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THE RELATIVE EFFECTS OF AUDIO-VISUAL VS. AUDIO-ONLY LECTURE PRESENTATION ON RETENTION AND EVALUATION

ABSTRACT

Sixty McGill undergraduates were exposed to one of two lecturers delivering the identical lecture on either radio or television. No differences were found on a retention test or a series of evaluative rating-scale variables and it was concluded that the TV image of the lecturer does not enhance the effectiveness (measured by retention and evaluation) of a lecture, and that such video is basically irrelevant information. In addition retention scores remained the same across lecturers in either condition even though one lecturer delivered the speech in 1/3 less time. Future research into the problems of lecture pacing and relevant video presentations is discussed.

AUDIO-VISUAL VS. AUDIO-ONLY LECTURE PRESENTATION

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by

James H. Katz

A thesis submitted
to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree
of Master of Arts

Department of Psychology
McGill University
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July, 1969.

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Television is now well established as an important classroom teaching tool (Kumata 1960). Schools from elementary to university levels are finding television an economic necessity in the face of rising student populations, rising salaries, and teacher specialization. In the lower grades especially, teachers have found TV to be a uniquely acceptable teaching medium, because children are so familiar with it. As one proponent has argued,

> Teaching children through the medium of television means that we are teaching them through a medium which is well known to them. The children in schools today have never known life without television. They do not regard it as we older folks tend to do, as a disturbing modern phenomenon like the airplane or the atomic bomb. For them it is something which is alive, which is part of their everyday life. They associate it with delight and interest; and that is something that every good teacher at all times has tried to give. (Weltman, 1963)

In addition to the classroom uses of instructional television, there are many non-commercial educational television stations offering university-extension courses as well as general educational programming.

In view of the widespread use of instructional television, it is important to consider some of the psychological aspects of teaching by TV. It has been argued, by McLuhan (1964) that television is a more involving medium than radio, because the low-definition pictures on the TV screen require mental filling-in and completion on the part of the viewer. By contrast, McLuhan considers radio, to be a passive non-involving medium because the information it presents is complete and does not require the listener's aid in the creation of that information.

If television is an involving medium because the viewer must mentally complete the incomplete pictures on the screen, however, it is

possible to consider radio as that much more involving because the listeners must create images entirely on their own. Most verbal descriptions are expressed in terms of visual imagery, and people attempt to understand written or spoken information by forming mental images of described objects or actions or relationships. The colloquial expression "I just can't picture that", expresses inability to understand or believe heard information. Another piece of evidence is the common observation that the old radio serials were far superior to their counterparts on television. The radio serials seemed more believable and appeared to engender higher levels of emotional involvement and suspense in the listeners. Perhaps this was because there was no picture to limit and channel the listener's use of his imagination in interpreting the program. For example, all a radio listener had to go on was a verbal description of a prehistoric monster presented with some lurid sound effects. That listener could conjure up all sorts of horrible, gigantic images for the beast. On television, the viewer is limited to 21" monsters, with none of the power to terrorize that the imagined beast possessed. The 'given' image prevents the viewer from forming his own images of described action, and so limits his participation, or emotional involvement in the program.

This sort of analysis should also apply to educational lecture material. As one observer has stated:

> What is it (television) then? It's above all an instrument for communicating information and ideas with pictures, but the pictures must add to the understanding of the ideas. Pictures for the sake of serving the "visual medium" cliché - picture for its own sake - merely detracts from the communication of ideas. (Bennett, 1964)

This raises the possibility, then, that a television lecture may be more difficult to understand in some cases simply because of the presence of the picture. The viewer of such a program might learn more if he shut the picture off.

The research on educational television is lacking in studies which adequately deal with the above questions of involvement and participation in television versus other media, and the importance of visual stimuli as aids to understanding. Most of the research to date has been sponsored by agencies interested in the applications of educational techniques. Therefore, most studies have asked the question 'could television teach as well as a live teacher in a specific classroom situation?' The standard procedure in these studies, no matter with what subject matter they have concerned themselves, is to separate two sections of the same course and teach one section via television, while a control section receives the usual live instruction (Bundy, 1960; Kumata, 1960; UNESCO, 1952). Grades at the end of the course are compared to judge the relative effectiveness of the new teaching method.

The standard result of these experiments is a finding of no significant differences between the two conditions. Schramm (1962) reviewed 393 television versus live instruction studies and found that 255 produced nonsignificant differences. Of the remaining comparisons, about one-half indicated television was superior, and the other half indicated television was inferior to live instruction. A major factor behind the finding of nonsignificant differences may be the logic of the question asked by these researchers. It is not possible to directly

compare televised and live instruction at such a gross level. These studies in effect make the assumption that the only change introduced into the classroom situation by television is the physical presence of the television set and the absence of the live teacher. However, with television, a student may find himself at a greater psychological distance from the teacher, and from the material. The personality of the teacher will be a less important factor when the teacher is a televised image. From the viewpoint of the instructor, there may be a change in lecture style due to the lack of immediate feedback which the live student audience would provide. Environmental considerations take on a much greater significance with the advent of classroom television. The ambient light level, and the acoustics of the classroom may become much more important when television is used. The medium may not be the message, as McLuhan (1964) would have it, but the medium certainly does have a great effect on the message, and alters the methods and efficiency with which it can be presented. Therefore, the basic question of the relative effectiveness of television versus live instruction can not be tested in its entirety by replacing a teacher with a TV set.

A second problem in the literature is one of inadequate design and control in many of the experiments. Stickell (1963) examined 250 comparisons made in 31 ETV studies and stated that he could accept as completely reliable only ten of these comparisons. The rest were considered unreliable because of poor controls.

One study from the literature will serve to illustrate some of the control problems which characterize this research. Barrow and

Westley (1959) carried out a study in which grade school children were exposed either to a radio or a television version of several "background to the news" programs. The hypothesis was that the television version, by providing two channels of communication, would be superior to the one channel radio presentation in terms of short and long-term factual recall.

The first problem occurs in the stimulus material itself, in order to be mutually comparable, the two programs, radio and television, would have to be precisely the same except for the variable under study - in this case, the television picture. The researchers report, however, that the two programs were taped independently from slightly different scripts. The stress on certain key words or phrases in one tape might have differed from the stress used in the other tape. Just that small difference would be enough to affect the amount retained, or which terms were remembered by the students. Another difference was that the television program used pictures of the material being discussed, while the radio script was written to describe the material more fully. These differences in the structure and taping of the two programs rendered them impossible to compare directly. The students in the two groups were effectively exposed to different programs and would be expected to react differently.

The programs in the above experiment were shown to students in their usual classroom groups. At a prearranged hour the teachers in the different classrooms turned on television sets or radios which had been provided for the experiment. Sources of error introduced by this procedure are many. Classes were chosen randomly, but students may have

been assigned to each class in some nonrandom fashion. Typically, in a school system classes will be selected on the basis of intelligence tests or aptitude measures. Classes chosen from different schools will also differ in non-random fashions since school students are grouped by neighbourhood of residence and neighbourhoods are self-selecting for socio-economic class and ethnic factors.

The programs were introduced by each teacher to his or her individual group, another possible source of error. Since there was no experimenter who went from class to class introducing the programs, there is no way of knowing how each teacher did the task. There may have been a set of written instructions given to the teachers, but did students in one class ask more questions about the procedure? Did the individual teacher volunteer information that was not available to the other classes? Some of the teachers might have harbored resentments about the electronic intrusion into their classrooms. This certainly would have shown up in the ways they introduced the programs.

The programs were shown to the students in these classroom groups. One difficulty encountered here is the effect members of group audiences have on each other. If one or two students in a group of thirty or so are extremely bored or fidgety, this may affect the other members of the group. Also some groups might have more talkers in them, or other disturbances.

There was one radio or television set for each classroom in the study, with no control mentioned over the quality of the equipment. Small differences in the state of repair of different sets could exhibit

themselves as occasionally rolling television pictures or scratchy sound from a radio. In addition, the sound from the radio speakers was undoubtedly of a different timbre and volume from the television speakers. Each teacher was apparently free to set the volume control to individual preferences.

The classrooms themselves were located in different school buildings and in different locations in each building. Sunlight streaming through the windows of one room would have wiped out the contrast on a television picture, and rendered pictures, charts, and diagrams difficult to interpret. A class in a noisy neighbourhood would have trouble hearing the program comfortably.

There are many problems in the Barrow and Westley study which might not appear in another project, and vice-versa. The general problem of control remains, however, and it is possible to attribute many of the non-significant differences to cases in which real effects may have been masked by poorly controlled testing conditions.

The present study is designed to make comparisons between radio and television versions of the same lecture. It is partially a test of Bennett's statement that a picture which does not add to understanding actually detracts from the understanding of ideas presented. Would a picture that carries no information relevant to the lecture result in less learning from a TV lecture than from a radio broadcast of the identical lecture?[1]

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[1]The idea of a television picture without information relevant to the content of the program is not artificial. In many videotaped academic lectures the visual portion does not add substantive information to the lecture, but only presents the basically irrelevant image of the lecturer.

In view of the difficulties encountered in studies such as that of Barrow and Westley, there was a greater effort placed on control procedures in this project. Subjects were assigned randomly to conditions, and the testing environment was the same for all subjects. Subjects were tested individually in the same rooms. Volume level and sound quality were the same in all conditions, and the stimulus material, the lecture, differed in the two conditions (audio and audio-visual) only in the presence of the television picture in the audio-visual condition.

Dependent measures used in the study were a measure of retention comprising a short objective test on the material presented in the lecture, and also an evaluative questionnaire containing semantic differential-type rating scales measuring attitudes towards the lecturer and the lecture material.

METHOD

A 2 x 2 analysis of variance design was used for this study. One half of the subjects viewed a videotape of a lecture on TV and the other half listened to the same lecture on an audio tape. Within each condition, one half of the subjects heard lecturer number one, and the other subjects were exposed to a second lecturer. Each subject was tested in only one of the four conditions.

Subjects

Subjects were 60 undergraduate students chosen randomly from a list of volunteers at McGill University. The subjects were first and second year students all of whom reported having some prior experience with instructional television. The great majority were presently enrolled in at least one televised-lecture course. None professed to have any prior knowledge of the lecture topic, and no subject said that he or she had heard the lecture previously.[2]

Apparatus

The apparatus used in this study included an Ampex 7000 video taperecorder used in recording and playback of the lecture tapes, a Roberts 770 audio tape recorder used in dubbing audiotapes from the video masters, and playing these dubbings, and two Admiral 23" 'Classroom' television monitors used for playback of the tapes. Also used were an Ampex video amplifier, for balancing the signal between the television monitors, and

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[2]This was a possibility because the lecture was presented originally at Expo'67 and was subsequently broadcast by the CBC Radio Network.

an Ampex camera for the original recordings.

