THE EFFECT OF LARGE-SCREEN, MULTI-IMAGE DISPLAY ON EVALUATIVE MEANING

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ABSTRACT

THE EFFECT OF LARGE-SCREEN, MULTI-IMAGE DISPLAY ON EVALUATIVE MEANING

By

Charles G. Bollmann

Since the early 1960's large-screen, multi-image displays and presentations have become increasingly popular. Numerous applications of the techniques have been made for educational and instructional purposes but little is known about the non-cognitive impact of such presentations.

This study explored the gross, affective impact of a multi-image presentation upon human subjects. The experimental data were intended to shed light on two general questions:

1. Will a multi-image and audio presentation cause greater positive shift in evaluative meaning than a parallel single-image and audio presentation?
2. Is the magnitude of shift in evaluative meaning related to the amount of the viewer's visual field which is covered by the projected image

area as determined by the viewer's distance from the screen?

Using a posttest-only design, the experiment pit a multi-image presentation against a parallel single-image version and a control presentation. All treatments were 10 minutes in length and used ten-foot images from 35mm slides and music-only audio components. The overall horizontal image area for the multi-image presentation was thirty feet.

Random assignment of the seventy-one graduate student subjects to the groups, simultaneous presentation of the treatments in identical rooms, and the use of the same twenty-scale semantic differential instrument made it possible to ascribe between-group variance on the dependent variable of evaluative meaning to the independent variable of presentation treatment.

A prerequisite factor analysis of the SD response data showed that the subjects rated the five concepts on three main "evaluative" dimensions. Accordingly, a separate analysis of variance was performed with respect to each research question for each concept on all the factors found in the prerequisite analysis--a total of thirty-two analyses of variance.

The findings were summarized as follows:

1. There is considerable evidence that a systematic main effect was operating on three of the five

concepts but the effect cannot be ascribed statistically to the multi-image presentation.

2. While not conclusive, there was some evidence that more positive shift in evaluative meaning was elicited from those viewers of the multi-image presentation who were situated the closest and farthest from the screen. This reversal of the expected finding seems to warrant further investigation since the viewers were situated from one-third to two screen widths from the projected images.

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CHAPTER I

INTRODUCTION AND THEORY OF THE STUDY

Introduction

At the 1962 convention of the Department of Audio-visual Instruction at Kansas City, the late Dr. James Finn startled his audience with a multi-screen, general session presentation.[1] Although preceded by multi-image[2] and multi-screen techniques in the military, business, entertainment and exhibition fields and by multi-image classroom experiments at the University of Georgia in 1954 and the University of Wisconsin in 1960,[3] Finn's 1962 presentation was a benchmark in the educational application of the technique.

After 1962 multi-image reports and presentations became fairly commonplace at educational meetings and facilities for handling such presentations were built at

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[1]"Professional Sights Soar with Finn-Hall Spectacular," Audiovisual Instruction, Vol. 7 (June, 1962), 366-367.

[2]Multi-image is now being called "multimage" in some quarters. In this paper the hyphenated term will be used, however.

[3]Richard D. Hubbard, "Telemation: AV Automatically Controlled," Audiovisual Instruction, Vol. 6 (November, 1961), 437-439.

various colleges and universities. The importance attached to the technique by Finn can be inferred from this statement by Donald Perrin, one of Finn's students and associates.

> In 1963 Finn initiated a course in "designing Large Group and Multi-Media Presentations" as a part of the graduate curriculum for USC's [University of Southern California's] Department of Instructional Technology. This course has served as a workshop and laboratory for the development of many excellent presentations of a cognitive and affective nature.[4]

Purpose and Scope of the Study

This study seeks first to establish that multi-image presentations have more affective impact than similar single-image presentations and then to explore the relationship between that effect and the viewer's location with respect to the screen. More specifically, the study undertakes to answer two general questions:

1. Will a multi-image and audio presentation cause greater positive shift in the evaluative meaning of presentation-related concepts than a parallel single-image and audio presentation?
2. Is the magnitude of shift in evaluative meaning related to the amount of the viewer's visual field which is covered by the projected image area as determined by the viewer's distance from the screen?

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[4]Donald G. Perrin, "A History and Analysis of Simultaneous Projected Images in Educational Communication" (unpublished Ph.D. dissertation, University of Southern California, 1969), p. 71.

Need for the Study

In his recent historical study, Perrin traces the development of multi-screen and multi-image techniques from the 1890's to the late 1960's in all fields from pure entertainment to education. Significantly, he remarks,

> Even though producers have designed multiple image presentations with remarkable skill, the underlying theory has not been verbalized. In 1963 when Allen made his first research study on the use of simultaneous images in classroom instruction, there were only three prior studies to be found. . . .
> . . . .
> In the past six years the literature has expanded enormously. The documentation is largely technical and descriptive, and only one new piece of research has been added.[5]

It is noteworthy that all of the studies cited by Perrin[6] and by Allen[7] were concerned with the ability of a multi-image presentation to increase cognitive learning more than a parallel single-image presentation. None of them dealt in a specific way with the possible influence on beliefs, emotions, attitudes or other constructs in the affective domain. The complete lack of research in this area is the more remarkable when one considers that people are willing to stand in line for hours to see a twenty-minute presentation such as Labyrinth at Expo 67, essentially an

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[5]Perrin, pp. 88-89.

[6]Perrin, pp. 88-94.

