even though the information arrives via both sense modalities, conventional class-room performance usually requires translation of both kinds of stimuli (audio & visual) into some kind of motor speech activity (e.g. retelling or writing answers), which in turn rely

upon verbal behavior on the student's part. In this respect, all pictorial information rests on possession of verbal knowledge. Conceivably, verbal information may be understood easily and therefore stored and remembered readily. With the same token audio-repetition of the information is expected to result in better performance in class-room situations.

In addition, the degree of meaningfulness of the input modality may affect the anticipated outcomes of the treatments; highly meaningful material is learned more efficiently when presented auditorily (Schultz and Kassachau, 1966). To the degree that meaning is assigned by verbal attachment or labeling, auditory rehearsal will thus be favored.

CHAPTER 4

PROCEDURE

PREPARATION OF INSTRUCTIONAL MATERIALS

The experimental objective of the slide-tape production was to determine the relative effectiveness of two types of supplementary presentation methods: repeating (extending) visual material and repetition of verbal material. The two techniques were programmed in a single slide-tape presentation. Care was taken to obtain good quality auditory and visual materials as well as unfamiliar content — the arts of ancient Iran. Materials were chosen to fit the requirements of the study while being flexible enough to allow a fair degree of generalization.

Most of the visual materials were reproduced from 4 illustrated books about Iranian art:

- *Arts of the World: Ancient Iran.* Dyson, R.H. First published in English, 1965. Hollen Verlag, Baden-Baden, Germany. Printed in Holland, Pope U.
- *Masterpieces of Persian Art.* Greenwood Press Publishers. Holt, Rinehart and Winston, Inc. Westport, Connecticut, 1945.
- *Persia from the Origin to Alexander the Great.* (Ed.) Malraux, A. and Salles, G. Thames & Hudson, 1964. Printed in France.
- *The Art of Ancient Iran.* Translated by Gilbert, S. and Emmons, J. Golen Press, New York, 1964.

These sources had ample black and white, good-quality illustrations. One hundred and nineteen pictures were selected to form a coherent pictorial coverage of the subject matter. Visual materials consisted of 119 monochrome slides, plus 10 more test slides which appeared in the testing portion of the program.

A number of Iranian mythological themes were characterized in pictorial representations. These were more complex visuals as compared to simple line drawings which have less redundant information. Illustration 1 presents an example of one of the visuals which was actually used in the slide-tape program. Auditory material was prepared using various sources including the above publications. Approximately 1500 words were used in the narration.

A total of thirty items were selected for post-testing. For 10 of these items, audio repetition (AR) was effected in the program by repeating (6-8 seconds) the audio portion of the message in the absence of the related slide. For another 10 of these items, visual repetition was effected by keeping the slide on the screen for 10 seconds (without repeating the related audio portion). Finally, 10 items (NR) were not followed by either AV or VR methods in the program, approximating standard tape-slide presentation.

In the audio rehearsal a black slide was faded in exactly at the start of the repeated audio message. Two seconds after the termination of each AR the black slide faded out and the normal AV program proceeded. "Black intervals" of the AR treatment were between 6 to 8 seconds long (2 seconds to activate the pulse generator and projector carousel).

Illustration 1: Example of visual material used in the presentation.

The ten black intervals of the AR treatments were balanced by providing ten silent intervals during visual repetition. Each silent pause occurred at the start of pictorial repetition of a target item and lasted exactly ten seconds while the slide remained on the screen.

The order of audio repetition (with accompanying black slides), pictorial extention (with accompanying silent pauses) and usual AV sequences were random. However, care was taken to avoid long processes of repetition which would disturb the continuity of the presentation and cause discomfort in the presentation session. Fig. 2 shows auditory repetition, visual repetition, and the usual AV sequence depicted against a time scale; and Fig. 3 shows the sample order of 24 slides out of a set of 119 slides, and a partial order in which 6 test items were treated according to repeting methods (AR, NR, VR). Off-set slides in Fig. 3 indicates post-tested items.

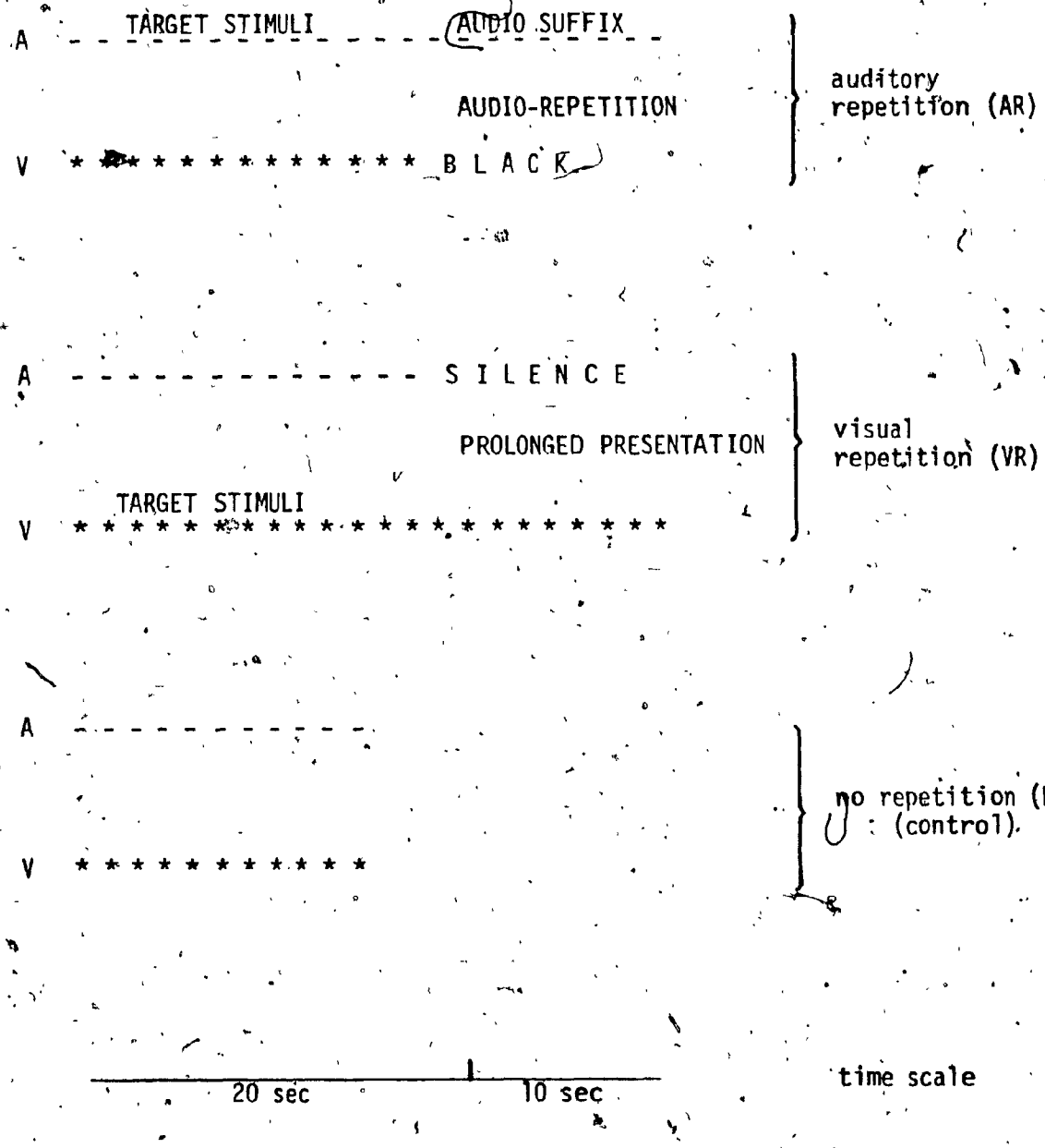


Fig. 1: Program Format: Auditory Repetition; Visual Repetition; and No-Repetition (control) AV Sequences Against Time Scale.

REPETITION EVENT	TAPE	SLIDE
NR	Verbal Description	Slide
Target Slide	Verbal Description	Slide
AR	Repeated Description	Black Slide
Target Slide	Verbal Description	Slide
VR	Silent Pause	Slide

Fig. 2: Composition of NR, AR and VR Items; Sequences of NR, AR and VR. NR Items are Equivalent to Standard AV Presentation.

NR
NR
NR

AR

NR
NR

NR

NR

NR

NR
NR
NR
NR
NR
NR

VR

NR

AR

NR

VR

NR
NR
NR
NR

-
-
-

END

Fig. 3: The Sample Order of 24 Slides Out of a Set of 119 Slides; Off-Set Slides Indicate Post-Tested Items.

Auditory and Visual Materials

Artificially lighted pictures were shot on 35mm black and white slides at the University's graphic laboratory. To produce properly focused pictures, a Nikon Copy Camera with two changeable micro-lenses was fixed to the copy stand and optimum framing was controlled through the SR view finder of the camera. All 129 monochrome slides (119 for instruction and 10 for test purposes) were produced in the same manner. Ten black slides were made, using a simple black cardboard to eliminate otherwise distracting bright illumination during rehearsal periods. All visual post-test slides were selected from the 119 slides shown to the students during the 20-minute presentation. These slides were placed among three other slides to form a four-choice visual test item. An example of a test item is given in Illustrations 4 and 6.

Two Kodak Carousel 750 H projectors, one accommodating 64, and the other 65 slides, were utilized. A smooth and gradual slide-to-slide transition between the two projectors was achieved by using a Kodak dissolve unit.

The auditory material was prepared from the four illustrated books noted earlier as well as some other supplementary literatures published by the Audio-Visual Department of the Iranian Ministry of Information.