In the testing situation, the tape machine fed the two classroom monitors simultaneously in separate rooms (Figure 1). The subject was seated approximately ten feet in front of the screen in each room. The only difference between conditions was that in the audio-only conditions small doors covering the TV screen were closed.

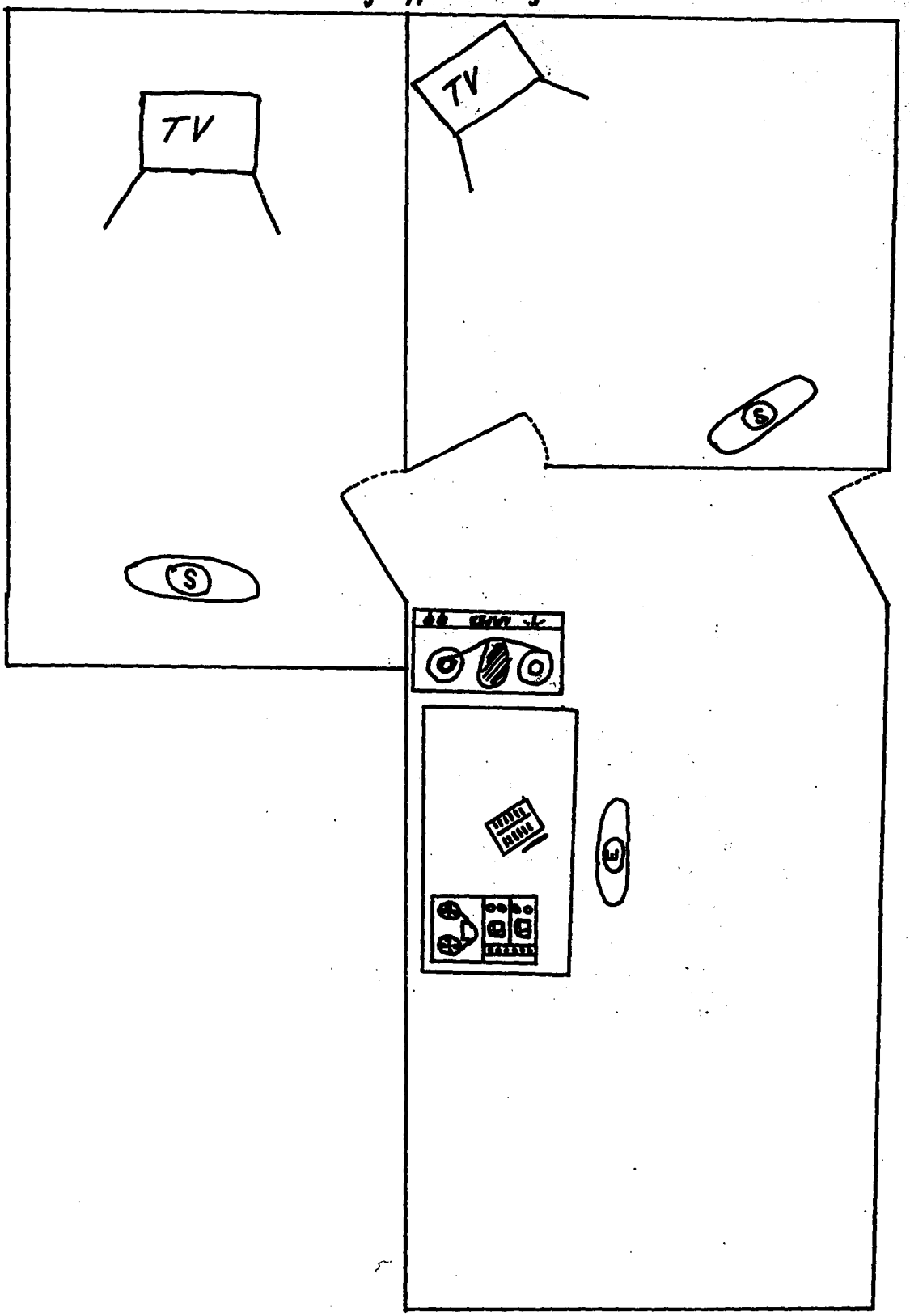
Lecture

The lecture used in the study had to meet several criteria. First, the lecture had to be audio material. A radio-broadcast lecture was ideal, to insure that no information in the form of pictures or graphs would have to be eliminated in making the tapes. Second, the speaker had to be unknown to McGill students, since two different men were to record the lecture, and each was to be identified as the original speaker. Third, the lecture had to be a factual discussion of a topic unfamiliar to McGill students, in order to facilitate the construction of a meaningful retention measure. Fourth, the lecture had to be about forty minutes in length, to approximate the length of classroom lectures. Fifth and final criterion was that the lecture had to be at least fairly interesting, so that the subjects would be attentive in all conditions.

The choice made under these criteria was a lecture delivered by Dr. Kinzell at Expo '67 in the lecture series underwritten by Noranda Mines Ltd. The speaker was the retired Carbide Corporation vice-president in charge of research. His topic was the general area of industrial research. The lecture was filled with examples of research processes and uses, and some of the consumer products developed through industrial research. (Appendix I)

Figure 1

Testing Apparatus Layout



The lecture was extremely personal, in the sense that Dr. Kinzell presented examples in terms of "something that I invented," or "something that we did." To preserve the speaker's credibility as actually being Dr. Kinzell, the lecturers who made the experiment tapes were older men. Two other criteria for the speaker selection were that the men had to be native English speakers and had to have some previous experience lecturing.[3]

The lecturers were each supplied with a typescript of the lecture with some indications as to the inflectional stress of words in the original delivery (the underlinings in Appendix 1). After reading the script several times over a period of three weeks, the two lecture presentations were videotaped. It was not required that the man stick exactly to the suggested stress marks, as these men were not professional actors and it was felt that any attempt to introduce this artificial constraint into their own style of lecturing would probably sound unnatural.

Each of the videotapes consisted of the picture of a man standing at a lectern delivering a lecture to a single camera from complete notes. Since the quality of a videotaped program deteriorates with each playback of the tape, audiotape dubbings were made from the videotapes to be used in the audio condition so as to preserve the videotapes. Any differences in sound quality between the videotape apparatus and the audiotape machine were minimized or eliminated by using high-quality recording

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[3]Dr. E.E. McCullogh, chairman of the Education Department and Dr. A.D. MacDonald, chairman of the History department, both of Sir George Williams University, for their invaluable aid in served as lecturers.

machinery, using the same speakers (inside the television monitors) for both tapes, and finally by equalizing volume and timbre of both sources through the use of an external VU meter and an A-B comparison of simultaneous tape playback.[4]

Questionnaire

Dependent measures of retention and attitudes were included in a questionnaire to be filled out by subjects after they had either seen or heard the lecture. The retention measure (Appendix II) was constructed by writing a series of multiple choice items based on the lecture material, and discarding those items which three out of five judges rated as subjectively "irrelevant", or "too hard" or "too easy", or just "bad". The judges were students from the same population as the subjects, who were exposed to the lecture twice, both television and audio-only, for familiarity.

The attitude items were chosen through a similar pretesting technique. Lists of paired polar adjectives were distributed to 79 McGill undergraduates (see Appendix III). The students were asked to decide which of the qualities represented by the polar adjectives they took into account when evaluating lectures and lecturers in the course of school work. Those qualities which were mentioned most often by these students as being

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[4]The A-B comparison consisted of placing a microphone and amplifier connected to a meter (similar to the recording level meters on tape recorders) in the testing room. The videotape and audiotape machines were both switched on and synchronized so that the tapes were at the same point on either machine. The volume controls and tone controls were adjusted until no difference was detected when the output was switched from videotape to audiotape or back. The comparison was made by both listening to and the playback and watching the meter needle. The balance was checked through the same procedure in the other testing room.

important or relevant were retained and these items formed the final attitude measure used in the study (Appendix IV). The semantic differential items were arranged with continuous scales rather than interval scales to encourage greater variability (Ramsay, 1968).

Procedure

A single subject was tested during each testing session in each of two rooms. The subjects were asked to be seated and the following instructions were given:

'This experiment is part of a study of recorded lecture design. I am working in cooperation with the Instructional Communications Center which is the McGill facility responsible for recording McGill lectures used in classroom instruction and educational broadcasts. These people naturally realize the problems involved in these productions and how little we really know about what makes a good lecture good and a bad lecture intolerable. This project is designed to uncover some of the important parameters of lectures. I will ask you to watch (listen to) a tape of a lecture and then fill out a questionnaire concerning your feelings and reactions towards the lecture and the speaker. In addition there will be a few questions about the material of the lecture. This particular lecture, which lasts 46 (32) minutes, was originally given as one of the Noranda lectures at Expo. The speaker is a Dr. Kinzell, who for many years was the head of the research department for a large U.S. chemical firm. He is now retired and travels around North America lecturing on the topic of industrial research.'

After these instructions, the testing room doors were closed and the tape started. At the completion of the lecture, each subject was given a questionnaire containing the attitude measures followed by the retention measure. There was also a space allowed for comments at the end of the questionnaire. The subjects completed the questionnaire at their own rate.

RESULTS

In order to reduce the raw data to a statistically meaningful small number of independent variables, fourteen variables were chosen from the attitude rating scales as being of greatest relevance to the study.[5] A fifteenth variable was the retention score corrected by item analysis of the test.[6] These fifteen variables were used in a factor analysis. Only those variables loading highest on the resulting factors were subjected to analysis of variance.

Factor Analysis

As argued by Barnsley (1968), an appropriate standard for evaluating the significance of a factor loading may be obtained by assuming the S_e (Standard Error) of a factor loading to be equal to one divided by the square root of the number of subjects ($1 \sqrt{N}$). A factor loading significant at $P < .05$ was thus equal to $\pm 1.96 s_e$. The corresponding factor loading at this level was $\geq \pm 0.510$. All variables which loaded significantly at this level are reported. Seventy percent of the significant factor loadings are $\geq \pm 0.60$, corresponding to a significance level of $p < .01$.

Independent factor analyses were carried out on audio-only and audio-visual (hereafter called 'audio' and 'video') conditions for each lecturer. Factors from the four factor analyses have been qualitatively

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[5] See appendix III for the items chosen (*).

[6] See appendix I for the items kept after item analysis (*).

assessed and labelled. In order to present these data in a comprehensable manner, four factors (one from each of the four analyses), have been grouped. The single factor resulting from this grouping is thought to be representative of similar evaluative variables for each group. Included with the factor loadings are "Factor Number", which is the ordinal position of that factor's extraction in its group's varimax solution; and "Percent Variance", which is the percentage of the total variance accounted for by the factor within its group. The grouped factors are ordered by mean percent Variance accounted for across all four groups.