[7]William H. Allen and Stuart M. Cooney, <u>A Study of the Non-Linearity Variable in Filmic Presentation</u>, Report of Title VII Project Number 422 of the National Defense Education Act. May, 1963 (Los Angeles: University of Southern California), pp. 5-14.

impressionistic and affective type of program which Kappler observed ". . . certainly drives hardest at sensations and emotions."[8]

The popularity of multi-image spectaculars such as those shown at Expo 67 and the publicity given to light shows and "happenings" in the youth subculture probably had a direct influence in causing media specialists to try similar techniques in education. A mark of this interest was the addition of a "Multimage Festival" at the 1969 Portland Convention of the Department of Audiovisual Instruction (DAVI) as a followup to the well-received "Media and the Affective Domain of Learning" presentation given at the 1968 DAVI Convention in Houston.[9] Wallington, Hale, and Conte state in reference to the presentations at the 1969 "Multimage Festival,"

> There seemed to be a high involvement on the part of the audience in the affective domain, and there seems to be a strong link with the cognitive domain.[10]

While there are clear differences of opinion on the value of the presentations at the "Multimage Festival" and whether or not a given program fulfilled its purpose, there

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[8]Frank Kappler, "The Mixed Media--Communication that Puzzles, Excites, and Involves," Life, July 14, 1967, p. 28.

[9]Department of Audiovisual Instruction, Handbook for the DAVI Convention, Houston, Texas, March 24-29, 1968 (Washington: DAVI, 1968), p. 40.

[10]Jim Wallington, Pryor Hale, and Joseph Conte, "Multimage Festival," Audiovisual Instruction, Vol. 14 (June-July, 1969), p. 53.

is general agreement that most of the designers seemed to have operated on the intuitive hunch that the audience becomes more deeply involved affectively when confronted with large screen areas, multiple images, and high fidelity sound amplification.[11] The importance of verifying the affective impact of multi-image presentations is underlined by the fact that three "Multimage Festival" rooms presented concurrent programs for three days at the 1970 DAVI Convention in Detroit.[12] The burgeoning interest in the multi-image technique would seem to call rather urgently for an investigation of its general effects as a first step in studying the principles of design and presentation which should be taken into consideration when it is used.

Definitions

Before proceeding with elaboration of the theory and hypotheses of the study, the following operational definitions are offered.

Evaluative Meaning

The discriminative judgment made by an experimental subject on a series of seven-point semantic differential scales of bi-polar adjectives with respect to a given

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[11]This statement is based on extended conversations with individuals who attended the "Festival."

[12]Department of Audiovisual Instruction, *Handbook for the DAVI Convention, Detroit, Michigan, April 27-May 1, 1970* (Washington: DAVI, 1970), pp. 24, 41, and 55.

concept or word. Direction (positive or negative) and the intensity with which the meaning is held is indicated by the location of the judgment from the neutral, central position. (A fuller, theoretical description of the term is given in the next section of this chapter.)

Semantic Differential

A measurement and scaling technique developed by Charles Osgood and his associates by which people indicate valuative judgments of concepts on seven-point scales of bi-polar adjectives.[13]

Best-Worst Technique

A modification of the semantic differential suggested by Donald Darnell which determines the evaluative discrimination capacity and positive/negative polarity of a given bi-polar adjective scale in reference to a given concept.[14]

Multi-image and Audio Presentation

A program of projected transparencies with music in which the visuals are displayed simultaneously on three adjacent screens. The entire sequence using three slide

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[13] Charles E. Osgood, George J. Suci, and Percy H. Tannenbaum, The Measurement of Meaning (Urbana: University of Illinois Press, 1957), pp. 25-30.

[14] Donald Keith Darnell, "A Technique for Determining the Evaluative Discrimination Capacity and Polarity of Semantic Differential Scales for Specific Concepts" (unpublished Ph.D. dissertation, Michigan State University, 1964), pp. 78-83.

projectors is under the automatic control of a multi-unit programer to achieve identical performances of the program each time it is presented.

Single-image and Audio Presentation

A program of projected transparencies with music in which the visuals (drawn from the parallel multi-image presentation) are displayed sequentially on one screen. The entire sequence using one slide projector is under the precise and automatic control of a synchronizing unit to insure repeatability.

Multi-unit Programer

A specially constructed device which discriminates three different sound frequencies on one track of a stereo audio tape to advance independently each of three slide projectors.

Aspect Ratio

The height to width ratio of a given visual, expressed, for example, either as 2:3 or 2x3 meaning 2 units high and 3 units wide.

Field of View or Visual Field

The total seeable area of 180° to 200° situated before an observer.

Viewer Location

The distance expressed in screen widths (W) of an observer from a projection screen in his visual field.

Theory and Rationale for the Study

This study involves the use of a multi-image and audio presentation to develop and/or alter the evaluative meaning of presentation-related concepts. In the design of the experiment, the media presentation is the independent variable and the evaluative meaning of concepts is the dependent variable. In this section the theory and rationale underlying each of these variables and their postulated relationship is discussed in turn.

Multi-image Theory

Reference was made previously to Perrin's observation that although the underlying theory of multi-image presentations had not been verbalized, producers have shown much skill in creating such displays.[15] However, Perrin does suggest three elements which should be included in such a theory.

> From the existing body of knowledge there appear to be three major areas which distinguish multiple image communication from conventional use of media. These are: 1. simultaneous images 2. screen size 3. information density.[16]

All three of the elements mentioned by Perrin are involved in the present study.

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[15] Supra, p. 3.