Verbal information was summarized in a script of approximately 1500 words and was spoken by a female narrator. An average of 20 words were allocated to each 'AR' item. Narration was recorded on a high quality Scotch audio-tape at 7 1/2 IPS in the University's sound studio.

On two occasions narrator's voice was processed through an echo-chamber to obtain normal and slowed sound effects. Selections from Symphonie Persepolis and Persanes Shéhérezade accompanied the narration during the normal (NR) presentation. For AR and VR, however, no background music was used.

The narrated script was initially recorded on the right track of the master tape, and cuts of the background music were then recorded on the left track of the master tape. Both the music cuts and the narration were subsequently transferred to the right track of the final tape, the second track was electronically pulsed to pull the slides into and out of position at the correct intervals, according to the repetition methods. Pulsing was precisely arranged to advance the slide at the end of the relevant annotation during usual presentation; and to hold the slide for visual repetition; and to advance the black slide during audio repetition.

The test materials (verbal recognition, visual recognition) are discussed in more detail in the section entitled "Testing Methods and Materials".

Program Preview

Before attempting to prepare the material, the degree of complexity, feasibility and its suitability for the intended audience were discussed with a member of the teaching staff of the sampled school. Throughout the developmental stages, critical views of involved individuals were elicited. Subsequently, the slide-tape program and testing

were presented to a panel of experts to judge the quality and length of the program. Further refinements were made according to the verdict of the panel. Among these were changes in the music from a television-type to a more subdued theme; omission of some very short sequences of background music, and lowering its overall level. Some modifications were also made in the timing and the quantity of the verbal and visual test items.

A week before the presentation session, a final script was inspected by the principal of the High School and the instructor of the two classes and its suitability for the target students was verified. The content of the slide-tape itself is believed, according to the students' teachers, to have been quite new to the sample students. After the actual presentation, however, the students expressed their interest and curiosity towards the subject matter.

Testing Method and Materials

The primary objective of the slide-tape production was to study the effects of audio-input information and visual-input information on performance on the immediate recognition task.

In the preparation of the post-test, a number of things have been taken into account. As noted by Bloom (1956), in testing situations which deal with recognition and recall of knowledge, the form of question and the level of precision and exactness required should not be too different from that originally encountered. "Thus, any test situation involving knowledge requires some organization and reorganization of the problem to furnish the appropriate signals or cues linking it to the

knowledge the individual possesses. It may be helpful in this case to think of knowledge as something filed or stored in the mind". (pp. 29 & 78). Caution is urged by Hurtman (1961) that verbal testing of pictorial information may be misleading; learning of the information presented in several channels is more likely to be demonstrated if it is tested in several channels. It is not sufficient to examine the effect of experimental presentation merely in terms of separate visual and auditory components. The composite message has its own characteristics (Allen & Cooney, 1963 as cited in Owens, 1975). Therefore, it was essential to construct pictorial multiple-choice items to test the memory for verbal material presented under experimental and normal sequences. The target items of the two experimental conditions (AR & VR), and control condition (NR) were grouped into three sets of 10 questions each, which was handed over to the Ss on the same answer sheet, after the presentation.

Verbal Questions

To provide audio repetition each verbal item was repeated from the script when the related picture was faded into black. In the verbal test, this segment or phase was reproduced on paper among 3 verbal distractors (alternatives) and S's task was to recognize the repeated verbal item and specify it by putting an 'X' mark in the brackets provided next to each of the four alternatives.

The non-repeated control items (NR) were tested by the verbal method, in essentially the same procedures followed for the verbally repeated material. Verbal multiple-choice items were presented before

the visual question on the same sheet.

Visual Questions

In the visual test, each test picture was placed among three different pictures to form a four-choice visual question item. The task was to recognize the repeated picture among the four pictures presented simultaneously on the screen (see Illustration 6). Students were instructed to read the question first and then look at the screen to find the correct picture, and specify the answer by putting an 'X' mark into one of the 4 sections of a square corresponding to the location of the correct picture being exposed on the screen. These squares were provided next to each question on the answer sheet.

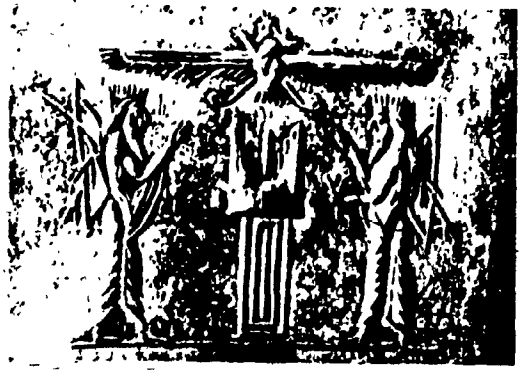
With regard to this type of testing, experiments have shown that most students can be paced to respond to objective test items more quickly than they do when working at their own rate, with no decrease in accuracy of response and no appreciable increase in tension. On the other hand, drawbacks to administration by visual projection are that the student's attention is not fixed so firmly on his own answer sheet. There must be enough light to facilitate marking the answer sheet, but not so much to make reading the projected test item difficult (Ebel, 1965, p. 78).

During the course of the audio-visual presentation, the pictures (e.g. shown in Illustrations 2 and 3) were projected, one at a time, at various cuts of the program. For each picture some verbal information was given via the audio-tape. The target item among pictures shown

in Illustrations 2 and 3 is the picture numbered 3. The exposure time for this picture was increased to exactly 10 seconds after its relevant verbal description ended. The other pictures were faded out exactly at the end of their related narration.

The subsequent pictorial multiple-choice question was presented by assembling the target visual item and 3 other pictorial alternatives. As shown in the Illustration 4, four assembled pictures are clearly separated by distinctive lines, separating each picture from the others. In the example shown in Illustration 4, the task was to recognize the repeated picture (bottom left) and mark its location on the square next to each question on the answer sheet (see Appendix C). In some instances, extraneous pictures were introduced among the visual distractors (alternatives). The extraneous pictures, however, were from the same category as the target pictures. This made it possible not to provide verbal cues when asking the Ss to recognize the correct picture, by referring to the item for example as "among these idols. . . or, among these statues . . .". Illustration 5 shows an example of an extraneous picture which did not appear in the presentation, but was used as an alternative in the pictorial recognition post-test.

Because of the technical necessity, pictures in visual test items were relatively smaller than the original size. The relative size of the original and the test item is shown in Illustration 6.



(1)

(2)

Illustration 2: Example of Two of the Four Visual Alternatives.

(3)

(4)

Illustration 3: Visual Test Item (Above) and the Fourth Alternative (Below).

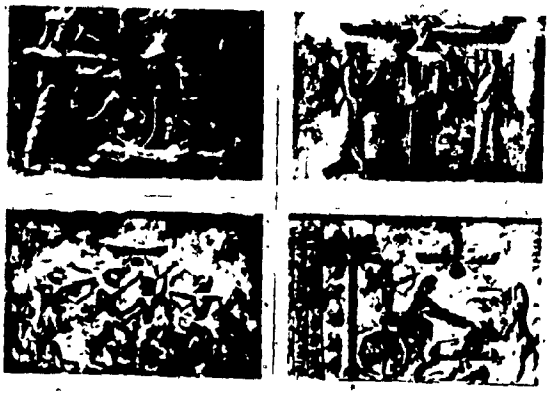


Illustration 4: Structure of a Multiple-Choice Question.

Illustration 5: Example of an Extraneous Pictorial Alternative.