			FACTOR 1	
	Audio 1	Audio 2	Video 1	Video 2
Factor No:	5	1	2	1
% Variance:	8.5	45.9	14.9	47.9
Variable	Loading	Loading	Loading	Loading
Precise (Material)				.524
Lecturer at ease			.929	
Lecturer's interest		.802		
Held attention	.938			
Convincing	.586	.713		
Liking for lecturer	1.056	1.023	.952	.977
Lecturer's enjoyment		.871	.912	1.027
Agreement				.922
Retention	.536			

Factor 1 is identified as Liking for the Lecturer. The common variable across all groups is the liking variable, and the other variables loading heavily on this factor indicate subjective estimates used when evaluating unfamiliar lecturer. The Liking factor accounts for a mean of 29.2% of the variance across all four groups.

	FACTOR II			
	Audio 1	Audio 2	Video 1	Video 2
Factor No:	4	2	1	6
% Variance:	11.9	17.5	44.5	3.7
Variable	Loading	Loading	Loading	Loading
Orderly (Lecturer)	.725		.557	.886
Precise (Lecturer)	.622	.986	.893	.642
Orderly (Material)			.612	
Precise (Material)			.545	.642
Lecturer at ease		.835		
Convincing				.590
Retention	.520			

Factor II is identified as relating to Clarity of Presentation. The variables which load on this factor are those which assure the auditor of a lecture that he is receiving an orderly, structured flow of information. Clarity accounts for a mean variance of 19.4%.

	FACTOR III			
	Audio 1	Audio 2	Video 1	Video 2
Factor No:	1	3	6	5
% Variance:	32.7	11.6	5.6	6.0
Variable	Loading	Loading	Loading	Loading
Orderly (Lecturer)		1.070		
Orderly (Material)		.591		.769
Precise (Material)	.854		.524	
Lecturer at ease	.642			1.075
Lecturer Interest	.911		.964	
Lecturer Enjoyment	.576	.565		.545

Factor III is weak in that loadings are scattered and there is no variable common to all four groups. However, it does seem to point to an evaluative factor similar to Factor I, (Liking for Lecturer) but of a more general nature. The Factor has been named Familiarity with Lecturer. The variables indicate a "sizing up" of the lecturer in terms of his style,

expertise, and commitment without reference to the auditor's own relationship to him. Familiarity accounts for 14% mean variance.

	FACTOR IV			
	Audio 1	Audio 2	Video 1	Video 2
Factor No:	2	4	5	3
% Variance:	25.7	10.9	7.9	9.9
Variable	Loading	Loading	Loading	Loading
Impartial	1.109			
Orderly		.598		
Liking for lecturer		.809		
Lecturer enjoyment		.698		
Retention	.729	.848	1.086	.822

Factor IV seems to be a relatively pure Retention factor, which accounts for a mean variance of 13.8%.

	FACTOR V			
	Audio 1	Audio 2	Video 1	Video 2
Factor No:	6	5	4	2
% Variance	3.0	4.6	13.3	16.5
Variable	Loading	Loading	Loading	Loading
Impartial				.573
Lecturer at ease			.541	
Pace		.861	.612	.673
Retention	.855			
Convincing	.748			

This factor is only partially interpretable in that it is not at all certain the data from Audio 1 belong in this factor. However, the arithmetic of grouping four factors dictate that the position is accurate. In any case the only common variable is Pace, which is thought to be the import of this faftor. The Pace of the lecture accounted for 9.4% of the average variance.

The five tables below summarize the analyses of variance for the variables loading highest on each factor in the factor analysis.

TABLE 1

ANALYSIS OF VARIANCE FOR "DID YOU LIKE THE LECTURER?"

Source of Variation	SS	df	MS	F
Video-Audio (A)	13.73	1	13.73	1.32----
Lecturers (B)	11.53	1	11.53	1.11----
A X B	15.10	1	15.10	1.45----
Error	583.15	56	10.41	

MEANS

	Lect. 1	Lect. 2
Audio	4.38	6.25
Video	5.06	6.61

TABLE 2

ANALYSIS OF VARIANCE FOR VAGUE PRECISE (LECTURER)

Source of Variation	SS	df	MS	F
Video-Audio (A)	21.12	1	21.12	3.91----
Lecturers (B)	11.09	1	11.09	2.05----
A X B	00.68	1	00.68	0.13----
Error	302.75	56	05.41	

MEANS

	Lect. 1	Lect. 2
Audio	7.78	8.85
Video	9.18	9.83

TABLE 3

ANALYSIS OF VARIANCE FOR "RATE THE PACE OF THE LECTURE"

Source of Variation	SS	df	MS	F
Video-Audio (A)	01.12	1	01.12	0.24----
Lecturers (B)	199.47	1	199.47	42.99 p .01
A X B	07.14	1	07.14	1.21----
Error	259.85	56	259.85	

MEANS

	Lect. 1	Lect. 2
Audio	5.49	8.52
Video	5.15	9.41

TABLE 4

ANALYSIS OF VARIANCE FOR ORDERLY DISORDERLY (LECTURER)

Source of Variation	SS	df	MS	F
Video-Audio (A)	11.79	1	11.79	1.85----
Lecturers (B)	00.04	1	00.04	0.01----
A X B	01.60	1	01.60	0.25
Error	357.61	56	06.39	

MEANS

	Lect. 1	Lect. 2
Audio	8.80	9.07
Video	10.01	9.63

TABLE 5

ANALYSIS OF VARIANCE FOR RETENTION MEASURE

Source of Variance	SS	df	MS	F
Video-Audio (A)	07.35	1	07.35	0.83----
Lecturers (B)	04.82	1	04.82	0.54----
A X B	20.42	1	20.42	2.30
Error	497.60	56	08.89	

MEANS

	Lect. 1	Lect. 2
Audio	4.27	4.87
Video	4.73	3.00

The only significant difference was a difference on the "Pace" variable indicating that the subjects (veridically) rated the lecture as delivered by lecturer 2 as being faster-paced. There were no significant differences on the audio vs. video dimension at all, and no differences on the lecturer dimension for: Precise Lecturer. Orderly Lecturer, Liking for lecturer, or Retention.

Tables of intercorrelations among the original fifteen variables may be found in Appendix V. These tables show that while the five variables subjected to analysis of variance are almost totally independent of each other, each variable is highly correlated with other variables not included in this five. Therefore it may be assumed that the five chosen variables are a representative sample of the group.

DISCUSSION

Audio-Video

The results of the factor analyses performed on the four groups demonstrate that the principal factors of lecture evaluation are common to audio and video presentations. That is, the student is taking into account the same factors whether the lecture is on television or radio. The analysis of variance data add a further dimension with the finding that there was no significant difference in retention between the two groups. In addition, none of the analyzed evaluative variables showed a difference on the audio vs. video dimension.

The above findings support the hypothesis that the presence of the televised image of the lecturer does not in itself constitute an improvement in the effectiveness of the lecture (measured by retention and evaluation) over an audio-only presentation.

Lecturer 1 - Lecturer 2

The inclusion of more than one lecturer in the experiment was originally viewed as a control procedure for lecturer effects, but the differences which have emerged on this variable are interesting in themselves. As outlined in the method section above, the constraints on the choice of lecturers were only on appearance, native tongue, and experience in lecturing. The men chosen were much alike except for the speed with which they delivered the lecture. Lecturer 1 required 46 minutes to deliver it, while lecturer 2 required only 32 minutes to give the same speech. By way of comparison, the original author of the lecture delivered it in 42 minutes. The slower lecturer did not appear to be "dragging", nor

was the faster lecturer "rushing". The differences merely reflect different styles of lecturing on the part of the two men.

The faster lecturer was rated accurately by the subjects as being faster paced, but the most striking finding is that there was no difference on the retention measure between the two lecturers. Effectively this means that the faster lecturer put the same amount of material across to the students in 30% less time, with no decrement in recall.

The finding is essentially a byproduct of the present study, and as such it is inconclusive because the experiment control procedures were not designed for the lecturer variable. For example, the pitch, dynamics, and timbre of the speakers' voices were not controlled. The result does stand, however, and it must be remembered that "pace" was one of the factors of lecture evaluation found. Future work to support and develop this finding is necessary.

Recent advances in the techniques of electronic speech compression make it possible to process a recorded speech tape such that speed, dynamics, pitch, timbre, and relative spacing of words may each be varied by the experimenter independently of one another. Studies using these techniques could be used to test the limits of the pace effect and divorce the effect from other variables. The author is not aware of any past research integrating such variables as pitch of voice, enunciation, and lecture content to arrive at optimum lecture pace. A fruitful area for research is certainly indicated here. Norms of this sort would be

invaluable to designers of information storage systems such as tape libraries for quick lecture review in the college situation.

The basis for most of the above findings is the retention measure, which may be criticized because it was an immediate-recall measure. However, the test is felt to be defensible first, in that it includes understanding items as well as straight note-memory questions. Second, many of the subjects were members of the same class sections and would discuss the experiment, and presumably the lecture, with other subjects after the testing session. It was only through an immediate retention test that control could be assured over the subjects' exposure to the material.

Several other potential problems in the experimental design did not show up directly in the results, but deserve some discussion. The experimental room was the same for audio and video conditions, and in the audio condition the television speakers were used to play back the taped lecture. The presence of the inoperative television monitor in the room during the audio condition may have been a distracting element to the subjects. That is, they felt that since there was a television set in the room, there should have been something to see. They felt they were missing something. It is pointed out that as this problem biased the experiment against the audio condition, elimination of the distracting element should have the effect of reinforcing the finding that the picture is not an aid to retention.

Another experimental artifact which probably affected subjects' responses is indicated by the fact that the variable "How much does the

lecture presentation, but only to show that the image of the lecturer accompanying a lecture on television is basically irrelevant information. Without this image, the video can be used as a true second information channel. For lecturers in those disciplines where it is appropriate, of course, television is used for demonstrations, diagrams, charts, and film clips. But many topics simply do not lend themselves to this treatment, and in no lecture would diagrams and charts be appropriate all the time. For these situations, then, the problem of what to do with the video, remains unsolved. One possibility may be key words or phrases flashed on the screen as the lecturer speaks, or topics in outline form similarly displayed. Some type of video material seems to be a necessity. Many subjects in the audio condition mentioned in exit interviews that there was nothing to look at, and that they felt this as a lack. This may have been due in part to the non-used TV monitor problem mentioned earlier, but the subjects ststed they looked around the room or out the window, and as a result did not feel they had paid sufficient attention to the lecture itself. Any picture would probably serve at least subjectively to focus attention. The picture of the lecturer, however, is not the best choice for the task.

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Another experimental artifact which probably affected subjects' responses is indicated by the fact that the variable "How much does the

lecturer seem to know about the topic?" did not show up at all in the factor structure. This is most probably an artifact of the instructions. Subjects were told that the speaker was an expert in his field, and therefore probably disregarded their own estimates of his knowledgeability. Without the constraint of the instructional set, this variable would probably have loaded highly on one factor. This is not thought to be a serious problem for the present study in that the factor analysis was employed mainly to reduce the number of variables for analysis of variance. No conclusions have been based on the specific factors elicited by the procedure.