[16] Perrin, p. 89.

First, with respect to screen size, it can be said that many of the multi-image presentations for educational purposes seem to have used the technique simply to widen the total image area into an aspect ratio resembling commercial/entertainment formats like Cinemascope, Todd AO, and the like, particularly when the purpose of the presentation has been to touch the observer's emotions or some other component of the affective domain.[17] However, various production constraints and limitations of the media available--primarily 35mm slides, 16mm and 8mm film footage--have usually forced the use of multiple rather than panoramic images for wide-screen educational presentations. One of these factors is the practical limit to the width of the projected image that can be achieved with a given piece of film (transparency) material. In this regard, Ben Schlanger has reported, "For average viewing distances, experience indicates that about 10½ in. of image width can be projected within acceptable limits, for each millimeter of film width."[18] This is an important consideration in the present study because the total image width for the experimental treatment is to be thirty feet, slightly more than the allowable maximum (35mm X 10/12 = 29 feet) under Schlanger's rule were a single image to be used.

[17]Supra, pp. 3-4.

[18]Ben Schlanger, "Criteria for Motion Picture Viewing and for a New 70mm System: Its Process and Viewing Arrangements," Journal of the Society of Motion Picture and Television Engineers, Vol. 75 (March, 1966), 165.

Thus, a second of Perrin's elements--multiple images--is closely related to that of screen size. But the use of multiple images involves other considerations also. For one thing, a tempo and rhythm can be imparted by the rate and pattern of image changes. In the present study the pace or tempo of the presentation is rather rapid to suggest excitement and liveliness and the pattern of image changes is intuitively calculated to suggest an artistic kind of rhythm in contradistinction to the effect which would be obtained with purely random changes and image conjunctions. For another, simultaneously presented images may either complement or contrast one another. In the present study, the visual part of the presentation is intentionally designed with image redundancy, i.e., simultaneously presented images complement and "repeat" the same essential information.

The characteristic of image redundancy just mentioned is related to Perrin's third factor, that of information density. While most of the visuals used in this experiment are "dense" in an information theory sense, intuitively it is felt that the use of redundancy across simultaneously displayed images keeps the total amount of information at a level which is probably close to that of any of the visuals taken individually.

The rationale thus far has dealt with image size in terms of overall scale. Specifically, in the experiment a ten-foot screen for each image is used so that the multi-image presentation covers a total width of thirty feet as compared to an image width of ten feet for the parallel single-image presentation. However, within the scale of any given screen width, image size is also related to the amount of the observer's visual field which that image covers and this in turn is governed by his distance from the screen.

Figure 1 shows that the amount of the visual field covered by a given screen width can be expressed as double the angle subtended by a line from a given point to either outer edge of the screen. Most recently built theaters have been designed so that the rear seats are not more than 2W from the screen so that observers seated there will have at least 30° of the visual field covered by the image.

Personal experience and a pilot experiment suggested the second purpose of the study, namely to determine if the amount of shift in evaluative meaning is influenced by the viewer's distance from the screen. Specifically, it is predicted that the greatest effect will occur when 50° to 70° of the viewer's visual field is covered by the image area or, from Figure 1, when the viewer is located from 2/3 W to 1 1/3 W from the screen along the center axis.

Evaluative Meaning

Earlier in this chapter an operational definition of evaluative meaning was offered. However, because it is actually the dependent variable in this study, it seems

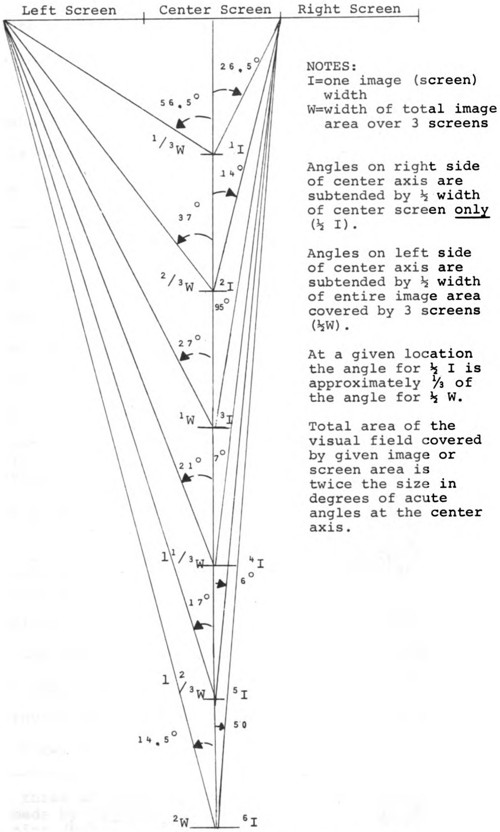

Figure 1.--Amount of Visual Field Covered by a Given Screen at Selected Distances.

appropriate to provide a separate and more detailed theoretical explication of the term and its relationship to the study.

The construct of evaluative meaning as it is used in this study is heavily dependent upon the theory of meaning presented by Charles Osgood and his associates in _The Measurement of Meaning_. It is felt appropriate to present the major highlights of this theory for two reasons: (1) it serves as the underpinning for the present study, (2) the measurement technique based on the theory is also used in the present investigation.

In order to follow the theoretical argumentation it is necessary to understand three psychological terms.[19]

> Significate: any stimulus which, in a given situation, regularly and reliable produces a predictable pattern of behavior.
>
> Sign: a stimulus other than a significate which evokes in an organism the same reactions evoked by a significate.
>
> Assign: a sign whose meaning has been "assigned" via association with other signs rather than via direct association with significates of those signs.