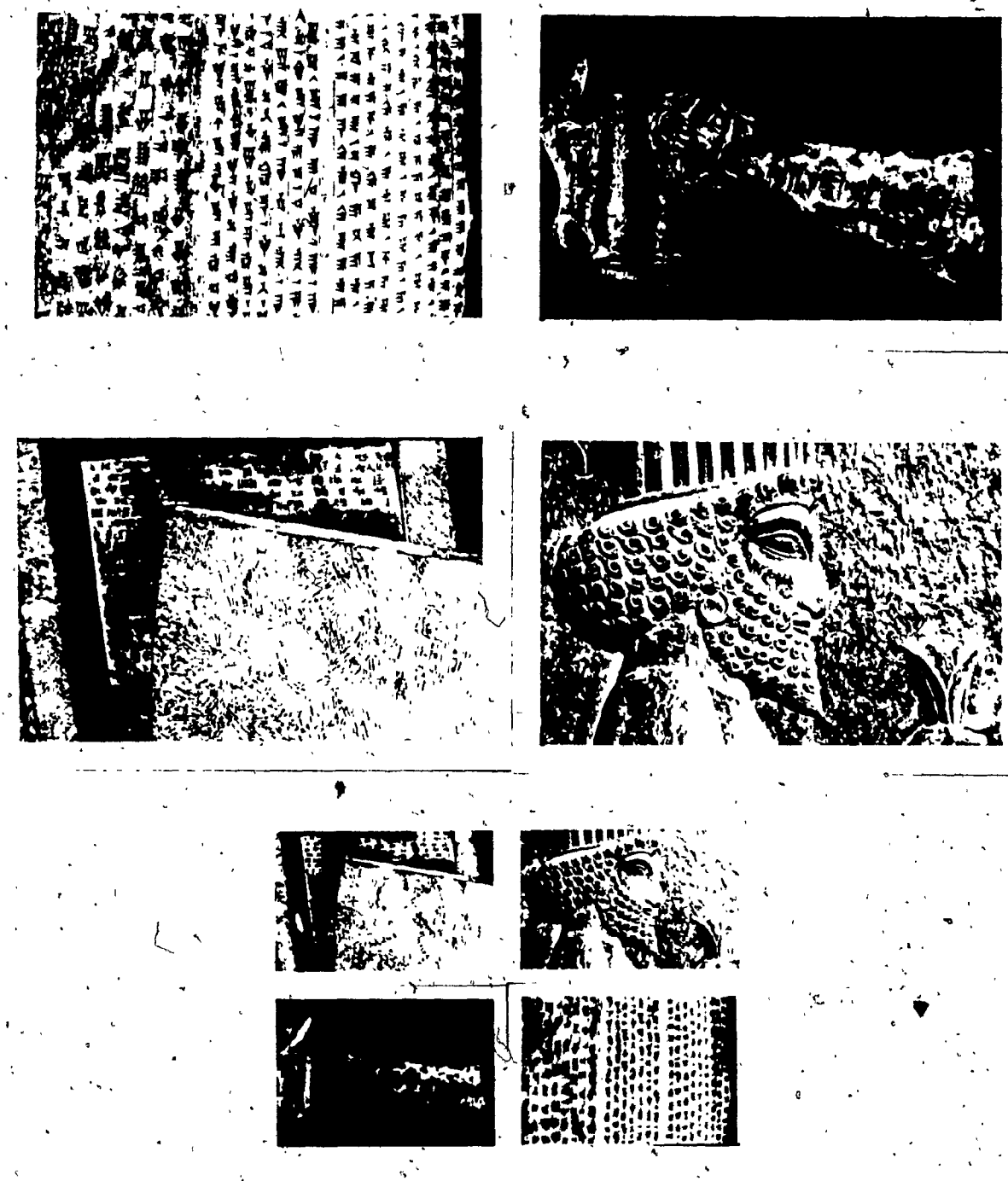


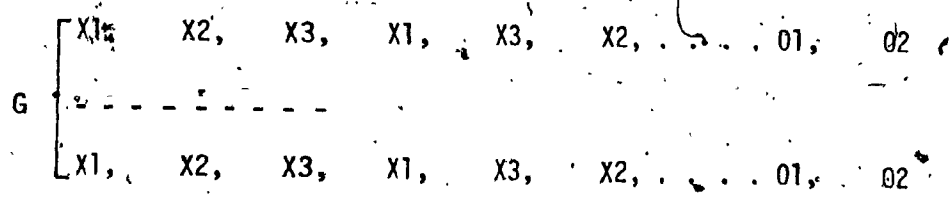
Illustration 6: Pictorial Multiple-Choice Question: Relative Size in the Instructional Presentation (Above) and in the Testing Presentation (Below).

DESIGN OF THE STUDY

The design selected for this study was a one-way design with repeated measurements for one group of subjects. The subjects were two intact classes of 24 pupils each who were exposed to all presentation formats and then were post-tested with verbal and pictorial recognition tasks. The repeated measures design ensured a high degree of comparability among different treatment conditions (Dayton, 1970, p. 244). Moreover, the repeated measures design was helpful in determining the students' overall preference for repetition modality. Mention should be made here of advantages and disadvantages of the repeated measures design. First, matching of a subject with himself reduced variability (Winer, 1962, p. 105); second, the use of repeated measures reduced the overall cost and the number of experimental subjects, because each subject is "used" three times. Nevertheless, the possibility of carry-over effects or multiple interference from one level of the treatments to another was a drawback in this design. However, to cancel possible carry-over effect, the order of the treatment levels was counter-balanced; that is to say that the levels were presented in all possible sequences (Dyton, 1970).

Figure 4 shows the experimental design of the study. Experimental variables are as follows:

- Independent variable: types of rehearsal.
- Dependent variable: Ss' performance on a recognition post-test.
- Controls: scholastic level, age, instructional messages.



G	-	group
X1	-	auditory rehearsal (AR)
X2	-	no rehearsal (NR)
X3	-	visual rehearsal (VR)
---	-	intact classes
O1	-	verbal recognition post-test
O2	-	visual recognition post-test

Fig. 4: Design of the Study; All Ss Listened and Viewed All Treatments and Responded to all Items on a Verbal and a Visual Recognition Post-Test.

Operational Definition of Variables

- Independent variable: The independent variable has 3 levels, all programmed in one tape-slide presentation. The 3 levels are:

  a) Auditory repetition technique (AR): a simultaneous AV presentation (pictorial slide and verbal message) followed by a 6-8 second repetition of verbal message by the narrator in the absence of the related slide.

  b) Visual repetition technique (VR): a simultaneous AV presentation followed by a 8-second persistence of the pictorial slide in the absence of the related verbal message.

  c) Control treatment (NR): a simultaneous AV presentation with no repetition, following normal production procedures.

- Dependent Variable: The dependent variable is student performance on two types of recognition post-test:

  01) Visual recognition post-test being presented on the screen.

  02) Verbal recognition post-test being presented on paper.

- Controls: 1) Equal number of test items in each treatment condition.

2) The average number of verbal messages used for each slide is approximately equal.

3) No background music used in the two experimental treatments.

4) Repetition time and total time span of the experimental conditions are equal.

5) Students' scholastic level and age is approximately equal.

6) Equal answering time for verbal and visual test items.

Population and Sample

Two groups of 24 male and female students aged between 13-15 participated in this study. It was assumed that students of this age would not have difficulty in comprehending the program. The entire sample of 48 are 8th and 9th graders of the Herzliah High School of the United Talmud Torahs School Board in Montreal and have similar educational levels and socio-economic status.

The same program was presented in 2 intact classes with approximately equal numbers of male and female students. A total of 144 observation values were obtained. Base line data came from the normal condition against which the two experimental observations were gauged.

PRESENTATION PROCEDURES

All necessary pieces of equipment were transported to the Herzliah High School, located in the outskirts of Montreal, where two groups of 24 students participated in the presentation session. The equipment included:

- one Sony TC-270 stereo tape recorder
- two Kodak Carousel 750 H 35mm slide projectors with similar lenses of equal projection field
- one projection screen
- one pulse generator
- one Kodak Dissolve Unit Model 2

During break time the equipment was set up in the classroom. (See Appendix E). The projection screen was placed at approximately 6 meters (20 feet) from the two slide projectors which were placed on a table high enough to allow the projection beams to pass over the students' heads. The Ss were asked to watch the presentation in the partly darkened room. No information about the nature of the program was given to the students until the instructional presentation was over.

One channel of the audio tape recorder was patched to a loud speaker. The second channel was used to advance the slides appropriately.

To minimize the carry-over effect which usually associates with the application of the repeated measures design, the actual presentation utilized all possible orders of the two treatments interspersed among various periods of normal AV programming. The sample order of the presentation is shown in Fig. 3.

Test Administration

After 20 minutes the slide-tape program ended and the testing instructions immediately followed. Questions were presented in two parts: the first part contained 20 verbal items (10 for AR & 10 for NR), the second part contained 10 visual questions asking the student to identify the picture pertaining to it. The order of administration was 10 questions for AR, 10 questions for NR, and 10 questions for VR sequences. Five minutes was allowed to finish the first 20 test items, and another 2 1/2 minutes was given to complete the 10 final items. Students had exactly 15 seconds to answer each question, as both verbal and visual tests were paced by the narrator, on tape.

Testing began with the following instructions: "You are now required to complete a multiple-choice test which is based on the slide-tape presentation you have just seen. . . you have 5 minutes to finish the first part of the test. When you finish the first part, you must stop and wait for my instructions. . . . Are there any questions? . . . Start the first question. . ."

At the end of the first part, students were told: "You have finished the first part. . .now let's start the second part . . . to answer this part you must read the question first and then look at the screen. You will see four different pictures on the screen; only one of them is the correct picture to choose for your answer. . . After each 15 seconds the slide will be changed and you must go on to the next question . . . . Are there any questions? . . . Start the first question." (For the complete version of the instruction see the script provided in Appendix A). Fifteen-second intervals were carefully timed

and pulsed into the second track of the tape to monitor the entire testing period and advance the visual question items.

Scoring Method

Questions had been divided into 3 sets of verbal (AR), normal (NR), visual (VR), multiple choice questions, each set containing 10 items. Each correct answer was given one mark. The total and subtotal scores for each subject were recorded.

Statistical Procedures

Test Reliability

Among a number of alternative measures of test consistency, Kuder-Richardson formula number 21 (K-R 21) was used in this study to establish the reliability coefficient of the test administered to the subjects. This formula is specially useful since it requires less computation procedures (as compared with K-R 20) and requires only one test administration.

Questions which appeared in the post-test equally represented the entire content of the program and the 3 treatment conditions. The index of content validity (introduced in Lewis, 1967, pp. 190-193) obtained for this study was .86.

Applying item analysis (provided in Appendix D), (Tuckman, 1972), items numbered 5, 8 and 18 were found too easy, and questions 12 and 28 were relatively difficult and therefore discarded. The average test difficulty (Mehrens & Lehmann, 1973, p. 328) of this study was

.68. Based on 26 items with average difficulty of .68, the reliability of the test was computed and the obtained reliability coefficient of this study was (.75). A coefficient between range of .60 - .80 is accepted for class-room tests (Ebel, 1972), (Gronlund, 1968, p. 96).

Data Analysis

Data obtained from the post-test were subjected to a number of statistical analyses: a one-way analysis of variance (Table 2), standard deviation, means, and range of scores were computed (Table 1), three histograms were printed through STATPAK (shown as Graphs 1, 2 and 3), percentile ranks of each group were calculated (Graph 4). The analyses were executed twice to check the computer output. One-way analysis of variance compared the differences among treatment levels. The Scheffé means test (Table 3) was used to determine the critical value of F statistics at .01. Mean differences were compared against the obtained critical value for the minimum mean differences.