Future research in audio-visual vs. audio-only lecture presentation should investigate subject variables. It may be, for example, that the need for the additional external stimulation of the lecturer's televised image varies inversely with intelligence, or is somehow related to age. The stability of the present findings should be ascertained over lectures on different topics and lecturers who use more or fewer gestures or other visual expressions to underline their talks.

The most important question for future educational television research is, what type of visual presentation would contribute to lecture effectiveness? If present findings are supported by future research, it will be the task of the TV lecturer and course designer to replace the image of the lecturer on the television screen with something that will contain relevant information, and thus make real use of the visual medium. It was never the purpose of this study to deny the value of television in

lecture presentation, but only to show that the image of the lecturer accompanying a lecture on television is basically irrelevant information. Without this image, the video can be used as a true second information channel. For lecturers in those disciplines where it is appropriate, of course, television is used for demonstrations, diagrams, charts, and film clips. But many topics simply do not lend themselves to this treatment, and in no lecture would diagrams and charts be appropriate all the time. For these situations, then, the problem of what to do with the video, remains unsolved. One possibility may be key words or phrases flashed on the screen as the lecturer speaks, or topics in outline form similarly displayed. Some type of video material seems to be a necessity. Many subjects in the audio condition mentioned in exit interviews that there was nothing to look at, and that they felt this as a lack. This may have been due in part to the non-used TV monitor problem mentioned earlier, but the subjects ststed they looked around the room or out the window, and as a result did not feel they had paid sufficient attention to the lecture itself. Any picture would probably serve at least subjectively to focus attention. The picture of the lecturer, however, is not the best choice for the task.

APPENDIX I

LECTURE

We are living in a changing world. Now that platitude was first uttered by Adam as he led Eve out of the garden of Eden, but, like all platitudes, it still holds. And the reason that our world is changing so fast today is by virtue of organized research, which has been made possible by a combination of: improvement in education, mass education, if you will, at the higher levels, communication, and organization. Organized research is a product of the twentieth century, really. Before that, it was an individual situation, as distinct from teams, but I would emphasize that even with the teams the key still remains the individual. But just to show how fast we are moving, it was about a hundred thousand years before man got off his legs and on to the back of a horse; it was about six thousand years from the time he did that until he rode in a locomotive; it was about a hundred years after that before he had the automobile at his disposal, in general, and about fifty years from then until the airplane was in common use: and only thirty years from the plane to the satellite, and if you want to go to another field to get right up to date, Sharkley, Britten and Bardeen invented the transistor in 1951, twelve years later we all had them in our radios. This twentieth century movement is well illustrated by the situation in New York City, mind you now it was one of the most advanced places, when we went from the gas lights to the electric light, between 1900 and 1910, and then between '10 and '20 the first radio, and between '20 and '30 the first commercial airplane, and between '30 and '40 the development of chemistry in the polymers and the plastics; between '40

and '50 atomics and all that went with it; between '50 and '60 electronics and you know what went with that; and computers today, and space. Now, this didn't just happen, it took place because we had organized research. Now the most advanced example of organized research is found in industry, and the most effective, I do believe, in spite of the fact that there is a good deal of very fine research government sponsored and so on; so I am going to talk about that primarily, and the first thing you had better remember about industrial research is that it has a single motive and it is important that any research, be it industrial or otherwise be motivated in a very clean cut way. Not the single motive in industry is to make a profit for the company. This motive - this profit - does not have to be made tomorrow, it can be a short range profit, medium range or long range proposition but the net result must be to make a profit for the corporation for which you are working. This means that research must be an integral part of the total endeavor, and here is where industry has one great advantage over government or other types of research, namely that because of the objective is exactly the same, namely to make a profit for the corporation, between top management and research you can get a high degree of integration. One of the mistakes that was made early in the game, early in the century, was to put research off on the side in industry and just make contact with it now and then; or when they had something good they made contact, and so on. Today it is generally recognized that to get the most out of research - and to do a really good job - the vice-president for research, or whoever is in charge of it,

should be a member of the top management team and sit with them regularly, so as to understand the nature of the business and what is required. Now, the first question that is generally asked is we start to talk about industrial research is: "How much research should a given company do?" This is a very difficult question to answer but I have two broad guidelines for this. First, it can't do much less than its best competitor, because is it does, it will be in trouble. It will be beaten along the way and become second rate. Mind you, I didn't say it should do more than its best competitor, of course if they did that then it would be one of these continuous cycles; each of the competitors would have to out do the other. So I say: not much less than your nearest competitor and this is why you will find that the amount of research done by any corporation is generally in line with that done by the whole industry. Now industries vary a great deal. A chemical industry will run around 4 1/2 to 5 percent of its yearly turn over as a research budget: pharmaceutical is up around 14%; aircraft and so on still higher; electronics around 11%; then you drop way down with machinery and the heavy equipment sort of industry, less than 1% in some of these industries. But the important thing is that the companies that grow within a given industry are right in the range within about half a percent of the rest of the good companies in that industry.

That sets the lower limit as it were. Now the upper limit is: "How much do you want to invest?" Of course you've got to remember that your research dollar in general does not come back to you for about seven

years: and, depending upon how long a research, and how important it is, it may be appreciably longer than that. So that in a sense you're investing in the future. Now fortunately, the tax people don't regard it as an investment, and I am always careful to point out that it is really an expense, but it can be thought of as an investment. Now, having decided about how much you're willing to spend on research and development, R and D, the next thing and the real heart of the whole matter is the selection of projects. How do you select projects? Well, first you must be sure, (Because not all of your projects are going to be successful). You must be sure that you have a balance between short range projects (that is something where you expect to get a result which you can turn over to production and sales in a year or two). Between short range projects, medium range projects, and the really long range projects you must have this balance. Because, if you don't, you're going to run out of good projects and you're going to have a big gap in turning out anything that shows. You're going to have a terrible time explaining to management or your stockholders that your research hasn't suddenly failed, because of the continuity of the flow that must come from this. Now, the other thing you've got to look out for, and in some ways this is a greater danger today than it's ever been, as I view the scene, is what I call the use of the research laboratory group to put out sales fires or production fires. The fire engine-minute man type of thing where you have this group of technical people, they're skilled, you have trouble, and the temptation to pick up this group and send them out to

clean up this trouble is very great, and it takes a strong director of research to resist this; but if it isn't resisted, then the main program suffers seriously. And this has to be watched all the time. Now, in picking your projects, of course you want imagination, - almost goes without saying, but you must have realism with it. And realism in this area involves a number of things, and probably the most important of the things that it involves is timing. Timing, both from the scientific and the social view point, in fact even from a psychological view point. For example, talk about one of the things that you will probably see before very long now, telephone with TV so that you can see your communicant as well as speak with him. This has been used, actually it was tried out in New York City, it was tried out in the Carbide Company for a while and there are several problems involved here but the initial problem that everyone thought of was: "How do you get the enormous number of bits of information that is needed for a TV picture through the set onto the wire and then at the other end how do you get off the wire and on to the set?" Now this could actually have been done fifteen years ago; and yet if they had put a lot of time and money on this fifteen years ago it would have been down the drain in a sense - it would have been mistimed - because the real problem is: "How do you get that much information along the wire?" And this problem has only been solved more recently with the introduction of the microwave and the mazer and the lazer type of carrier wave so that you can get a great deal more information along the wire in a given period of time. Today is very timely to have it, fifteen

years ago it would have been nice research but it would not have shown up on the balance sheet. That's scientific timing. Social timing: - best illustration I can think of there is the pill. Suppose we got some pharmaceutical company to come out with the pill in 1900 or 1910, and just to make it harder, just suppose this happened in Italy or Spain. You can see it would have been mistimed. Today, socially we are ready for this sort of thing pretty much, not completely, but pretty much; and so that a research that winds up with the pill, today, is not mistimed, but it would have been not so many years ago. Psychologically, there are some things that are psychologically unacceptable in a given time and then changed. There are others that don't change. I remember many years ago inventing a silver alloy with silicon. It had the same lustre and shade as pure silver, it didn't tarnish and it was somewhat harder. It didn't scratch as easily. Now you might say "great", and I was young and innocent enough at the time to have actually said "great" to myself. But it went absolutely nowhere. Why? Because it contained 87% silver, and, to be sterling it has to, by decree, contain 92 plus percent silver. So, it wasn't sterling, it couldn't be marked sterling, and if it wasn't sterling it wasn't silver by God; and so what, just another stainless alloy. So that was another case of bad timing in Psychology and that hasn't changed yet; and I don't know if it ever will change, although ever is a long time.

But you can take another one that I'm sure will change. You read about desalination. That is, taking the salt out of sea water in

order to supply water for local drinking in areas where water shortages exist. There are many localities where it is a real problem. Now the same techniques that are used for taking the salt out of the sea water or brackish water, can be used, perhaps with some modifications, to clean up sewage water. You can take sewage effluent from a city, and by going through a few process steps and than a plant similar to the desalination plant, you can come up with a very pure, potable water. But I haven't mentioned this to anybody yet that they haven't wrinkled their nose. And the timing on that isn't quite right, we're not wuite ready for that; although I suspect it won't be long before we get over that particular feeling. Now, then there is the matter of realism with respect to the cost and demand. I am reminded many years ago, and I obviously pick these illustrations from the past or the future rather than from the present because I don't want to get my friends too angry with me. I remember in the past at Union Carbide, we made ferrochromium for stainless steel. And somewhere along the line it was decided, partly rightly, although not completely, that certain quantities of nitrogen were harmful; and the steel companies to whom we supplied the ferrochrome put up a great howl because of the nitrogen quantity in the ferrochrome and pointed out that some had been made in Europe and some had been made elsewhere which had a little bit less and so forth so we said - alright, what do you want? So? Well, they gave us a very low number. This is what we want. We said fine, it didn't matter. Took a little while to figure out how to do it, but we did, and having put effort on it and so on, said

"well", - I think the material was selling for about 32 cents a pound that contained chromium at the time, - "We said, well, we'll put a quarter of a cent premium on the low nitrogen ferrochrome". Which we did. And the result was that none was sold; because, while they wanted low nitrogen, they didn't want it badly enough to pay an extra quarter of a cent. And this is what I mean when I say, the realism of the demand. It's something you've got to watch very closely in picking your projects.

I have a converse illustration. I was in Europe with one of the top men at Carbide and we ran into a thing called; silicon briquets. What they did was they put the silicon metal, the ferrous silicon, into a concrete block, a little brick. And the theory was that you could take this brick and throw it into a cupola and that the concrete would protect the silicon until it got way down into the pig iron bath, and therefore it was superior. Well, those of us who were metallurgists took one look at that and said, that's nonsense. It isn't gonna protect it; there's no point in it. But for a variety of reasons, we bought the thing anyway, and the briquets were put on the market. They sold like hotcakes.