The definitions for the first two terms are fairly standard in the psychological literature. However, the notion of an _assign_ and the linkage between a _sign_ and an _assign_ provide the key to Osgood's definition of meaning. In Osgood's view, a sign comes to elicit a response formerly

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[19]All three of these definitions are paraphrases of statements made by Osgood and his associates in _The Measurement of Meaning_ (Urbana: University of Illinois Press, 1957), pp. 5-8.

elicited by a significate by an internal mediating process within the organism. He says,

> Whenever some stimulus sign other than the significate is contiguous with the significate, it will acquire an increment of association with some portion of the total behavior elicited by the significate as a representational mediating process.[20]

The "representational mediating process" is the organism's internalized association of a sign with a significate and, thus, is the learned meaning of that sign for the organism. Whenever such learning takes place via association between signs without direct association with significates, meaning is "assigned." It follows, then, that

> Variation in meaning should be particularly characteristic of _assigns_ since their representational processes [meanings] depend entirely upon the samples of other signs with which they occur.[21]

This theoretical notion has important implications for the present study which, in fact, seeks to develop _assigns_ via a media presentation. Specifically, the idea is to produce and/or alter the _assigned_ meaning of several concepts held by human subjects by presenting them with a series of _signs_--projected visuals and recorded music. In order to explain how this might be accomplished with a relatively short treatment and how such an effect might be measured, it is necessary next to consider Osgood's "logic of semantic differentiation."

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[20]Osgood, _et al_., p. 6.

[21]Osgood, _et al_., p. 9.

A precise explanation of semantic differentiation and its theoretical components is provided by the following statements from The Measurement of Meaning.

> We begin by postulating a semantic space, a region of some unknown dimensionality and Euclidian in character. Each semantic scale, defined by a pair of polar (opposite-in-meaning) adjectives, is assumed to represent a straight line function that passes through the origin of this space, and a smaple of such scales then represents a multidimensional space. . . .
> . . . .
> . . . . When a subject judges a concept against a series of scales, each judgment represents a selection among a set of given alternatives and serves to localize the concept as a point in semantic space. . . . By semantic differentiation, then, we mean the successive allocation of a concept to a point in the multidimensional semantic space by selection from among a set of given scaled semantic alternatives. Difference in the meaning between two concepts is then merely a function of the differences in their respective allocations within the same space, i.e., it is a function of the multidimensional distance between the two points.[22]

Thus, a subject differentiates between concepts by making judgments on bi-polar scales which indicate direction and distance from the origin of the postulated semantic space.

Osgood then completes the theory by tying his conceptualization of "meaning" (representational mediation process) to the idea of semantic differentiation as follows:

> Let us assume that there is some finite number of representational mediation reactions [meanings] available to the organism and let us further assume that the number of these alternative reactions (excitatory or inhibitory) corresponds to the number of dimensions or factors in the semantic space. Direction of a point in the semantic space will then correspond to what reactions are elicited by the sign, and distance from the origin will correspond to the intensity of the reactions.[23]

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[22] Osgood, et al., pp. 25-26. [23] Osgood, et al., p. 27.

So if a subject indicates his true judgments of a concept on a set of bi-polar scales and if the set of bi-polar scales are, in fact, associated with the concept as far as the subject is concerned, then it can be said that the subject's judgments provide a quantifiable description of the concept's meaning for him. Of course the description so obtained is only a part of the total meaning of the concept since the scales are but a sample of the entire population of possible scales which are relevant to the given concept.

Because a subject cannot make ratings on the entire population of scales relevant to a concept, Osgood's measurement model and its dependence on representative sampling must be considered. In this regard he says,

> The essential operation of measurement is the successive allocation of a concept to a series of descriptive scales defined by polar adjectives, these scales selected so as to be representative of the major dimensions along which meaningful processes vary. In order to select a set of scales having these properties, it is necessary to determine what the major dimensions of the semantic space are.[24]

After a detailed presentation of various studies using factor analytic techniques to explore the dimensionality of semantic space, Osgood and his associates conclude,

> For one thing, it is clear that it is a multidimensional space. In every analysis more than three factors have been contributing to the meaningful judgments by subjects. It is also clear that these *N* factors or dimensions are not equally important in mediating judgments, or perhaps better, are not

[24]Osgood, *et al.*, p. 31.

> equally used by subjects in differentiating among the things judged. Three factors appear to be dominant, appearing in most of the analyses made and in roughly the same orders of magnitude.[25]

The three recurring factors have been named "evaluation," "potency," and "activity" because those terms provide general descriptions or labels of the scales which usually load upon them. It has become customary to refer to these named factors as the major dimensions of semantic space.

Of the three major dimensions, that of evaluation is the most dominant. Osgood reports,

> A pervasive evaluative factor in human judgment regularly appears first [in factor analysis] and accounts for approximately half to three-quarters of the extractable variance.[26]

This study undertakes to produce and/or alter the meaning of certain concepts with a specific kind of audiovisual treatment. As such it falls squarely within Osgood's learning-theory conceptualization of meaning as a "representational mediation process" because the experimental manipulation is designed to form assigns through new associations of signs (audiovisual elements). Furthermore, the resulting assigns are to be indexed with Osgood's measurement technique of semantic differentiation, particularly on the dimension which he has labeled evaluation. Although further reasons and the methodology for measuring the meaning of these assigns on the evaluative dimension are

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[25] Osgood, et al., pp. 71-72.