CHAPTER 5

RESULTS AND DISCUSSION

RESULTS

Forty-eight male and female students of grade eight and nine (13-15 years old) were treated under 3 conditions: audio repetition, visual repetition, and no repetition. Repeated measures of recognition of material presented under each condition were made. Table 1 summarizes the raw data obtained on these measures. A one-way analysis of variance table indicated a significant difference between the treatment levels ($P < .01$). Table 2 summarizes this analysis.

To find where the differences occured, the critical value of L was computed following the Scheffé means test, Winer (1962, p. 85). Comparison of the ordered mean differences with the critical value at the 99% level of confidence showed significant superiority of AR technique ($\bar{X}_1 = 7.13$) over VR ($\bar{X}_2 = 5.33$) and NR ($\bar{X}_3 = 4.92$). Table 3 shows the diffrence among the means. Moreover, the mean of NR was significantly higher ($P < .01$) than the mean of VR.

AR and Recognition

As revealed by a one-way analysis of variance there was a significant difference between different treatment methods. Referring to

the means of the three conditions, it is apparent that the best performance occurred under the AR method ($\bar{X}_1 = 7.1$) in comparison with the NR($\bar{X}_2 = 5.3$) and VR($\bar{X}_3 = 4.9$) conditions. Examination of Table 3 shows that the AR method resulted in significant differences from both the VR (1.8) and NR(2.2) methods at the 99% level of confidence. Looking at the frequency distribution of Graph 4, 95% of the student scores in the AR treatment are above the grand mean of 5.8) which is considerably better than 79% for the scores under the NR and 68% under the VR condition. Therefore, it could be concluded that AR with average of 19% higher ratio, successfully promoted retention of the information transmitted through two sense modalities in comparison with VR and NR.

NR, VR and Recognition

It was found, by the Scheffe means test, that the no-repetition (NR) condition resulted in better performance ($\bar{X}_2 = 5.3$) than the VR ($\bar{X}_3 = 4.9$). The difference between the two means (.4) was significant at .01. It may be said that imposing visual repetition did not facilitate the retrieval of information; on the contrary, it had some negative effects which hindered the process.

METHODS	MEAN	STD. DEV.	STD. ERROR	MAX.	MIN.	RANGE
AR Method	7.1	.81	.12	8	5	3
NR Method	5.3	1.26	.18	8	2	6
VR Method (Control)	4.9	1.68	.24	8	1	7

Grand Mean = 5.8

Table 1: Means, Standard Deviation and Range of the Scores for Three Treatment Methods.

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	SUMS OF SQUARES	DEGREES of FREEDOM	MEAN SQUARES	F-VALUE
Between Conditions	84.50	2	42.25	**20.59
Within Conditions	289.25	141	2.05	
TOTAL	373.75	143		

**P < .01

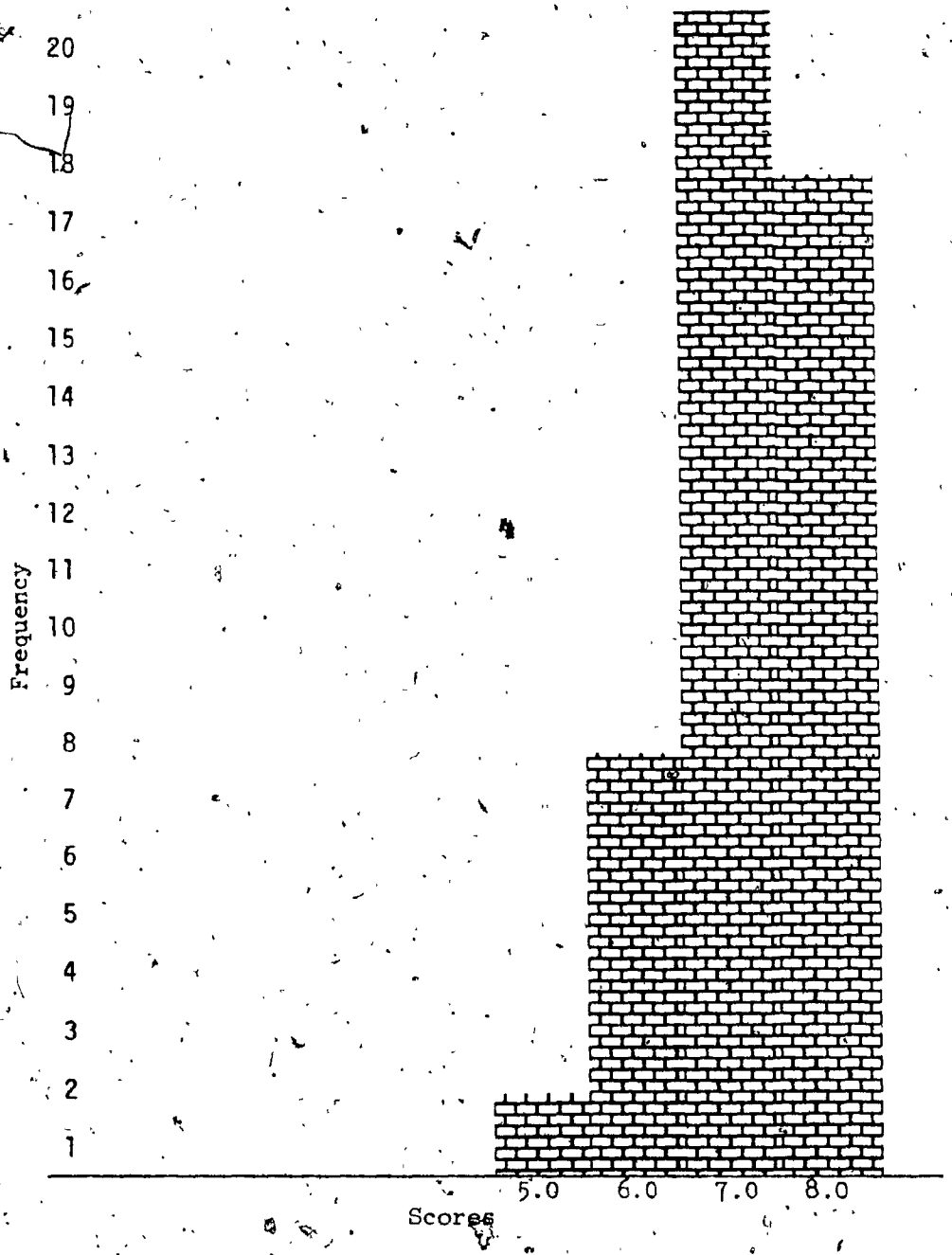
Table 2: Analysis of Variance for the Three Treatment Conditions.