A great success. The reason? Each briquet contained one pound. You didn't have to weigh out your silicon and you didn't make mistakes and it was so easy, you know, if you wanted to add five pounds of silicon you just throw five bricks in, Amen. In other words, the psychology of being able to do things conveniently even in as odd a place as the foundry played a role there. And there, actually the silicon did

cost them a little bit more, but they were willing to pay for it because of the convenience. So you run into that kind of thing.

Now let's take a look at the detail of organized research. Normally, people say, you have basic research, and applied research and development. These are very poor terms as a matter of fact when you stop and look at what actually happens. While it's true that you have an area, a study of certain areas and that's basic in character, that isn't all the basic research you do. Because, when you do applied research you're doing a certain amount of basic, you're doing a certain amount of engineering and development. You cut right across. When you're doing the development you may have to go back and do some of what we've been calling applied research and go back still further and maybe even do a little basic here or there in order to finally round the thing out. So the three terms that I prefer to use and think about, and it's the thinking that's important really, not the verbiage, are: Area research, where you are doing basic research in an area in which you're interested and I'll come to what you do there in just a minute. The product and process research, where you have a specific product or process in mind; you have imagined something; you have conceived it; it's tangible, you know what you want to do. And the third type of research I call engineering research. You've got your product to the stage where you've proved its worth and you know you're going to go ahead with it. You then engineer it in order to get the results you want, in the profit and the manufacturing details.

All three of these relate to motives. Not to the way it's done, or to any particular part of the system. But you think of these three areas, phase one, two, and three of research, as areas that are motivated, they will then fall into place. And when you're considering phase two research, that is, product and process, whether you're some basic research or some engineering, it still fits.

Now, one question you always ask is: "Why should any industrial organization or company do any basic research or any area research?" And the answer is pretty simple. If you ask those that don't know too well, the answer you'll get is: "Well, we might hit the jackpot; we might find a polyethylene; we might find a diamond process. We might find a new this or a that, really revolutionary, and this is well worth while." Well, I'll give you just a little arithmetic here. The biggest company that I can think of, does less than half of one percent of the world's research done in its own field. In any given field you get a breakthrough or a polyethylene or something that is really jackpot maybe once in five years. That means that there is half a percent or less probability of that breakthrough happening in this one good company. Because no one organization has a monopoly on brains or creativity. You add this up, and you find that the chances are very small. You wouldn't begin to spend this money on basic research if that's all you got out of it, namely, that chance. Now, what else do you get out of it? Well, you get people, to start with. Because, the way the educational system intertwines with the research world, when the good people come out of

school, they're oriented towards research. Now, those who are capable of becoming first-class researchers, will stay in research. But many of them, after they have a certain amount of research, either, out of their own opinion, or the opinion of the research community, learn that they will do better elsewhere. They'll go into production, they'll go into sales, they'll go into analysis; they go many places. Some of them may go into teaching. But, they all want to start out - - the best, the top ten percent - - by and large want to start out in research. And here you have to have the opportunity to do basic research, area research, with a high degree of freedom, until they get over the hurdle of the complete freedom that they more or less have had in the academic world. They curtail this freedom, not by order, but by their own motivation and desire to do something specific. This makes them curtail it themselves and get down to the thing they're interested in. But, more important than that is what I call the coupling effect. If you're doing half of one percent or less of the research of the world, basic research, knowledge, understanding; think of the opportunity if you could just cop off some of the rest, for yourself. I'm reminded of talking to the head of the General Electric research labs one day. We were chatting, and I said "By the way, what's the most important thing you think has come out of your lab in the last fifteen years?" Without hesitating a second, he said: "The transistor". I knew what he meant. Now what he meant was, that even though the transistor was invented at the Bell Telephone laboratories, the publication of that information, the finding itself, when dovetailed with all the research that had been going on in that area in the General

Electric labs gave the General Electric a real jump in many directions where the transistor was involved. And it's this coupling with the outside world. You can't do it by just reading: you can't do it by just talking to a few people and scouting. You've got to be working in the field. And you not only have to be working in the field, but you have to be working in the field and know the problems and the general interest of your own company in that field at the same time. Then, when you hear or read something to the effect that this or that has been done here or there, you realize "Ah that's what we want for this work".

And of course you can get the coupling right within your own company. I mentioned polyethylene a minute ago. I'm reminded that polyethylene was invented in England; the patents belonged to ICI, after one acquisition. During World War II it was required in large quantities for radar installations, relatively large quantities for those days. It was being made by a batch process because of the heat transfer problem involved. The United States Navy asked practically every large company to see if they couldn't find a way to make a lot more, faster. And Carbide among others turned this job over to the chemical engineers. And they worked hard and long and furiously, but to no avail. But one day one of our people from Charleston, West Virginia who was working on this happened to be up at one of the other laboratories in Buffalo. And at that laboratory we had a fellow working on how to make diamonds. We thought the way to make diamonds was not the hard way, which was finally done, by building up great pressures and temperatures, in massive

form; but by hitting a diamond with an atom, an ionized atom, so hard that the impact would give you both the pressure and the temperature, and this way build up diamonds. We never succeeded in doing that, but in trying to do this, this fellow who was working on it had developed certain techniques with the handling of gases. These two fellows happened to get together, the fellow from West Virginia and the fellow from Bullafo, and the polyethylene fellow said "Well, if I could only do thus and such." And the diamond man said: "Well, I'm doing it every day." Well, I don't have to tell you that a matter of weeks after that, polyethylene was coming out in tank-car lots, the urgency was so grave. Nor do I have to tell you that as a result of that, the Carbide Corporation got a tremendous jump on the field. I haven't kept up with the latest figures, but I think probably all told Carbide makes somewhere between a third and a half of the total world production of polyethylene today, by virtue of having had this jump.

Now, the next thing to remember is that area research, this basic research, is relatively inexpensive. For any given successful project, if you have spent one dollar in the basic and area sense, you will spend ten dollars in the product and process section; after you have imagined a product or a process, you develop this idea, and then you will spend a hundred dollars on engineering the product, getting it ready for the plant; and your market studies and whatnot. And then you'll spend a thousand dollars for the plant. Now, you can afford lots of one-dollar failures; you can afford a few ten-dollar failures. You

better not have many dundred-dollar failures; and a thousand-dollar failure means somebody is going home . . . by request. Now if you add up the number, you can have more projects of the dollar kind, of course, and so on; and actually, if you take the area research, and the product and process research, and think of those two together as being the research, as distinct from engineering, about thirty percent of your dollar in that zone can be spent on basic research projects. For a Hundred dollars, you'd have thirty projects. And for the other seventy dollars, you'd have seven projects in the applied and product stages. Now as to the ratio of engineering and development to these other two, that varies quite a bit, depending on your philosophy. Now the philosophy we followed at Carbide, and to the best of my knowledge, it still holds, (I think you realize that I haven't worked for Union Carbide for two years as a result of having reached the age of statutory senility,) I think it still goes, anyhow, is about a two to one ratio. Last time I looked at DuPont's figures it was four to one for them. It varies with the companies. It has always been my philosophy that there is no excuse, for development projects not to go into production. Other than an unforseen external happening. Somebody may come out with a patent on what you've been doing, someone may come out with a better way of doing it, or some reason why the market has vanished. There are a few things like that that can cause you to spend your hundred dollars on development and then not go on. But they should be very few.

Now, if you will come back for a minute and say: "How do you get your area projects?" How do you choose projects. Now choosing the projects is the most important thing of the lot. Well, first: New tools. New tools always give you new opportunities. For example, when X-rays first became a metallurgist's tool, and I'm talking about diffraction analysis X-ray for crystal structure and the like. As a result of that, we came out with the first of the low-alloy, rolled steels. There's been a great many since and it's a tremendous market and this is a direct result of having the X-ray as a new tool. And I remember shortly after the War, radioactive tracers. We put a tracer lab into Charleston, into the chemical company. Why? Well, we weren't quite sure why, but here's a new tool, and we better find out what it's good for. And so, well, what do we do with it? Well, first let's just sort of check it out, and the first thing we'll do is go back and recheck the mechanism of the oxidation of ethylene. Now that was something that had been done in Carbide ever since the corporation was formed, or shortly thereafter, and we figured we knew all about that, and it would be a good way to check it out. Well, we found that we didn't know all about it at all. Using this new tool gave us insights that some of the things we thought were so weren't so at all. It so happened that we were able to take advantage of our findings in a new plant that had just been built, just by changing the valves a little bit and increased the efficiency. We paid for that research many times over in the first month. And increased that plant's capacity enough to defer the building of another plant, a little bit.

Now it's that kind of thing that you can get from using new tools.

Another way to get at it is to take a look at your raw materials. If you have raw materials that are available to you in excess, well proced. Again come back to a Carbide illustration. Way back, they started to make acetylene. From Carbide in those days one of the important products was calcium carbide from which we made acetylene. Calcium carbide is still a very good way of making acetylene. Well, we figured, if somebody figures out how to make acetylene other than from calcium carbide we'll be in trouble so we better find out ourselves. So we did a lot of research, paid for by Carbide, and found out how to make acetylene other than by calcium carbide, but the yield was so low that it was uneconomic. And the reason the yield was so low is they made a lot, of ethylene. Ethylene wasn't good for anything. So, following the saying that if you have a raw material, take a look at it, we did a lot of basic research of the properties of ethylene and its compounds. And one of the compounds that they happened to run into was diethylene glycol, and that, ladies and gentlemen, was the original permanent anti-freeze, Prestone. And a terrific market suddenly developed, as a result. That's the second way of getting at choosing projects.

Another one is demands from the outside. For example, it wasn't too many years ago, but still quite a few, that air pollution began to look like a real problem. And obviously, if you want to lick air pollution, the nicest way would be to have hydrogen as a fuel.

Because the product of combustion with hydrogen is water and nothing else. Now, this would be great, so let's take a look at the catalytic exydation of hydrogen. We weren't quite sure why, or where we were going to go with it and so on, just take a look at it. Well, one result was the fuel cell. And another was a new type rechargeable battery, and these are now coming to the fore.

And another thing you can do is to work on those things which are basic to the nature of your business. For example, in your work, if you're interested in detergents, you better work on surface phenomena. Just the general prpblem of surface reactions. If you're interested in oxidation compounds, you'd better work on the peroxide bond. We did that. We did fifteen years of basic research on the peroxide bond and finally came up with a new way, of making peracetic acid which is the base for the less costly epoxy resins that you've all heard about. Heat insulation. We were in cryogenics and we knew that insulation was something that needed work so we did a lot of basic area research into the nature of heat transfer. Results? Well, I can give you two. One:tank cars which will take liquid hydrogen from California to Cape Kennedy with the loss of about a pint in three weeks: something of that kind, the insulation is so good. Another, the cryogenic needle; where you can actually put liquid nitrogen through a small needle, insulated, and have that whole thing in the brain so that the sides of that tiny tube are insulated enough so that the brain is not damaged. Only the point gets cold. And there'll be more things coming from that.