[26] Osgood, et al., p. 72.

set forth in the section on instrumentation in Chapter Three, it can be mentioned here, (1) that this dimension is most closely related to the purposes of the audiovisual presentation/treatment, and (2) that this dimension is likely to detect differences since it usually accounts for twice as much of the variance as any other factors or dimensions in studies using the semantic differential technique.

Assumptions of the Study

This study and its experimental design rest on several assumptions. Some of these prerequisite postulates have been referred to or implied in the previous discussion but they are explicitly restated in this section along with those which have not yet been touched upon.

First, the rationale for the entire study rests upon the assumption that mediated presentations can be shown experimentally to convey affective impact. When this basic assumption of the study is particularized to multi-image presentations, it becomes the nuclear idea of the main research hypothesis.

Second, it is assumed that evaluative meaning, a component of the affective domain, can be indexed by a paper and pencil measurement technique. The explanation of the construct evaluative meaning given in the previous section of this chapter is clearly dependent upon the theories developed by Charles Osgood as is the measurement technique of semantic differentiation. The development of the specific instrument, explained in Chapter III, is further predicated upon special procedures for deriving an instrument which indexes the meaning of concepts mainly on the evaluative dimension.

The third assumption--that the first logical step in investigating the affective impact of multi-image presentations is to show the existence of a general effect--follows from the assumptions already stated. There are many independent variables which are of interest to the message designer and which may either enhance or diminish the affective impact of multi-image presentations. However, it appears necessary and appropriate to demonstrate the general affective impact of such presentations as they are currently designed before investigating specific independent variables.

Next, it is assumed that the experimental population is sufficiently like the "target" population for whom the multi-image treatment presentation was originally designed to allow the treatment to demonstrate its impact. The investigator had to compromise somewhat to obtain a population with a sufficient number of experimental subjects at the right time, but it was felt at the outset that the experimental and "target" populations are roughly equal with respect to knowledge of and feeling for the content of the multi-image presentation prior to seeing it.

Also with regard to the experimental population, it is assumed that its size is sufficiently large to perform the experiment. Ideally, each of the three treatment groups required by the experimental design should have thirty or more people, but it is felt that a moderate reduction to twenty-five or so should not seriously impair the results, especially for the main research question.

Finally, as stated previously, it is assumed that a parallel, single-image presentation equivalent in information content can be assembled on an intuitive basis from the original multi-image presentation. That is, it is felt that the experimenter can select the visuals for the parallel, single-image version from those of the original multi-image presentation so that both will convey essentially the same information.

Limitations of the Study

There are several limitations of the study which should be mentioned. Two are imposed by the investigator to delimit the study and two arise from general research principles.

The investigator has chosen two independent treatment variables--multiple images and coverage of the visual field by the image area--for study in the experiment. Other independent variables which might be of interest (such as rate of change of images and number of images) are left for later experimentation. Also, while two sense modalities (sight and hearing) are involved with the treatment presentation, the study is not concerned with issues of multi-channel or cross-channel communication.

Consonant with customary research procedures, the results of the experiment will not be generalizable beyond the experimental population, except in so far as other populations are not unlike the experimental population. And the experimental results will not be generalizable from the experimental treatment presentation to other multi-image presentations. In short, the results of this experiment will provide but one piece of evidence for or against the general effect being investigated.

CHAPTER II

REVIEW OF THE LITERATURE

In this chapter pertinent studies which are related to the present investigation are reviewed. Consistent with the purpose, rationale, and theory presented in Chapter I, this chapter is divided into three main sections: affective impact studies, image size studies, and multi-image studies.

Affective Impact Studies

Audiovisual media have been involved in attitude change studies and other investigations in the affective domain in two ways. First, various media, such as audio tape recordings and film, have been used as stimulus materials because their characteristic of repeatability allows controlled replication in experiments designed to test theories of attitude change. Studies of this class are considered beyond the scope of this review since their attention is focused upon message variables such as order of presentation of argument, source credibility, and other manipulatable *oral* elements. Second, some studies have centered on the efficacy of media or specific elements of a medium to induce attitude change. This second class of studies is more closely related to the present investigation and pertinent experiments of this type will be reviewed briefly.

In a comparatively recent study, Edling summarizes previous experiments assessing the amount of attitude change associated with specially-designed, mediated messages by saying,

> The consistent finding in these studies has been that initial attitudes are related to the acceptance and retention of new associations, i.e., information perceived as congruent to existing attitude is more readily accepted, and retained longer, than information perceived to be contradictory to initial attitudes. . . . By identifying strongly held attitudinal objects and associating new concepts with them, it appears possible to modify attitudes toward objects not originally highly regarded, and to do so via media, both quickly and effectively.[1]

Although Edling was speaking specifically in reference to audiences of school children, presumably through senior high school age, there is sufficient evidence in the literature to suggest that the generalization applies to older people as well. Merrill found in an experiment with adult males (military reservists) that an attitude film arousing strong fears produced "defensive avoidance" and prevented attitude shift.[2]

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[1]Jack V. Edling, Experiments with Educational Media Designed to Modify Attitudes (Final Report for Project No. 6-2454 USOE Dept. of H.E.W. and Teaching Research Division of the Oregon State System of Higher Education, 1968), p. 9.

[2]Irving R. Merrill, "Attitude Films and Attitude Change," AV Communication Review, Vol. 10 (January-February, 1962), p. 13.