MEANS	AR	NR	VR
AR 7.1	-	1.8**	2.2**
NR 5.3	-	-	.4**
VR 4.9	-	-	-

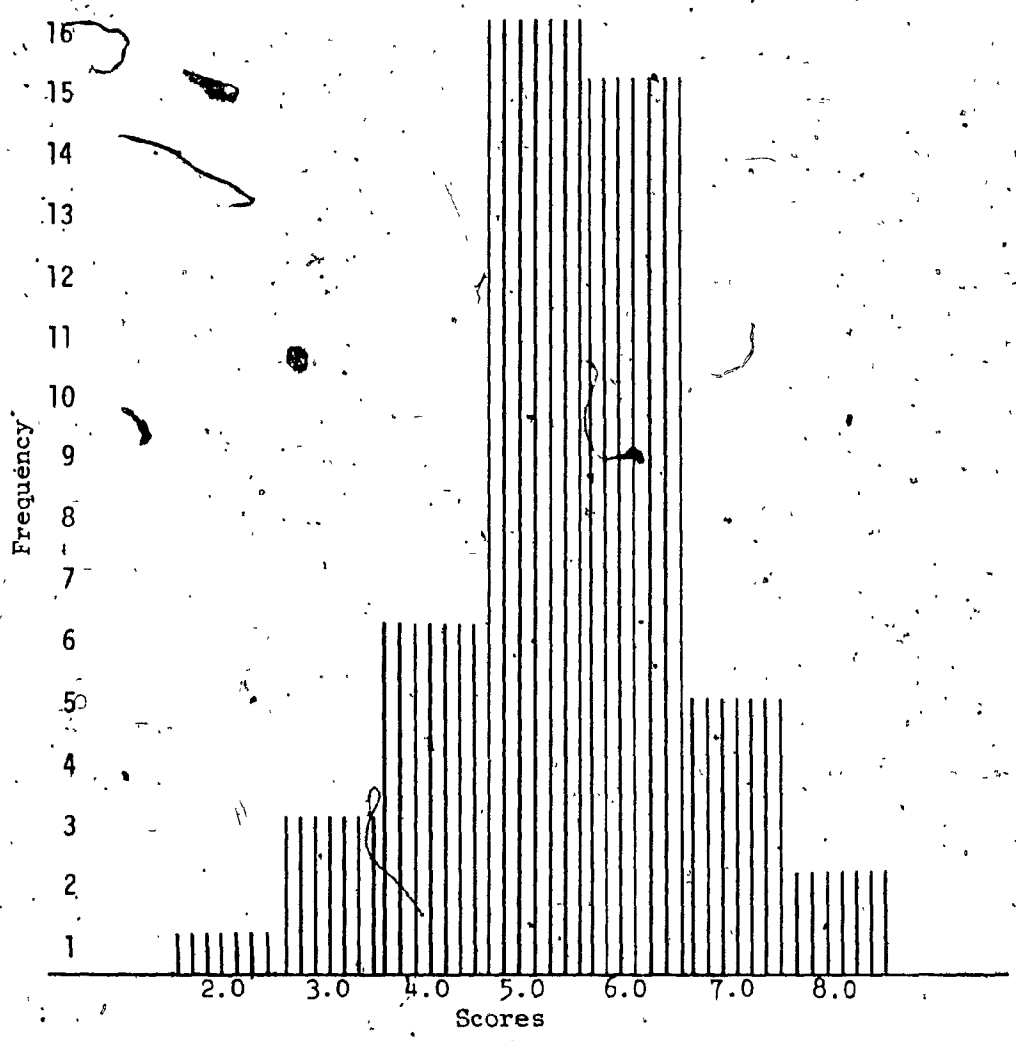
Min. Diff. (.01) = .2

**P < .01

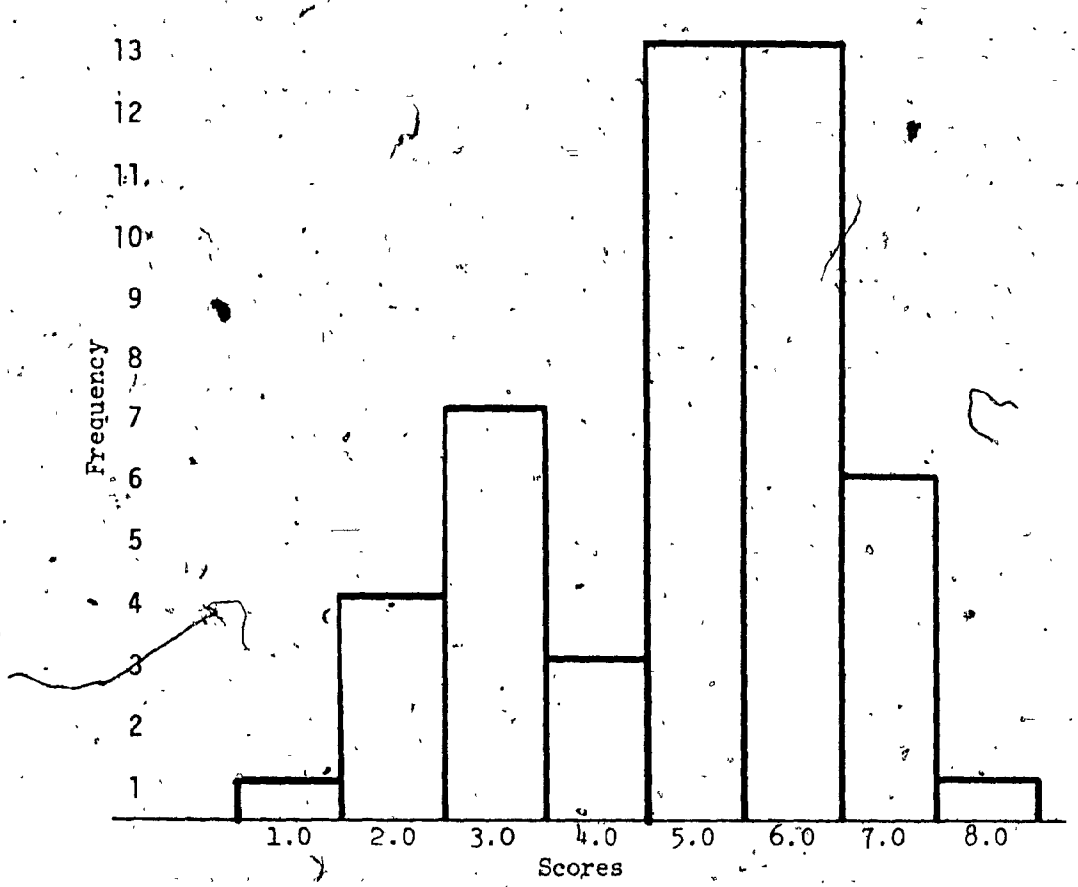
Table 3: Application of Scheffe Means Test and the Obtained Critical Value.



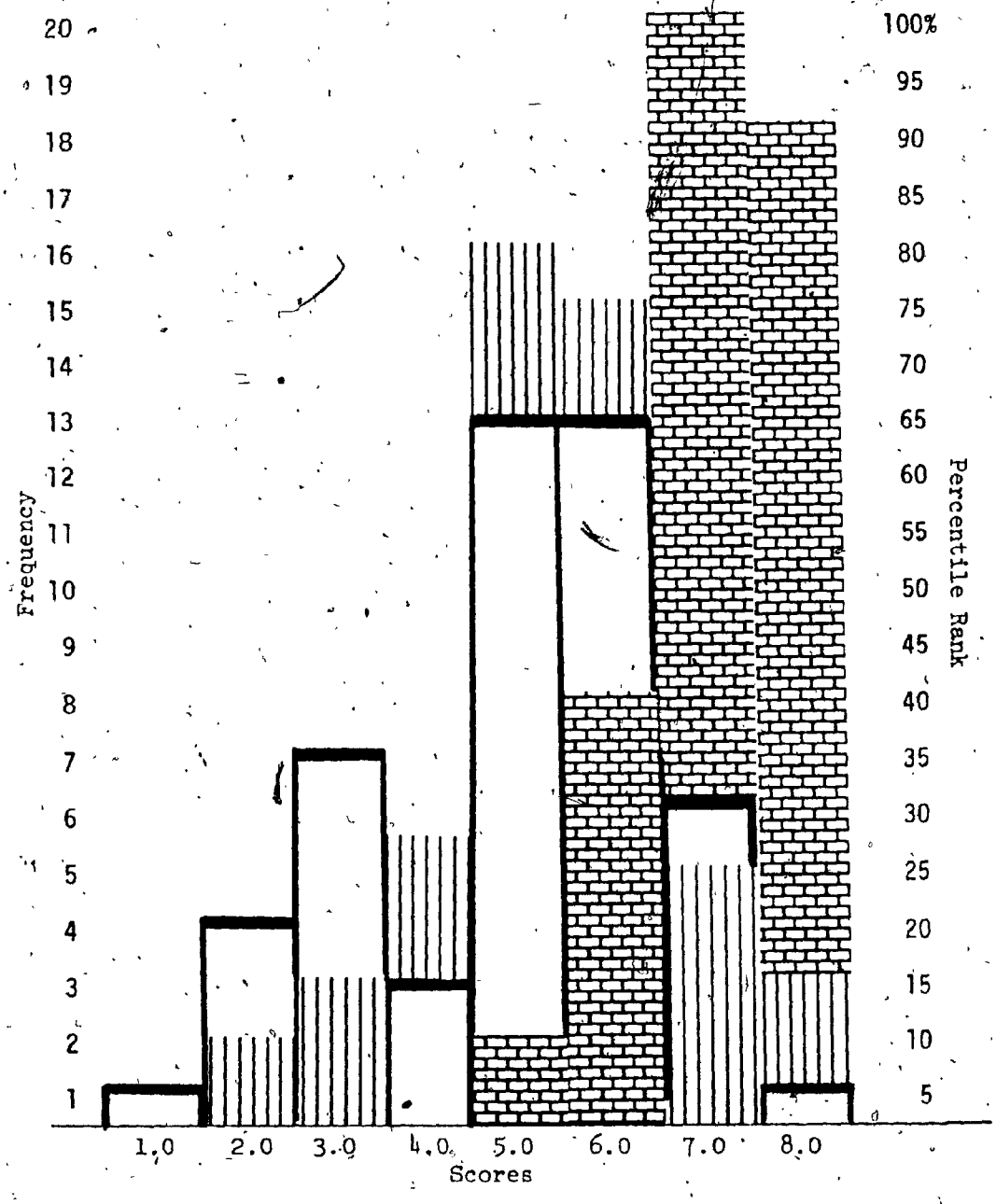
Graph 1: Frequency Distribution of Total Number of Correct Responses to 8 AR Test Items on a Verbal Post-Test of Recognition.



Graph 2: Frequency Distribution of Total Number of Correct Responses to 8 NR Test Items on a Verbal Post-Test of Recognition.



Graph 3: Frequency Distribution of Total Number of Correct Responses to 9 VR Test Items on a Visual Post-Test of Recognition.



Graph 4: Comparative Frequency and Percentile Rank of the Three Treatment Methods.

DISCUSSION

This study was conducted to examine the relative efficiency of two experimental techniques — verbal-repetition (AR) and visual (pictorial) repetition (VR), in comparison with the conventional method of audio-visual instructional presentation called non-repetition (NR) in this study.

The experiment dealt with the cognitive aspect of the instructional program. To accommodate Hurtman's (1961) suggestion that verbal testing of pictorial material may yield misleading results, separate visual test items were produced in the form of ten 4-choice multiple-choice questions to test recognition of the visually-repeated material. Auditorily-repeated and non-repeated items were tested by conventional verbal 4-choice multiple-choice questions. The null hypothesis of no difference between the 3 conditions can be readily rejected in view of the significant F ratio ($P < .01$) obtained in the analysis of variance. The remainder of this paper will cover areas related to the 3 hypotheses set formally in Chapter 2.

> Hypothesis I: [illegible] vs NR). Performance on auditory repeated items in the recognition post-test will be superior to performance on non-repeated items.

Statistical analysis of the data supported on the central hypothesis at 99% level of confidence.

The relative efficiency of audio-repetition may be first discussed in terms of division of attention. Broadbent (1958) stated that subjects may not be able to attend to two stimuli arriving simultaneously. The same notion is expressed by Dornbush (1968); S cannot attend to both channels equally, or if he can attend to both channels equally, he cannot

recall what they present equally well (p. 43).