Then you say, "Fine". This tells you where your projects are: your basic or area projects. How about your product and process projects? Remember: Nothing pays off till it's gone through all three steps. And into manufacture. Alright, for the product and process work you get ideas from what I've just illustrated here, and you get ideas from the area work you're doing, you also get it from the coupling with the world outside where you haven't done the basic work yourself. I remember very well the Bureau of Mines, not so many years ago, the United States Bureau of Mines coming out with the finding that they'd learned how to deposit, how to plate tri-valent chromium. Now this is the chromium atom with three electric charges on it. And most chromium atoms, and all that we had been able to handle up to that time had six. Now obviously, if you're going to electroplate one with three charges it is only going to take half as much current as with six. That would make a lot of things economical. They came out with it and of course it was less than three months afterwards that we at Carbide had developed an electrolytic chromium process based on it, and here is one case where we hadn't done the basic work, but if we hadn't been doing basic work on the nature of the chromium atom, we never would have thought of it. We spotted it, put it to work and there it is. Now also you get feedback from the engineering group and from the marketplace. And here you have to judge as you go.

Now one thing I wanted to point out is that in selecting your projects for the area part and the product and process part, the decisions should and must be made by the research people and primarily by the

research director. Because at that stage you can not answer the questions that have to be asked by management and by engineering and by the marketplace people. I know too many good projects that have been killed by a market survey prematurely. Obviously, there's no market for something that has never existed. Obviously, there's not going to be a market for something is you have to guess at the price and put it up twice as high as it finally turns out to be. And so I repeat, the decisions and judgments with respect to the program and area research and product and process research should be solely in the hands of the research people. Now, the research director obviously can't ignore economics, but he has to do his own, and make his own interpretations of it. And then we come to the big decision. That is, do we or do we not go into development. Now here, sure the researchers can have a voice, but the decision should be made completely by top management. They should be completely involved in it, and that day it goes into development there should be no reason for it not going into production except as one may turn up from outside. Which still gives you a chance to change your mind. But, this decision is the one you live with in the commercial end of the business and it should be made completely by the commercial people. Now that's the time you can stop and do your market survey. That's the time you can get down to close costs on your engineering, and so on. You may not have all the answers then, but you'll have enough of them and be able to project sufficiently well and that the answer of a yes or no on the go-ahead can be fixed. Now, in order to do this, you have to have good

communications. Now you can get communication among the lab people quickly enough and easily enough, but you've got to get the communication to the fellow who's going to have something to say about the next step. In other words, the basic research people, when they hold a symposium, should invite those guys who are going to work on the products and processes if something turns up. The product and process people should invite the people from engineering as they go along or at least one of them, so that when you have to make that tough decision of do you or don't you spend that large sum of money, it's not a sudden thing. It's something that the people are familiar with and it's something that they have had the time to work on and think through. Annual reviews; a visit of one man, a key man in the decision making ptocess: bring him in and let him see the story, and when you do and you're still in the product stage, let the technical fellow tell the technical story. And don't try to make an economic pronouncement then, because it's too soon and if you do and there's a flaw in it, it'll be picked up and the fellow who is trying to look over your shoulder as it were, will be prejudiced. Untimely economic assays are bad all the way through.

Now this business of keeping in touch with top management has a double feature to it. There's feedback. That is, not only do top management have to know about these things in order to make the decision, but research has to know these things in order to help management in some of their decisions. For example, suppose you're a company not so long ago making steel fishing rods. Well, the first thing would have happened

to you if you ran such a company is one of your researchers would have come in to you and said "Hey, have you heard about fibreglass?" And then somebody would start looking at fibreglass and thinking about it. And then you get together with top management and then you have to make a decision which research will have a serious effect on: namely, let's assume that the steel fishing-rod industry is going to be badly hurt by fibreglass; do you then go into fibreglass? Or do you say "well, that's out of our field, we don't know how to handle that sort of thing. We'll drop fishing rods and make steel golf clubs, and airplane parts. Or maybe we'll do both." Now that decision is a top management decision which can be strongly influenced by the technical people. And so you have a feedback working both ways in this general area. And remember that this organized research, while it looks like it costs an arm and a leg, is actually cheaper than unorganized, bootleg research. And man being the curious animal that he is, the investigation and the triale and the experimentation are going to go on whether it's organized and directed or not. And the cheapest way is to organize it. And remember too, that you have a case of stability involved here. Research organization takes people that have to be educated not only technologically but also psychologically to your business. This doesn't happen by itself. You can't turn a research organization on and off like a faucet. You can turn it off, all right, but it'll take you seven years to turn it on again and that's a long time and you're out of luck. You can influence rates of change, by putting pressures on to get friends: you can increase or

decrease it; you can put more emphasis on the basic and more on the area or more on the engineering. You can change these things, slowly, ten, fifteen, maximum twenty percent a year by putting pressure on, but to make sudden moves here, is really very uneconomical.

Now to sum up, I'd say that in selecting your projects, you should temper your theory with realism, you should weigh the human factors, you should modify the principles and the aims in line with the participants that you have. You should apply judgment; use operations research, use present-net-value, which is a scheme involving applying interest-discounts and the like for the timing of money. Use all these things, but don't use them to give you an answer. Use them to get pictures, each of which helps you to form your own final judgment on these things, whether you're in research deciding what should go into the research program, or whether you're in management deciding what should go on. This is important in all of these areas. Now, what we're saying is, that in the research people themselves we need creativity, knowledge and ingenuity. In the research administration, the director of research, we need breadth, scope, comprehension, and finally, as every administration post should involve, judgment. And probably the most important single thing that top management can do, whether it be business or government, or university, or somebody else, is to choose the right research director. Without that individual, you're really in trouble. His most important job is to spot the young fellows, bring them along, see that those who don't fit, from the standpoint of creativity,

are transferred. In other words, build up the human side of his organization.

When we get it all finished, what we have is contribution to the public welfare; bloodbanks have come out of industrial research, cryogenic needles I mentioned: all sorts of things to benefit man. And with it all, when you're doing this research, bear one thing in mind, and that is: If you don't really contribute to man's welfare, you're not going to make money for the company. Thank you.

APPENDIX II

RETENTION MEASURE

Answer the following questions on the basis of information given by Dr. Kinzell in the lecture. Even if there is a question in your own mind as to the objective facts of the situation, or if you have other information than that presented, try to answer on the basis of the lecture information. If you are not certain of the answer, guess.

Check the blank to the left of the correct answer.

* 1. Which is not a good reason for a company to do basic or area research?

____a. To attract good people just out of university to the company.

____b. To utilize the "coupling effect" with other companies in the field.

____c. To be able to take advantage of breakthroughs made by other industries.

____d. The chance of coming up with a fabulously profitable new product or process.

* 2. For every $1 spent on the basic research for a single product, how much will be spent for the final plant?

____a. $10

____b. $100

____c. $1000

____d. $10000

3. One of the new tools for research not mentioned in the lectureis:

____a. Radioactive tracers

____b. Efficient high-vacuum pumps

____c. Diffraction-analysis X-ray

4. Out of research on insulation came the development of:

____a. Transistors

____b. Cryogenic needles

____c. Silicon briquets

____d. Prestone antifreeze

* Kept after item analysis.

5. The best example of organized research is found in:

____a. Industrial research

____b. Government-sponsored military research

____c. Privately-sponsored military research

____d. College or university-sponsored academic research

6. An example used to illustrate good social timing in research was:

____a. The transistor

____b. The pill

____c. The Cryogenic needles

____d. Silver alloy

7. Dr. Kinzell (the lecturer, remember?) worked for:

____a. General Electric

____b. Union Carbide

____c. Bell Telephone Laboratories

____d. Westinghouse

8. Match the terms with their definitions:

____ Area research

✱____ Product and Process Research

____ Engineering

a. Preliminary product development.
b. Basic inquiry into a field of interest.
c. Production of the product.
d. Final ironing out of academic and production problems.

9. The lecturer worked as a:

____a. Research Director

____b. Top Management Officer

____c. Union Representative

____d. Economic Advisor

✱ Kept after item analysis.

10. What is the single motive behind research in industry?

____a. To improve speed of production.

____b. To invent new products.

____c. To make profit for the company.

____d. To dovetail with university research programs in furthering the cause of scientific inquiry.

*11. How much research should one company do?

____a. As much as is economically possible.

____b. 10% of the company's annual turnover.

____c. ½% of one percent of all the research being done in the field.

____d. An amount about equal to that being done by the company's best competitor.

*12. Selection of products for basic or area research should be in the province of:

____a. Top management.

____b. Economic and market specialists.

____c. The researchers themselves.

____d. Product engineering experts.

13. Which statement was not made by the lecturer?

____a. "Any research must be motivated in a very clean-cut way."

____b. "Government-sponsored research is, as a rule, vastly inferior to industrial research in concepts and organization."

____c. "Research must be an integral part of the total endeavor."

____d. "The most advanced, and I do believe, the best example of organized research is to be found in industry."

* Kept after item analysis.

14. "The lecture began:

____a. "Good Afternoon ladies and gentlemen . . ."

____b. "Organized research is a product of the twentieth century . . . "

____c. "It was about 100,000 years before man got off his legs and onto the back of a horse . . . "

____d. "We are living in a changing world . . . "

15. Dr. Kinzell did <u>not</u> deal directly with which question?

____a. "When do you decide you have pursued a given line of research about as far as you profitably can?"

____b. "How do you select your research projects?"

____c. "How much research should a given company do?"

____d. "How much do you want to invest?"

16. The mention of "maser and laser types of carrier waves" was in reference to:

____a. advanced surgical techniques.

____b. TV telephones

____c. military research

____d. new tools for research

* 17. In any given field, a major breakthrough occurs perhaps once in:

____a. Five years.

____b. Seven years.

____c. One year.

____d. A decade.

* Kept after item analysis.

18. Permanent antifreeze was a product of research on:

____a. Oxidation compounds

____b. Insulation

____c. Tri-valent chromium

____d. Ethylene.

* 19. Which chemical compound was not mentioned in the lecture?

____a. Calcium carbide

____b. Zinc oxide

____c. Acetylene

____d. di-ethylene glycol

* 20. Which of the following should not be the responsibility of company management?

____a. Choosing the director of research

____b. Making technical decisions of the methods of production.

____c. Making far-reaching economic decisions.

____d. Initiating programs of basic research.

21. "Carbide makes 1/3 to 1/2 of the total world production of _____ today."

____a. Transistors

____b. Polyethylene

____c. Calcium carbide

____d. Permanent antifreeze

* Kept after item analysis.

✱22. The most important thing a company can do in terms of their research department is to:

____a. Choose the right projects.

____b. Choose the right research director.

____c. Provide adequate funds and equipment.

____d. Give the researchers freedom of inquiry into areas of interest.

23. You do <u>not</u> get ideas for new projects from:

____a. New tools

____b. New research personnel

____c. Outside demands from the marketplace

____d. Raw materials available.

✱ 24. "Your research dollar does not come back to you for about ____??____ years."