Kumata and Berlo found that college students who listened to a satirical radio drama about Senator Joseph McCarthy entitled "The Investigator" shifted in a negative direction toward congressional investigations and in a positive direction toward the Senator. The experimenters suggest that the first finding resulted from "a change in the context of the perceived object" and represented a successful attack on attitudes related to that object. The second finding is described as a boomerang effect due to the one-sidedness of the message against the Senator which called into play "the dominance of the pressure toward impartial, fairly presented analyses" which were even stronger for these higher education students than their initial dislike of Senator McCarthy.[3]

The negative or boomerang results reported by Kumata and Berlo indicate that communication effects in the affective domain are somewhat difficult to predict and control because of human variables and previous attitudes, especially when those attitudes are covertly held and are not apparent to the investigator. The caution and precision required in this area is also pointed up by an experiment conducted by Miller on the effect of "motion"

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[3]David K. Berlo and Hideya Kumata, "The Investigator: The Impact of a Satirical Radio Drama," Journalism Quarterly, Vol. 33 (Summer, 1956), 287-298.

in film upon attitudes.[4] Because this experiment is one of the few which attempted to measure the attitudinal effect of projected moving and still images, it is particularly relevant to the present investigation and it will be described in some detail.

Miller's experiment was designed to test the formal property of motion in film. He states the purpose of the study as follows:

> This study was concerned with measuring affective (emotional) response to a formal quality (motion) of a communication medium (film) and its effect on information recall and attitude formation.[5]

The basic experiment pitted an experimental treatment group who saw a 16mm film entitled Corral against a second treatment group who saw a filmograph[6] version of the 16mm film and two groups which each saw one-half of each version, but in opposite orders. Measures used were: a fifteen-scale semantic differential on four general,

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[4]William C. Miller, "An Experimental Study of the Relationship of Film Movement and Emotional Involvement Response, and Its Effect on Learning and Attitude Formation" (unpublished Ph.D. dissertation, University of Southern California, 1967) and Final Report of NDEA Title VII Project Number 5-1731.

[5]William C. Miller, "Film Movement and Affective Response and the Effect on Learning and Attitude Formation," AV Communication Review (AVCR), Vol. 17 (Summer, 1969), 172.

[6]Miller defines a filmograph as follows: "A filmograph is a series of still frames on motion picture film, each printed repeatedly a predetermined number of times so that the time each still scene appears in the film is controlled by the normal speed of projection" (AVCR Article, p. 173).

film-related concepts; a 22-item Likert-type attitude scale; and galvanic skin response (GSR) recordings. Miller summarizes the three major hypotheses as follows:

> It was hypothesized that film motion would, of itself, create audience emotional involvement response as measured by GSR, and that this would produce positive audience response, but would not be a significant factor in information recall.[7]

With respect to the first hypothesis, Miller's results indicate that the arousal of the motion-only group was significantly greater only for the climax portion of the film but that GSR is a useful tool in measuring audience involvement,[8] in spite of the methodological problems in interpreting GSR profiles reported by Becker,[9] Levonian,[10] and Miller[11] himself. It must be remembered, also, that GSR is an individual measure and requires a measuring and recording device for each subject receiving an experimental treatment.

Proceeding to the third hypothesis, Miller's hunch that arousal and recall of information would not be related

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[7] Miller (AVCR), p. 173.

[8] Miller (AVCR), pp. 177 and 179.

[9] Samuel L. Becker, The Relationship of Interest and Attention to Retention and Attitude Change (Iowa City: University of Iowa, 1963).

[10] Edward Levonian, Measurement and Analysis of Physiological Response to Film (Los Angeles: University of Southern California, 1962), Final Report, Grant No. 704094, NDEA Title VII project No. 458.

[11] Miller (dissertation), pp. 94-97.

was correct--although one must add that the "null" nature of this theoretical hypothesis requires caution in interpretation of the finding.[12]

Miller's second hypothesis, that of positive audience response as measured by the SD, is of the most interest for the present investigation. Miller reports, "Quite to this investigator's surprise, the film generally affected negative changes on this the SD measure," and again, "The data indicate that the film, in both motion and filmograph versions, affected greater negative attitude change to most concepts tested."[13]

One explanation for this finding according to Miller is that the necessity of running the experiment in the psychiatric building of a Veterans hospital where the required six GSR units were available unsettled the experimental subjects.[14] Miller offers as a second explanation that the subjects may also have expected something more "shocking" in the way of a presentation because of the somewhat extraordinary transportation arrangements and because of the fee they were paid for participation.[15]

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[12]Miller (AVCR), p. 179.

[13]Miller (dissertation), pp. 151 and 154.

[14]The location of the experiment in the psychiatric ward is mentioned in the dissertation but not in the journal article (cf. pp. 98-101 of the former with p. 175 of the latter). Such differences in the two reports explain quoting from both sources.

[15]Miller (dissertation), p. 103.

However, in the judgment of the present reviewer, the "boomerang" results on the SD measure may also have been caused by two other methodological artifacts. First, Miller apparently made no effort to check the relevancy of the SD scales to the concepts of interest, even though he acknowledges Darnell's finding of concept-scale interaction.[16] Second, all groups received the SD as a pretest and as a posttest measure, and thus may have been negatively influenced by the repeated exposure in combination with the treatment. With respect to the present study, the Darnell "Best-Worst" technique will be used to eliminate the first problem and a posttest-only design will be used to avoid the second problem.