This may partly explain the present finding. In the usual AV presentation (NR), S's attention may have been divided between the two channels; thus, he paid less attention to each channel. On the other hand, in AR his attention was directed toward the repeated verbal information. AR gave students a specific opportunity to attend to the message.

Additionally, repeating the track in auditory repetition may serve as feedback for checking the message received in the initial exposure and help Ss selectively attend to relevant information. The latter interpretation agrees with Broadbent's (1958) filter theory of selective attention, according to the importance of the incoming signals from different channels. Repeating the audio-message of the AV program may be said to have motivational effectiveness in arousal of student's attention to the information flowing in the auditory channel.

Superiority of the audio-repetition to no-repetition method may be alternatively explained through the findings that emphasize the importance of words in AV presentation. The meaning of visual message is often ambiguous and subject to personal interpretation. The use of words to direct attention is essential (Hurtman, 1961, as cited in Kemp, 1975).

A more complex line of explanation is given in terms of the meaningfulness of the material. Since the visual material may also be encoded into words (Sperling, 1963; Peterson, 1959; Norman, 1969), the meaning, or perhaps more appropriately, the common meaning of verbal and pictorial representations may be reinforced through auditory repetition of AV information. In other words, pictorial (visual) codes may be contri-

buting to the superior recognition of verbal material on the post-test. This is consistent with the finding of Bencomo and Daniel (1975) that in the retrieval process an advantage exists for a translation in the picture-to-word direction. "Visual coding is widely recognized as a potent factor promoting verbal learning" (Standing and Smith, 1975). Verbal coding of visual stimuli has its primary effect on recognition memory via increased rehearsal efficiency in short-term memory (Santa & Ranken, 1972). Verbal codes are also a description of graphemic, phonemic, as well as semantic features of words (Seymour, 1975). This leads to a problem of semantic memory on which little information has been provided. Walter (1973), indicates that long-term memory (LTM) contains semantic information. If these assumptions are valid, then auditory repetition may help transfer information from STM to LTM (Norman, 1973, p. 340; Peterson and Peterson, 1959); and subjects may use the meaning of the verbal message as a basis for verbal recognition.

Hypothesis 2: (AR vs VR). Performance on auditory repeated items on the recognition post-test will be superior to performance on visually repeated items.

As expected, statistical analysis confirmed the hypothesis that repetition of auditory information has more beneficial effects than visual repetition on subsequent retention of input material. The present finding is compatible with a number of earlier findings in regard to the rehearsal process for pictorial and verbal material (Peterson and Peterson, 1959; Sperling, 1963; Norman, 1969; Cohen, 1973). There is a strong agreement among these investigators that pictorial material passes through the verbal system and is stored in terms of a verbal code. In the verbal

repetition method, this verbal processing might be restricted by the prolonged pictorial presentation. Therefore, higher retention of verbal material may well be expected when this material is aurally repeated.

Dual-encoding theory (the extent to which visual material is also coded verbally and, conversely, verbal material is coded visually), accounts for the present and similar finding in that pictorial and verbal memory are interconnected and that the retrieval may be from either source or be enhanced by a trade-off process between the two codes (Cohen and Granstrom, 1970). It could be inferred that the trade-off process between the two systems operates to the advantage of verbal material rather than visual material (Bencomo & Daniel, 1975). The result is also similar to the finding of Buschke (1962) who reported that approximately 17% more of repeated auditory items were recognized than visual items; the present result shows an average of 19% more recognition for auditory repeated items as compared to visual repeated and non-repeated items.

Lower recognition under VR method may be due to lack of verbal cues during the visual repetition. These verbal cues were repeated under AR condition. Paivio and Csapo (1969) showed that exclusion of verbal indicators of pictures caused a decrement in observers' performance. This supports the contention put forward by Hurtman (1961) that the meaning of a visual message is not usually accurate and is subject to varied interpretations, as well as the contention that the use of words to direct a student's attention is essential.

Hypothesis 3: (VR vs NR). Performance on the visual repetition items in the recognition post-test will be superior to performance on non-repeated items.

In this case the result was statistically significant in the direction opposite to that predicted by the hypothesis.

The outcome supports a similar finding of Conrad (1960) in which rehearsal manipulation had little effect on visual memory; and a similar finding of Shaffer and Shiffrin (1972) that there is no direct analog of verbal rehearsal in the processing of complex visual information. Nevertheless, Paivio et al (1968), and Standing (1973) have reported recall better for pictures than for verbal material. The difference between the present finding and the latter's may be due to some experimental factors which are apparently ignored in Standing's testing procedures. The most important of these is that: he used small groups of 10 subjects for each type of stimuli (pictures, words presented visually, words presented auditory). To this extent, Ss who were tested for visual material might have been visual learners (Levin et al, 1971; Goldberg, 1977). Secondly, in picture recognition measures, subjects were tested with written recall response, "in the case of pictures Ss wrote down a description of each item recalled". Here, it may be said that picture recognition was tested verbally, which as Hurtman (1961) suggested may lead to misleading results; its reliability is open to question. Further he did not couple the pictures with any specific verbal description in the presentation session; subsequently his subjects were free to remember whatever description they remembered. However, he has stated, in the same report, that "these subjects recognized an average of . . . descriptions", then, he claimed that pictures are not only recognized better but are also recalled better than words, whether presented in the visual or auditory modality. Finally, the unexpected result may also be tied to the retention time allowed; Standings' subjects

were given an unlimited time (40 min.) as compared to a limited time (2 1/2 min.) in the present paper. The finding of superior verbal recall, as regards the speed of verbal retrieval, is similar to that of Standing, however.

The result may also be due to different cues and information available in the different test items (Shaffer and Shiffrin in Tevresky, 1969): "When information is high, visual rehearsal may not be an effective device." Also, increasing the exposure time in the visual repetition method may be said to have some inhibiting effect over both audio and visual perception. Briggs (1974) reported auditory and visual confusions by varying exposure duration. Lack of accessibility to verbal cues under VR duration, and availability of verbal cues in NR sequences may have contributed to better results for normal presentation. In fact, the result confirms Dwyer's (1973), contention that the most difficult information in an audio-visual presentation is the pictorial component, that words serve an important cueing role and should be incorporated into visual presentation.

Superior retention under combined audio-visual presentation, however, is compatible with much of the literature advocating combined mode of AV presentation, e.g. Day and Beach (1950); Travers et al (1966); Menn and Menn (1972).

Conclusions and Recommendations

Psychological investigation suggests that both auditory and visual material are transformed into a verbal-auditory code and stored in short-term memory (STM), e.g. Sperling (1969). Further, rehearsal of stored material in STM may permit it to be retained for an indefinite period of time, e.g. Miller (1956); Peterson and Peterson (1959); finally, combined audio-visual presentation is superior to presentation of either channel alone, e.g. Travers et al. (1966).

The general question examined here was degree to which the relative efficiency of combined AV presentation may be enhanced by introducing extended unimodal presentation in either audio or visual channels of a slide-tape program. Learning was tested by 30 multiple-choice questions on the entire content of the program; 10 items were based on the information presented pictorially; 10 items on the narration; and the remainder upon information contained in both visual and auditory channels. Pictorial information was tested visually, other information was tested verbally. This provided a testing situation similar to that in which learning took place and where retention could be accordingly tested (Bloom, 1956).

The results suggested that there may not be a direct analog of verbal rehearsal in visual learning. Prolonged exposure of pictorial material was not an effective means of facilitating its retrieval. This is consistent with the view expressed in Norman (1969, p. 139), in which rehearsability of visual scenes has been questioned. The outcome supported the contention that repetition appears to be beneficial, perhaps necessary to the learning of verbal material (Lindsay & Norman, 1973).

Wagh and Norman (1965) implied that rehearsal is primarily a verbal function in the memory system and purely visual presentation may not be rehearsable by the visual system (except, perhaps, when the pictures "tell a story" for an experiment by Nelson, 1949 (cited by Hoban, 1970), using silent motion pictures resulted in better learning than listening to its narration only).

It may be concluded that in slide-tape presentation the narration is carrying the burden of the instruction, and that visual presentation is somewhat incomprehensible without the narration (cf Hoban, 1970, p. 8-19). Therefore, in AV instructional communication it may be better to rely on an auditory channel which handles verbal information.

Generally speaking, things one may remember are things that mean something. And the meaning is usually conveyed via the verbal channel. The results of many studies have shown that the encoding and storage of letters and forms involves an audio-speech system (Posner, 1967); for example, reproduction and recognition of visual figures in STM correlate with the Ss ability to describe them (Cohen & Granstrom, 1970). All the evidence suggests a high proportion of AV instruction is carried on the auditory channel, perhaps because aquisition of formal knowledge is still very much verbally-oriented.

There are other aspects of an AV presentation which are frequently misunderstood. Educational or instructional visuals somehow differ from, say, visuals in creative art. In the latter, the producer himself is free to decide which aspects of this subject are to be ignored and which ones are to be transformed and what the rules of transformation are to be in his representation. Such freedom is

not found in the type of material designed to be used for teaching. Academic visuals are constrained by the requirements of the content/concept which they are supposed to represent. Ad-hoc arrangment of pictorial content of an AV program will not ensure transmission of the desired information. Farnham-Diggory (1972) has stated that "the use of iconic material will not ensure comprehension of academic visuals that have symbolic meanings."