____a. Twelve

____b. Seven

____c. Two

____d. Four

✱ 25. "Realism of the demand" was mentioned with the example of:

____a. The transistor

____b. The pill

____c. Low-nitrogen Ferrochromium

____d. Cryogenic needles.

✱ Kept after item analysis.

26. "Realism in choosing projects" involves:

____a. Market surveys

____b. Checking the practical economics of the ideas

____c. Availability of personnel

____d. Scientific, social, and psychological timing.

27. An example of a way in which convenience can insure the success of a product is contained in the example of:

____a. silicon briquets

____b. cryogenic needles

____c. non-tarnish silver alloy

____d. transistors

* 28. The example of a steel-fishing-rod manufacturer's dealing with the advent of fibreglass illustrates:

____a. "Feedback" from research to management in influencing top management decisions.

____b. Modern technology of product improvements.

____c. A "Vanishing Market" for a previously satisfactory product.

____d. The superiority of Fibreglass fishingrods.

* 29. Economic assays, that is, final estimated of the eventual profitability of a product should be made when the product is:

____a. In the basic or area research phase.

____b. In the development stage.

____c. Undergoing final engineering for the plant.

____d. Actually on the market and in production.

* Kept after item analysis.

✱30. By "Good communications in an organization are a necessity." Dr. Kinzell meant:

____a. Every department in a company should have a vote on all major decisions.

____b. Information on products in any stage of development should be in the hands of the decision-makers for the next stage.

____c. Researchers should meet among themselves to discuss mutual problems.

____d. Publication of an informative house journal is a necessity.

COMMENTS

✱ Kept after item analysis.

APPENDIX III

"QUALITY SCALES"

QUALITY RELEVANCE QUESTIONNAIRE

Each pair of words on the following pages represents a Quality Scale along which some item may be rated.

> For example, if the item is "SKYSCRAPER" and the scale is "Small-Large", it is obvious that this quality of "largeness" is a quality on which a skyscraper can be rated.

The qualities may or may not be too relevant to the items being rated.

> For example, in rating a "PLUMBER" the quality "Skilled-Unskilled" would be quite relevant, but the quality "Happy-Sad" would be less relevant and the quality "Round-Square" would be totally unrelated.

This point, that there are differing degrees of relevance of the qualities to the items, is what this questionnaire is concerned with.

Here is another example to illustrate this gradient of relatedness, or the fact that some qualities may be more related to an item than other qualities.

> If the item is "BOOK" and the qualities are:
> _____Large-Small
> _____Interesting-Dull
> _____Skilled-Unskilled
>
> The relative importance of these qualities to "BOOK" might be indicated as follows:
>
> 2 Large-Small
> 1 Interesting-Dull
> 3 Skilled-Unskilled
>
> with number one indicating the quality most relevant to the item.

Out of the qualities listed on the next page, choose the <u>five</u> which in your opinion <u>best</u> relate to the item of a <u>teacher</u> or <u>lecturer</u>. Rank these five qualities in order of importance or relevance as in the last example above. Rank them <u>one</u> to <u>five</u> with the quality receiving number one being the one you view as the most important, or most clearly related to the item.

__Discontented-Contented

__Successful-Unsuccessful

__Dependable-Undependable

__Introverted-Extraverted

__Prejudiced-Nonprejudiced

__Ambitious-Nonambitious

__Traditional-Nontraditional

__Forgetful-Retentive

__Fortunate-Unfortunate

__Attracting-Repelling

__Elevated-Depressed

__Ungrateful-Grateful

__Religious-Nonreligious

__Quarrelsome-Congenial

__Pessimistic-Optimistic

__Broadminded-Narrowminded

__Contemporary-Noncontemporary

__Colorful-Colorless

__Friendly-Unfriendly

__Lazy-Hardworking

__Unpleasant-Pleasant

__Personal-Impersonal

__Impartial-Opinionated

__Meaningful-Meaningless

__Feminine-Masculine

__Polite-Impolite

__Boring-Interesting

__Stable-Unstable

__Orderly-Disorderly

__Mature-Immature

__Trite-Original

__Popular-Unpopular

__Stingy-Generous

__Profound-Superficial

__Honest-Dishonest

__Earnest-Flippant

__Vigorous-Placid

__Selfish-Unselfish

__Unwanted-Wanted

__Secure-Insecure

__Remote-Intimate

__Affected-Natural

__Varied-Monotonous

__Energetic-Tired

__Follower-Leader

__Humorous-Serious

__Elegant-Uncouth

__Inferior-Superior

__Worried-Unworried

__Sexual-Nonsexual

__Graceful-Awkward

__Concrete-Abstract

__Emotional-Rational

__Strict-Permissive

__Useless-Useful

__Flexible-Rigid

__Relaxed-Tense

__Wise-Foolish

__Related-Lonely

__Sick-Healthy

__Calm-Excitable

__Fragile-Tough

__Wordy-Succinct

__Simple-Complex

__Plain-Florid

__Vague-Precise

__Brave-Cowardly

__Ugly-Handsome

__Sharp-Dull

__Poor-Rich

__Stupid-Smart

__Kind-Cruel

__Happy-Sad

__Bad-Good

__Pale-Vivid

__Strong-Weak

__Clear-Hazy

__Austere-Lush

__Obvious-Subtle

Out of the qualities listed on the next page, this time choose the five which, in your opinion are least relevant to the item of a teacher or lecturer. That is, which qualities are of little or no importance in rating a teacher or lecturer. Rank these five in order of unimportance or irrelevance. Rank them one to five, with number one being the least important or least relevant quality.

___Obvious-subtle
___Austere-Lush
___Clear-Hazy
___Strong-Weak
___Pale-Vivid
___Bad-Good
___Happy-Sad
___Kind-Cruel
___Stupid-Smart
___Poor-Rich
___Sharp-Dull
___Ugly-Handsome
___Brave-Cowardly
___Vague-Precise
___Plain-Florid
___Simple-Complex
___Wordy-Succinct
___Fragile-Tough
___Calm-Excitable
___Sick-Healthy
___Related-Lonely
___Wise-Foolish
___Relaxed-Tense
___Flexible-Rigid
___Useless-Useful
___Struct-Permissive
___Emotional-Rational

___Concrete-Abstract
____Graceful-Awkward
___Sexual-Nonsexual
___Worried-Unworried
___Inferior-Superior
___Elegant-Uncouth
___Humorous-Serious
___Follower-Leader
___Energetic-Tired
___Varied-Monotonous
___Affected-Natural
___Remote-Intimate
___Secure-Insecure
___Unwanted-Wanted
___Selfish-Unselfish
___Vigorous-Placid
___Earnest-Flippant
___Honest-Dishonest
___Profound-Superficial
___Stingy-Generous
___Popular-Unpopular
___Trite-Original
___Mature-Immature
___Orderly-Disorderly
___Stable-Unstable
___Boring-Interesting
___Polite-Impolite
___Feminine-Masculine

___Meaningful-Meaningless
___Impartial-Opinionated
___Personal-Impersonal
___Unpleasant-Pleasant
___Lazy-Hardworking
___Friendly-Unfriendly
___Colorful-Colorless
___Contemporary-Noncontemporary
___Broadminded-Narrowminded
___Pessimistic-Optimistic
___Quarrelsome-Congenial
___Religious-nonreligious
___Ungrateful-Grateful
___Elevated-Depressed
___Attracting-Repelling
___Fortunate-Unfortunate
___Forgetful-Retentive
___Traditional-Nontraditional
___Ambitious-Nonambitious
___Prejudiced-Nonprejudiced
___Introverted-Extroverted
___Dependable-Undependable
___Successful-Unsuccessful
___Discontented-Contented

Out of the qualities listed on the next page, now choose the five which in your opinion are most relevant to the item of a lecture, (the spoken or written material itself). That is, which qualities are of most importance in evaluating the content of a lecture. These are to be ranked as before in order of importance with number one being the most important or most relevant quality.

___Discontended-Contented

___Successful-Unsuccessful

___Dependable-Undependable

___Introverted-Extraverted

___Prejudiced-Nonprejudiced

___Ambitious-Nonambitious

___Traditional-Nontraditional

___Forgetful-Retentive

___Fortunate-Unfortunate

___Attracting-Repelling

___Elevated-Depressed

___Ungrateful-Grateful

___Religious-Nonreligious

___Quarrelsome-Congenial

___Pessimistic-Optimistic

___Broadminded-Narrowminded

___Contemporary-Noncontemporary

___Colorful-Colorless

___Friendly-Unfriendly

___Lazy-Hardworking

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___Impartial-Opinionated

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___Graceful-Awkward

___Concrete-Abstract

___Emotional-Rational

___Strict-Permissive

___Useless-Useful

___Flexible-Rigid

___Relaxed-Tense

___Wise-Foolish

___Related-Lonely

___Sick-Healthy

___Calm-Excitable

___Fragile-Tough

___Wordy-Succinct

___Simple-Complex

___Plain-Florid

___Vague-Precise

___Brave-Cowardly

___Ugly-Handsome

___Sharp-Dull

___Poor-Rich

___Stupid-Smart

___Kind-Cruel

___Happy-Sad

___Bad-Good

___Pale-Vivid

___Strong-Weak

___Clear-Hazy

___Austere-Lush

___Obvious-Subtle

Out of the qualities listed on the next page, finally choose the five which, in your opinion are least relevant to the item of a lecture. (the spoken or written material itself). That is, which qualities are of little or no importance in evaluating the content of a lecture. Rank these five in order of unimportance or irrelevance as before, with number one being the least important or least relevant quality.