Image Size Studies

It seems remarkable that so few experimental studies have manipulated the seemingly obvious variable of image size. The scarcity of research on this variable may account for the fact that most studies make no mention at all of image size or the distance of viewers from the screen--a related variable which accounts for the portion of the field of view occupied by a stimulus display--even though this variable may conceivably account, at least partially, for the results obtained when other variables are manipulated.

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[16]See Chapter III of this study for a fuller explanation of concept-scale interaction and the Darnell "Best-Worst" technique for determining the relevance and polarity of given scales to given concepts.

In a thorough search of the literature only two studies were found which directly investigated the effect of the size of a projected image.

Using images projected with a rear-screen technique, Ash and Jaspen concluded that most learning occurred with subjects seated in a cone 60° wide (30° on each side of the center line) and 18 feet (12 screen widths) deep and that losses in learning can be minimized outside the optimum viewing area by expanding the area along the angular sides rather than the base of the cone, thus keeping viewers as close to the screen as possible.[17]

As implied by its name, the Telekit screen used by Ash and Jaspen was very similar in size to the screen of a classroom television monitor. In discussing the optimum conditions for viewing television, McVey[18] indicates that a distance of 12 screen widths is usually acceptable as a maximum distance--a recommendation probably drawn (but not so stated) from the Ash and Jaspen study. With respect to a front-projected image, McVey recommends 6¼ screen widths as the optimum viewing distance since the display will then subtend an arc of 9° and, "Studies show that the

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[17] Philip Ash and Nathan Jaspen, "Optimum Physical Viewing Conditions for a Rear Projection Daylight Screen," Technical Report No. SDC 269-7-37 of the Pennsylvania State University Instructional Film Research Program (Port Washington, N. Y.: U. S. Naval Training Devices Center, Office of Naval Research, 1953), p. 9.

[18] Gerald F. McVey, "Where Do We Sit?" Educational Television, Vol. 1 (December, 1969), 25.

eye moves in well-dispersed patterns of fixation when watching a visual display that subtends a visual angle of 9°."[19]

Although McVey does not cite it, a study by Enoch did indeed show a change in eye fixations as the display size drops under 9°. However, Enoch makes clear that this finding really applies to static displays to be used in visual search tasks--in his experiment locating a specific design in a black and white aerial map.[20] In view of these considerations, one might question the application of the finding to most television material, to say nothing of large-screen projections, especially of material designed to produce non-cognitive effects.

In a more recent study, Reynolds attempted to determine the effect of viewer distance upon presentation-induced anxiety.[21] Using the film Subincision, which shows circumsion rites as practiced by certain African natives, Reynolds found that the level of anxiety was more related to the type of stimuli than to viewer distance from the screen. In applying this finding, however, it should be kept in mind that the stimulus film showed scenes which

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[19]McVey, p. 25.

[20]Jay M. Enoch, "Effect of the Size of a Complex Display Upon Visual Search," Journal of the Optical Society of America, Vol. 49 (March, 1959), pp. 281 and 285.

[21]James C. Reynolds, "The Effect of Viewer Distance on Film Induced Anxiety," in Dissertation Abstracts, Vol. 29 (Ann Arbor, Michigan: University Microfilms), p. 3341-A.

very likely were distasteful to the audience--the converse of the intention in the present study.

In the previous chapter, reference was made to Perrin's rudimentary theory of large images. Two of the elements, it will be recalled, were the visual task factor and the visual impact factor. These elements might be subsumed in the notion of "attention value" of an image investigated much earlier by Adams. Basically, Adams found that attention is approximately proportional to the square root of the size of an area or stated conversely, quadrupuling the image size doubles its attention value.[22]

Of course there are practical limits to the absolute maximum image size one can attain because of the physical constraints of viewing rooms, screens, and film-light-lens sytems. But there are theoretical limits to image size also, as Wagner convincingly argues, because the media should attempt to produce an illusion of reality. He continues in commenting about motion pictures in particular,

> The motion picture is, after all, a performance--a highly complex symbol system. Its power is not in the fact that it reproduces reality, but rather that it intensifies, abridges, and reorganizes the real world, focussing the attention of an audience on significant details, moving the spectator through an arranged, selective sequence of visual cues in a highly unrealistic way.[23]

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[22] H. F. Adams, Advertising and Its Mental Laws (New York: Macmillan, 1921), p. 107.

[23] Robert W. Wagner, "The Spectator and the Spectacle," AV Communication Review, Vol. 3 (Fall, 1955), 298.

This contention would seem to be especially appropriate to sequences designed to have impact in the affective domain as does the treatment presentation of the present study.

Multi-Image Studies

In the multi-image area there is also a paucity of studies and those which are reported in the literature were concerned with the learning of either motor skills or cognitive information. Nevertheless, for the sake of completeness, their findings will be discussed briefly.

Reference was made in Chapter I to Perrin's statement that in 1963 Allen found only three prior studies in the literature pertaining to simultaneous images.[24] A close reading of the Allen report[25] failed to reveal either such a summary statement or the specific studies to which Perrin referred. But the most likely candidates seem to be Roshka,[26] Reed,[27] and Malandin. However, since Roshka used actual concrete objects and Reed used nonsense "concept"

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[24]Supra, p. 3.

[25]William H. Allen and Stuart M. Cooney, A Study of the Non-Linearity Variable in Filmic Presentation (Los Angeles: University of Southern California, 1963).