Empirical support for this notion can be found in Vernon's (1945) study of the ability of 231 adults to comprehend visual information and to answer questions of what they had seen. Ss were not very sure of their interpretations. She concludes: "it is often not sufficiently recognized by those who advocate the visual method of presentation that nearly everyone in the course of their upbringing acquires some fluency in making verbal statements of ideas and meanings. . .consequently, it is not surprising that this interpretation was found to be difficult and the subjects were slow to make it spontaneously without explicit instructions. In particular, there was a tendency to describe the appearance of the graphs or chart, rather than to report the information they were intended to convey. Thus (about 35% of the reports) contained irrelevant descriptions of appearance. . . The Ss might be so preoccupied with appearance as to pay no attention to the meaning." She, too, emphasized the use of verbal mediators to interprete the non-verbal materials.

Another point that should be taken into account in presentation of AV instruction is the interference between the two channels; interference between auditory and visual channels arises during the simultaneous

transmission of information via two channels when the cues in one channel are not relevant to those in the other channel and thus result in loss of information. The remedy is adequate narration to accompany pictures; preferably the same semantic relationship that exists in successive paragraphs should also exist in successive presentation of visual material. "We must therefore develop a verbal program for threading our way through academic visuals. We must learn what to "say" about what we are seeing and in what order to say it." The verbal program is another version of iconic-to-symbolic translation described by Bruner et al (1966): "it may be true that a picture is worth a thousand words, but if the object is to locate its functional equivalent in another context, then perhaps one word is worth a thousand pictures if it contains the conceptual key" (pp. 28-29).

Studies of Dwyer (1967) with simple line drawings of the human heart and taped lectures revealed that: "on all except the drawing test, even the label slides (with no picture at all) led to higher scores." He noted that if one is going to be asked to draw something, any kind of picture may be more helpful than none at all. Pictorial cues stimulate a rich flood of mental associations. Under some conditions, it may be difficult for a student to consolidate selected associations into a single, clear concept. It, therefore, behooves a teacher to choose visual aids with extreme care (Farnham-Diggory, 1972, p. 432). Pictures should be introduced into a curriculum for the purpose of expanding and enriching associations, rather than constricting them. . . "pictorial comprehension" involves the arousal and consolidation of personal ideas – that is both its power and its danger (p. 432). Visual materials are potentially "con-

taminated" by the pupil's previous verbal knowledge; therefore, it is desirable to transmit the essential information through the verbal modality, and to provide the student with verbal feedback to confirm that they are following the correct conceptual thread.

The study indicates that extended pictorial presentation for an extra 10 seconds after the termination of its narrative portion may not be an effective technique to promote retention. The results suggest that a) a novel succession of simultaneous audio-visual sequences may be able to keep student's sense modality alive and interested, and b) the audio-channel might best be used to steer student's attention to critical cues in either the audio or visual channel throughout a slide-tape presentation.

It should be noted, however, that the scope of the conclusion arrived at is, in the safest sense, limited to the conditions maintained, to the medium, and to the student sample (whose verbal ability might be relatively high).

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APPENDIX A

(SLIDE-TAPE SCRIPT)

SLIDE	METHOD	TAPE
CHANGING SLIDES	NR	You are about to see a presentation about ancient Iranian Arts. After this presentation, you should be able to recognize some historical relics, and distinguish the meaning of these findings from an early civilization.
CHANGING SLIDES	NR	One of the earliest signs of human settlement has been found in Western Asia in a country called Persia. Persian people call it Iran.
CHANGING SLIDES	NR	In the following program, you will see a part of the evolution of man's artistic records along with his concept of life between 3000 and 2000 years B.C.
CHANGING TO TITLE SLIDE	NR	This presentation is then concerned with early civilization which we will review as "The Arts of Ancient Iran."

SLIDE	METHOD	TAPE
TARGET ITEM	AR	Generally speaking, these painted potteries are known as "man's first book of history" for recording and communicating his thoughts, fears, and hopes.
CHANGING SLIDES	NR	This painted jar, for example, tells us that in the beginning, primitive man was an inhabitant of mountains.
TARGET ITEM	NR	They showed the mountains with high peaks. . .the peak between the two peaks implies rain, and the 4 rushes growing there clearly indicate water between the mountains. It also recalls plant-growing energy in water.
TARGET ITEM	NR	The weavy lines on this jar are a pictograph of water. . .in fact it is the first photograph for water.
CHANGING SLIDES	NR	The sky in this representation is associated with the outstretched wings of a bird from which rain is falling onto the weavy water below.

SLIDE	METHOD	TAPE
CHANGING SLIDES	NR	This one is telling a story of a hunter . . . looking for this lion which is cleverly painted on the other side of the same pot.
CHANGING SLIDES	NR	The usefulness and importance of the bull and horse in those days, led to a production of many bull and horse-like objects and. . . paintings.
CHANGING SLIDES	NR	Another interesting painting is a scene of a man fighting animals.
TARGET ITEM	NR	Fear and superstition is represented in repeated mysterious lines. This kind of painting is closely connected with the strange world of the unknown.
CHANGING SLIDES	NR	Then we see idols which are again a sign of fear of the devil or an evil power.
CHANGING SLIDES	NR	In ancient Iran supernatural power was always connected with the moon and sky... The conception of this superior power is represented in a combination of these three elements; the sky which looks like a wing; the moon, and the head of super-natural power.

SLIDE	METHOD	TAPE
TARGET ITEM	AR	Because of the belief in secret power, which endangered their lives, people created their own gods to protect them from disease and other disasters.
CHANGING SLIDES	NR	For example, this is the shepard god which is holding two dead evil animals with his hands.
TARGET ITEM	VR	Another strange looking god is called "Protector of Folks". This god is supproted by a group of heads.
CHANGING SLIDES	NR	They even created a female god or goddess. . . This particular goddess has cocks head growing out of her shoulders.
TARGET ITEM	NR	The only way to distinquish a goddess from a god is to look for the differences in their physical appearance; a goddess usually is holding up her breast!
CHANGING SLIDES	NR	Because these goddesses are mainly a symbole of fertility, any woman who wanted a child, used to appeal to a fer-

SLIDE	METHOD	TAPE
		tility goddess to help her in giving birth to a child.
TARGET SLIDE	VR	This fertility charm for example was to be worn by a pregnant woman to guarantee a successful childbirth.
CHANGING SLIDES	NR	Because of the fear of death and the belief in life after death, primitive man provided their dead with objects to use in another world. Idols like these have been found in old tombs, and generally appear to be some sort of container which is held by a human or has bird characteristics. The bird container has a long neck and large eyes.
TARGET SLIDE	NR	These containers were sued for funeral rites. The liquid can pour out of its beak.
CHANGING SLIDES	NR	The function of this woman-shaped container is quite interesting; when filled with some water, the liquid will pour out of her breast, resembling a feeding mother.

SLIDE	METHOD	TAPE
CHANGING SLIDES	NR	Later with the discovery of metal, craftsmen found the opportunity to give some sense of permanent existence to their creations.
CHANGING SLIDES	NR	These marvelous ornaments. . .and this silver mirror with its woman-shaped handle and jewelery are all characteristics of such effort.
CHANGING SLIDES	NR	It is evident that even in earlier ages jewelery was popular with women; her hands and neck are covered with jewelery.
CHANGING SLIDES	NR	In this period silver and gold objects are made with more delicacy.
TARGET ITEM	NR	Expensive gold objects are mainly designed for chieftains who could also possess an offensive weapon like this silver sword with its beautiful handle.
CHANGING SLIDES	NR	This interesting axe bears an inscription which is engraved in cuneiform writing. As we'll see, this kind of carving was the first handwriting known to people over 2000 years ago.

SLIDE	METHOD	TAPE
TARGET SLIDE	NR	Now, let's go to the southern part of Iran where we can see the old capital of the country. . .the ancient Royal Palace.
TARGET ITEM	AR	Surrounded by mountains. . .here are the ruins of the Persepolis. . .the Royal Palace. Persepolis was made over 2000 years ago.
TARGET ITEM	AR	The building was started in Cyprus kingship and was completed by 9 other kings who came to power at a later period.
CHANGING SLIDES	NR	Aryan people, under the leadership of King Cyrus, occupied Babylon and began to expand their empire.
CHANGING SLIDES	NR	In the political sense Persepolis was the headquarters of a complex organization to administer 28 nations of the vast empire.
TARGET ITEM	AR	The liberal policy of Cyrus in permitting the return of Jews from their exile in Babylone won him a tribute in the first chapter of the book of Ezra.

SLIDE	METHOD	TAPE
TARGET ITEM	AR	Within 25 years Cyprus and later his successors created a vast empire by conquering 28 different nations.
CHANGING SLIDES	NR	This empire ranged from Egypt to Hungary. These 28 nations are represented here by 28 figures carrying a king's throne.
CHANGING SLIDES	NR	Each figure represents a different ration. . .This can be seen by their different hair styles and costumes.
TARGET SLIDE	NR	There were two main staircases to the Throne Hall, where the King used to receive foreign deligates.
TARGET SLIDE	VR	Delegates on the way to the Throne Hall had to pass in front of designs showing a royal hero fighting some fabulous animal.

SLIDE	METHOD	TAPE
CHANGING SLIDES	NR	These scenes were intended to remind the delegates how ruthlessly any hostile forces would be crushed by imperial power.
TARGET ITEM	AR	Later, Darius came to power and built a hall which is known as "the hall of one hundred columns". . . here he received gifts from different provinces of the country.
CHANGING SLIDES	NR	These gifts were in fact taxes that provinces had to pay. Tax could be anything valuable from a noble horse to an expensive gold pot.
CHANGING SLIDES	NR	For example, this is an Armenian leading a horse to the hall.
CHANGING SLIDES	NR	Babylonians, carrying silk and gold pots.
TARGET SLIDE	VR	Syrian delegates bringing gold ornaments and horses.
CHANGING SLIDES	NR	And finally, delegates from a Persian province are led by an usher to the hall.