___Obvious-Subtle
___Austere-Lush
___Clear-Hazy
___Strong-Weak
___Pale-Vivid
___Bad-Good
___Happy-Sad
___Kind-Cruel
___Stupid-Smart
___Poor-Rich
___Sharp-Dull
___Ugly-Handsome
___Brave-Cowardly
___Vague-Precise
___Plain-Florid
___Simple-Complex
___Wordy-Succinct
___Fragile-Tough
___Calm-Excitable
___Sick-Healthy
___Related-Lonely
___Wise-Foolish
___Relaxed-Tense
___Flexible-Rigid
___Useless-Useful
___Strict-Permissive
___Emotional-Rational

___Concrete-Abstract
___Graceful-Awkward
___Sexual-Nonsexual
___Worried-Unworried
___Inferior-Superior
___Elegant-Uncouth
___Humorous-Serious
___Follower-Leader
___Energetic-Tired
___Varied-Monotonous
___Affected-Natural
___Remote-Intimate
___Secure-Insecure
___Unwanted-Wanted
___Selfish-Unselfish
___Vigorous-Placid
___Earnest-Flippant
___Honest-Dishonest
___Profound-Superficial
___Stingy-Generous
___Popular-Unpopular
___Trite-Original
___Mature-Immature
___Orderly-Disorderly
___Stable-Unstable
___Boring-Interesting
___Polite-Impolite
___Feminine-Masculine

___Meaningful-Meaningless
___Impartial-Opinionated
___Personal-Impersonal
___Unpleasant-Pleasant
___Lazy-Hardworking
___Friendly-Unfriendly
___Colorful-Colorless
___Contemporary-Noncontemporary
___Broadminded-Narrowminded
___Pessimistic-Optimistic
___Quarrelsome-Congenial
___Religious-Nonreligious
___Ungrateful-Grateful
___Elevated-Depressed
___Attracting-Repelling
___Fortunate-Unfortunate
___Forgetful-Retentive
___Traditional-Nontraditional
___Ambitious-Nonambitious
___Prejudiced-Nonprejudiced
___Introverted-Extroverted
___Dependable-Undependable
___Successful-Unsuccessful
___Discontented-Contented

APPENDIX IV

ATTITUDE MEASURES

Fill in the rating scales on the next two pages by placing a mark on the line indicating where you would rate the lecturer (or, on the second page following the lecture) on the scale.

For example: If you are rating the lecturer on this scale:

Short_____Tall

and you wanted to indicate that the man was, or seemed to be, taller than average, but not extremely tall, you would put your mark slightly to the right of center, but not all the way over to the right, like this:

Short_____/_____Tall

If the scale does not seem at all relevant to the lecture or lecturer, or if the lecture or lecturer is nearer neither one end nor the other, place your mark on the center of the scale.

Complete the scale on the third page following in the same manner by marking the rating scale under each question in relation to that specific question.

RATE THE LECTURER

(That is, give us some idea of the type of person you think the lecturer is on the basis of the way he gave the talk. How did he come across? Try to make these ratings on the basis of the way the lecturer personally projected himself without thinking of the material he was presenting).

Boring _____ Interesting

Contemporary _____ Noncontemporary

Broadminded _____ Narrowminded

Memorable _____ Not Memorable

Monotonous _____ Varied

Meaningless _____ Meaningful

* Orderly _____ Disorderly

* Vague _____ Precise

Profound _____ Superficial

Humorous _____ Serious

Prejudiced _____ Nonprejudiced

Useless _____ Useful

Smart _____ Stupid

Hazy _____ Clear

Flexible _____ Rigid

Impartial _____ Opinionated

Dishonest _____ Honest

Energetic _____ Tired

Dull _____ Sharp

Contented _____ Discontented

Happy _____ Sad

* Kept after factor analysis

RATE THE LECTURE

(This time, rate the spoken material, the content of the lecture itself as distinct from the lecturer).

Boring_____Interesting

Contemporary_____Noncontemporary

Broadminded_____Narrowminded

Memorable_____Not memorable

Monotonous_____Varied

Meaningless_____Meaningful

Orderly_____Disorderly

Vague_____Precise

Profound_____Superficial

Humorous_____Serious

Prejudiced_____Nonprejudiced

Useless_____Useful

Smart_____Stupid

Hazy_____Clear

Flexible_____Rigid

Trite_____Original

Wordy_____Succinct

Simple_____Complex

Subtle_____Obvious

Colorful_____Colorless

Concrete_____Abstract

* Kept after factor analysis

How much does the lecturer seem to know about the topic?

Little or nothing _____ All there is to know

Did the lecturer seem to be at ease?

Not at all at ease _____ Completely at ease

Rate the volume of the lecturer's voice:

Much too soft _____ Much too loud

How intelligent does the lecturer seem to be?

Very Superior _____ Much below average

How interested in the topic was the lecturer?

Not at all interested _____ Highly interested

* Rate the pace of the lecturer:

Much too slow _____ Much too fast

Generally, how well did the lecture hold your attention?

Extremely well _____ Not at all well

Rate the pitch of the lecturer's voice:

Too low _____ Too high

How convincing was the material?

Not at all convincing _____ Completely convincing

* Did you like the lecturer?

Highly enjoyed _____ Not at all

* Kept after factor analysis

Did the lecturer enjoy lecturing?

Did not enjoy _____ Highly enjoyed it

To what extent do you agree with the lecturer's viewpoints?

Completely agree _____ Disagree completely

* Kept after factor analysis

AUDIO 1 INTERCORRELATIONS

	Orderly (Lecturer)	Precise (Lecturer)	Impartial (Lecturer)	Orderly (Lecture)	Precise (Lecture)	Lecturer Knowledgeable	Lecturer at ease	Lecturer interested	Pace of Lecture	Held Attention	Convincing	Subject's Liking	Lecturer Enjoyment	Agreement	Retention Error Score
Orderly (Lecturer)	.85	.41	.46	-.23	.04	.11	.24	.02	.19	-.29	-.07	.26	.24	.24	
Precise (Lecturer)		.22	.30	-.24	.05	.19	.19	-.07	.21	-.41	-.09	-.07	-.12	.34	
Impartial (Lecturer)			.29	.01	-.08	-.04	.22	-.08	.35	-.54	-.33	.46	-.14	-.52	
Orderly (Lecture)				.54	.27	.52	.72	.16	.16	-.03	.16	.58	.04	-.01	
Precise (Lecture)					-.04	.71	.70	.59	.49	.34	.52	.67	-.45	-.06	
Lecturer Knowledgeable						.44	.19	-.10	-.11	.43	.13	.01	.34	.35	
Lecturer at ease							.76	.62	.41	.45	.52	.48	-.29	.47	
Lecturer interested								.63	.16	.10	.14	.55	-.13	-.02	
Pace of lecture									.25	.50	.31	.52	-.11	.24	
Held attention										.15	.64	.54	-.46	.14	
Convincing											.68	.24	.33	.56	
Subject's liking												.31	-.03	.57	
Lecturer enjoyment													-.06	-.15	
Agreement														.15	
Retention error score															

Significance Levels .51 =p .05
.63 =p .01

AUDIO 2 INTERCORRELATIONS

	Orderly (Lecturer)	Precise (Lecturer)	Impartial (Lecturer)	Orderly (Lecture)	Precise (Lecture)	Lecturer Knowledge	Lecturer at ease	Lecturer Interested	Pace of Lecture	Held Attention	Convincing	Subject's liking	Lecturer Enjoyment	Agreement	Retention Error Score
Orderly (Lecturer)	.12	-.10	.60	.78	.08	.45	.24	-.35	.16	.32	.10	.46	.31	-.35	
Precise (Lecturer)		.27	-.16	.30	.28	.78	-.03	-.22	.23	.02	.18	-.17	.48	-.36	
Impartial (Lecturer			-.28	-.00	-.27	-.11	-.37	-.57	-.07	-.45	-.18	-.42	.21	-.28	
Orderly (Lecture)				.59	.26	.07	.39	.05	.61	.61	.50	.85	.42	-.63	
Precise (Lecture)					.11	.50	.26	-.01	.23	.60	.23	.49	.51	-.32	
Lecturer Knowledgeable						.53	.61	.18	.35	.30	.65	.44	.53	-.40	
Lecturer at ease							.39	-.21	.29	.37	.46	.26	.48	-.25	
Lecturer interested								.30	.21	.72	.59	.67	.49	-.05	
Pace of lecture									-.22	.38	-.04	.09	-.04	.40	
Held attention										.47	.79	.65	.55	-.75	
Convincing											.66	.80	.50	-.10	
Subject's liking												.74	.62	-.50	
Lecturer enjoyment													.38	-.41	
Agreement														-.63	
Retention error score															

Significance levels .51= p .05
.63= p .01

VIDEO 1 INTERCORRELATIONS

	Orderly (Lecturer)	Precise (Lecturer)	Impartial (Lecturer)	Orderly (Lecture)	Precise (Lecture)	Lecturer Knowledgeable	Lecturer at ease	Lecturer interested	Pace of Lecture	Held Attention	Convincing	Subject's Liking	Lecturer Enjoyment	Agreement	Retention Error Score
Orderly (Lecturer)	.64	.34	.79	.82	.52	.37	.58	.46	.08	.79	.61	.35	.15	-.10	
Precise (Lecturer)		.12	.69	.70	.59	.51	.34	.27	.14	.43	.65	.42	-.02	-.27	
Impartial (Lecturer)			.40	.08	-.21	.40	.08	.43	-.18	.53	.40	.22	-.33	-.17	
Orderly (Lecture)				.70	.60	.40	.43	.52	.08	.76	.44	.27	-.05	-.34	
Precise (Lecture)					.61	.40	.82	.44	.15	.73	.36	.42	.18	-.28	
Lecturer Knowledgeable						.24	.40	.08	.23	.38	.22	.14	.39	-.24	
Lecturer at ease							.38	.50	.60	.60	.71	.71	.33	-.49	
Lecturer interested								.54	.24	.76	.18	.39	.32	-.02	
Pace of lecture									.42	.76	.37	.18	.25	-.16	
Held attention										.25	.35	.40	.54	-.24	
Convincing											.49	.40	.21	-.25	
Subject's liking												.68	.05	-.22	
Lecturer enjoyment													-.07	-.47	
Agreement														.14	
Retention error score															

Significance levels .51= p .05
.63= p .01

VIDEO 2 INTERCORRELATIONS

	Orderly (Lecturer)	Precise (Lecturer)	Impartial (Lecturer)	Orderly (Lecture)	Precise (Lecture)	Lecture Knowledgeable	Lecturer at ease	Lecturer Interested	Pace of Lecture	Held Attention	Convincing	Subject's Liking	Lecture Enjoyment	Agreement	Retention Error Score
Orderly (Lecturer)	.77	-.70	.44	.64	.60	-.20	.71	.07	.14	.46	.48	.27	.47	.08	
Precise (Lecturer)		-.33	.67	.73	.81	.10	.70	-.28	.34	.52	.60	.44	.52	.19	
Impartial (Lecturer)			-.11	-.25	-.75	.17	-.27	-.41	-.05	-.11	-.19	-.18	-.39	-.36	
Orderly (Lecture)				.70	.60	.62	.34	-.28	.27	.64	.34	.47	.34	-.03	
Precise (Lecture)					.28	.34	.64	-.39	.44	.83	.74	.60	.54	-.15	
Lecture knowledgeable						-.37	.22	.57	-.18	-.01	.26	-.13	.11	-.08	
Lecturer at ease							-.20	-.15	.25	.54	.14	.60	.38	-.02	
Lecturer interested								-.24	.40	.37	.40	.17	.12	-.11	
Pace of lecture									-.35	-.51	-.21	-.47	-.19	.04	
Held attention										.38	.47	.50	.17	.23	
Convincing											.63	.67	.70	-.01	
Subject's liking												.66	.68	.05	
Lecturer enjoyment													.73	.31	
Agreement														.31	
Retention Error Score															

Significance levels .51= p .05
.63= p .01

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