SLIDE	METHOD	TAPE
CHANGING SLIDES	NR	To offer their taxes, delegates were expected to go through a huge doorway, known as "the gate of all counties".
TARGET SLIDE	VR	All gifts were then gathered here. . .in the royal treasury.
TARGET ITEM	AR	At some important passages, huge statues of animals were represented to keep the bad spirits away from the palace.
CHANGING SLIDES	NR	Many other massive statues of mighty animals like lion. . .and the phenix were also carved to serve the same purpose.
CHANGING SLIDES	NR	Some of these statues were made to be placed at the top of pillars to guard the palace.
TARGET SLIDE	VR	It was a labourious and lengthy job to carve these statues out of massive pieces of stone. . .perhaps this is why some of them like the double-headed bull were left unfinished.

SLIDE	METHOD	TAPE
TARGET SLIDE	NR	This monster was the master guardian of Persepolis. . .it has a human head. . . a lion's ear. . .and a bull's leg.
TARGET SLIDE	VR	It is said that Cyrus set down what is known "as the first document of human rights" in ancient cuneiform writing.
TARGET SLIDE	NR	The inscription is written in 3 ancient languages of gold and silver tables.
TARGET ITEM	AR	The number of letters and signs of this language was reduced from 1000 to about 32 signs.
TARGET SLIDE	VR	This is the royal seal of Darius, showing him hunting a lion. The inscription on the right side of the seal is carved in cuneiform characters.
TARGET SLIDE	VR	For the first time, as a major development, people started to worship the great God. . . God is symbolized as Farhoud with two wings.

SLIDE	METHOD	TAPE
CHANGING SLIDES	NR	Great God, or Farhoud, is placed above all other gods and like this relic he is carved over Darius's head at the King's tomb.
CHANGING SLIDES	NR	There is an inscription next to Darius's tomb. Part of its translation reads. . . I AM DARIUS, THE GREAT KING, KING OF KINGS, IF THOU THINKEST HOW MANY WERE THE LANDS WHICH DARIUS RULED? THEN BEHOLD THIS PICTURE: THEY BEAR MY THRONE. THEREBY THOU MYEST KNOW THEM. O MAN! THIS IS THE GREAT GOD'S COMMAND TO THEE. ABANDON NOT THE RIGHT PATH. SIN NOT.
TARGET SLIDE	VR	Cyrus, the founder of the Persian empire is placed here in his solid tomb.
TARGET SLIDE	AR	There are also two inscriptions: one inside and one outside his tomb. These inscriptions have been translated: I AM CYRUS WHO FOUND THE EMPIRE OF PERSIA, GRUDGE ME NOT THEREFOR THIS LITTLE EARTH THAT COVERS MY BODY.
CHANGING TO END SLIDE	NR	And so ends our trip to man's past history.

TEST

SLIDE	TAPE
BLACK SLIDE	You are now required to complete a multiple-choice test which is based on the slide-tape presentation you have just seen. When you receive your copy do not write your name, there is no grade for this test. We are only testing the presentation. . . Now let's wait for everyone to get a copy of the test. . .
	Now that everyone has a copy, please look at page one. . .to answer the first part, like any other multiple-choice answering, you must simply read the question, then look at the four choices, A, B, C and D, and choose the correct answer by putting a cross mark in the brackets next to the answer you think is correct. Do not leave the questions unanswered. . .
	After each 15 seconds I'll tell you to go on to the next question. . .Are there any questions. . .? Start the first question. . .
	Start question 2 . . ., 3. . ., 4. . ., 5. . ., 6. . ., 7. . ., 8. . ., 9. . ., 10. . ., 11. . ., 12. . ., 13. . ., 14. . ., 15. . ., 16. . ., 17. . ., 18. . ., 19. . . Start the final question. . . Stop!

SLIDE	TAPE
	You have finished the first part. Now let's start the second and the final part. To answer this part, you must read the question first and then look at the screen. You will see 4 different pictures on the screen, only one of them is the correct picture to choose for your answer. When you choose the correct picture, you must put a cross mark onto the corresponding portion of each square next to the question you are answering. . .
GUIDE SLIDE	You can see on the screen an example of how a block should be marked.
	Now let's do a practice as an example. . .
SAMPLE SLIDE	Read the sample question first. . . The question is. . . "Which picture is showing the gate of all countries. . .? "Now you must look at the screen to find that picture. The top right picture is of course the correct picture to choose for your answer, therefore, you must mark the top right block of the square. Your answer to the sample question should look like this one you see on the screen. . .
BLACK SLIDE	Remember, mark only one block which you think is correct. Do not leave the question unanswered. . .

11. The pool between the two peaks implies:

( ) a. A small lake between the two mountains
( ) b. A river which had been running between the two peaks
( ) c. Rain
( ) d. Plant growing energy in water

12. The only way to recognize a god from a goddess is to:

( ) a. Look at their different hats
( ) b. Look at their different costumes
( ) c. Look for the differences in their jewelry
( ) d. Look for differences in their physical appearance

13. Bird and human shaped containers were used for holy liquids and were also used:

( ) a. To keep drinking water
( ) b. To keep precious perfume
( ) c. In funeral rites
( ) d. To preserve rare liquids only

14. The fear and superstition were represented:

( ) a. In repeated mysterious lines
( ) b. In strange looking animals
( ) c. Non-realistic figures
( ) d. Clever paintings

15. There were two staircases to the Throne Hall:

( ) a. One for horses and one for visitors
( ) b. Where people used to listen to the King's speech
( ) c. Which were covered with gold
( ) d. None of the above

16. Expensive golden objects were mainly designed:

( ) a. To give some sense of permanence
( ) b. For chieftain
( ) c. For rich people
( ) d. To provide luxury

17. The inscription known "as the first document of the human rights":

( ) a. Found under Pasargad ruins
( ) b. Is written in three ancient languages
( ) c. Were carved on two blue stones
( ) d. Were carved on one stone with cuneiform characters.

18. The master guardian of the Persepolis:

( ) a. Was a double-headed bull
( ) b. Was a symbol of royal power
( ) c. Was placed in front of the private room of Cyrus
( ) d. Had a human head, lion's ear, and bull's leg

19. Persepolis or ancient capital of the country is situated in:

( ) a. South-Eastern part of Iran
( ) b. Eastern part of Iran
( ) c. Southern part of Iran
( ) d. Northern part of the country

20. Wavy lines painted in the jar were:

( ) a. One of the first men's painting
( ) b. An effort to communicate with us
( ) c. A pictograph of rain
( ) d. A first pictograph of water.

STOP! - WAIT FOR INSTRUCTION.

SECOND PART

"To find the correct answer you must look at the screen."

SAMPLE QUESTION:

Which picture is showing the "gate of all countries"?

The "TOP RIGHT" picture is the correct picture, therefore you must mark (X) in the "TOP RIGHT" block.

1. Among these four statues of animals, which one was left unfinished?

2. Among these four idols, which one is supposed to be the "protector of folks"?

3. Among these four pictures, which one is showing the royal treasury?

4. Among these four relics, which one is regarded as the first document of human rights?

5. Among these four pictures, which one is showing the royal seal?

6. Among these four pictures, which one is showing the fertility charm?

7. Among these four pictures, which one is showing the royal hero?

8. Among these four structures, which one is the tomb of Cyrus?

9. Among these four remains, which one is representing the Great God?

10. Among these four different groups, which ones are Syrians bringing gifts?

STOP!

If you have any comments about the presentation, please write it on the back of your questionnaire and leave it on the table to be collected.

. . . . AND THANK YOU FOR YOUR COOPERATION.

APPENDIX D

(ITEM ANALYSIS AND TEST RELIABILITY)

ITEM	HIGH	LOW	DIFF.	DIS.
1	12	8	0.16	0.60
2	12	8	0.16	0.60
3	10	6	0.33	0.62
4	9	7	0.37	0.56
5	12	12	0.00	0.50
6	11	7	0.25	0.61
7	12	7	0.20	0.63
8	12	12	0.00	0.50
9	4	3	0.70	0.57
10	11	8	0.20	0.57
11	9	6	0.37	0.60
12	11	11	0.83	0.50
13	10	7	0.29	0.58
14	8	3	0.54	0.72
15	12	5	0.29	0.70
16	10	4	0.41	0.71
17	8	5	0.45	0.61
18	12	12	0.00	0.50
19	11	8	0.20	0.57
20	5	3	0.66	0.62
21	6	3	0.62	0.66
22	10	4	0.41	0.71
23	10	6	0.33	0.62
24	12	7	0.20	0.63
25	10	6	0.33	0.62
26	6	2	0.66	0.75
27	12	7	0.20	0.63
28	11	11	0.83	0.50
29	10	6	0.33	0.62
30	8	0	0.66	1.00

Difficulty and Discriminability indices are based on 27% high and 27% low scores of the correct responses (Ebel, 1965, p. 347).

$$\text{(K-R 21)}\quad r = \frac{K}{K-1}\left[1 - \frac{M(K-M)}{K s^2}\right]$$

Where K - the number of items in the test
M - the mean of the test scores
s - the standard deviation of the test scores

$$r = 1.04\left[1 - \frac{17(26-17)}{26 \times 21}\right] = .75$$

(K-R = .75)

APPENDIX E

EQUIPMENT LAY-OUT