[26]A. Usloviia Roshka, "Conditions Facilitating Abstraction and Generalization." VOP PSIKHOL, 4 (6), 1958, pp. 89-96 as reported by I. D. London, Psychological Abstracts, Vol. 34 (1960), p. 85.

[27]H. B. Reed, "The Learning and Retention of Concepts: V, The Influence of Form of Presentation," Journal of Experimental Psychology, Vol. 40 (1950), pp. 504-511.

syllables and real words on cards as stimulus materials, they are really outside the parameters of interest in a study focusing upon projected images.

Malandin, on the other hand, did use projected materials in his two studies. Because these mimeographed reports in French are unavailable to the present investigator, it is necessary to rely on secondary sources for Malandin's findings. Specifically, Allen reports,

> Malandin . . . found in his studies that younger students could not relate one image to another if they were isolated in time, that is, presented sequentially.[28]

In their own experiment Allen and Cooney found that simultaneous presentation of multiple images was more effective than sequential (linear) presentation for sixth but not eighth grade students when the treatment was factual and conceptual in nature. The investigators further concluded,

> (1) Mode of presentation has less effect on learning as the student grows older.
> (2) Ability to comprehend and to apply subject matter of this type taught in these ways [apparently either linear or multi-image] improves with age.[29]

After the Allen and Cooney experiment there is a hiatus in multi-image studies until 1969 when two appeared. First, Lombard found only a significant difference for girls

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[28]Claude Malandin, "Grouped and Successive Images," Centre d'Etudes st de Recherches pour la Diffusion duFrancais (C.R.E.D.I.F.), Ecole Normale Superieur de Saint-Cloud, France, (Carbon of original in French, undated) as summarized in Allen and Cooney, p. 109.

[29]Allen and Cooney, p. 108.

in learning synthesis skills in eleventh grade U. S. History in favor of a three-screen instructional presentation and even that difference, Lombard suggests, might be accounted for by a significant F value (pre-experiment) between the sub-groups of girls in the two treatment and one control groups.[30] Second, Olsen determined that the addition of film to slides and audio tape enhanced the learning of motor skills but that multi-sensory (audio and visual components) and multi-image modalities did not significantly affect cognitive learning.[31]

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[30]Emanuel S. Lombard, "Multi-channel, Multi-image Teaching of Synthesis Skills in Eleventh Grade United States History" (unpublished Ph.D. dissertation, University of Southern California, 1969), abstract.

[31]John R. Olsen, "The effect of Multi-Stimuli Presentations on Learning Gain," in Dissertation Abstracts, Vol. 30 (Ann Arbor, Michigan: University Microfilms), p. 2235-A

CHAPTER III

DESIGN OF THE STUDY

Introduction

This study investigated the effect of a multi-image presentation upon the evaluative meaning of presentation-related concepts held by human subjects. As shown in Figure 2, the study was divided into three phases. In this chapter, first the overall design and methodology of the experiment are discussed briefly to provide a general background. Next, the two pre-experiment phases for the selection of the experimental presentation and the derivation of the criterion instrument are explained in turn. Finally, the detailed procedures followed in phase three, the experiment itself, are presented.

Overall Design and Methodology

The experimental design to test the general hypothesis that a multi-image presentation has an effect on evaluative meaning pits two treatment groups against each other and against a control group. Treatment Group 1 received a ten-minute multi-image and audio presentation on Biochemistry at Michigan State University. Treatment Group 2 received a parallel, ten-minute single-image and audio presentation

	PHASE 1	PHASE 2	PHASE 3
DESCRIPTION	Pre-Experiment Population A Fall, 1969	Pre-Experiment Population B Winter, 1970	Experiment Population C Winter, 1970
FUNCTION	Pilot Experiment with two multi-image presentations	Test SD Concepts and Scales	Test H_1 & H_2 in 2 Treatment & 1 Control Groups

Figure 2.--Organization of the Study.

on Biochemistry at Michigan State University. Nearly one-half of the visuals and the same audio component of the multi-image presentation were used in the parallel one-image version. The control group (Treatment Group 3) received a single-image and audio presentation on instructional media and technology using different slides and audio component from the other two programs.

Random assignment of the experimental population to the three groups, simultaneous presentation of the treatments in identical rooms, and the use of the same semantic differential (SD) measuring instrument in all groups makes it possible to ascribe between-group variance on the dependent variable of evaluative meaning to the independent variable of presentation treatment.

By also randomly assigning pre-selected seats to experimental subjects in the multi-image groups, it was convenient to examine the second hypothesis that the amount of effect on evaluative meaning would be related to the viewer's distance from the screen. For control purposes on the test for the general effect, seats at identical locations were also occupied by subjects in the single-image treatment group (Group 2).

Phase One

After exhausting avenues of obtaining from other sources a presentation which had demonstrated its effectiveness in some manner, a total of ten multi-image programs which had been prepared at Michigan State University were considered for use in the experiment. Some of these programs were eliminated because they included undesired variables such as recorded narration and 16mm motion picture footage. Of the remainder, two were selected for trial because of the responses which they generally elicited.

The first, a three-screen and music presentation on Expo 67 designed by Dr. Elwood E. Miller, had been shown to many different groups of all age levels. Consistently, those who attended the fair praised the presentation because it gave a clear impression of what Expo was like and seemed to communicate even the fair's "atmosphere." Those who had not attended the exposition usually commented that they wished more than ever that they had been able to go to Montreal. Thus, the Expo 67 presentation appeared to be worthy of serious consideration for the experiment.

The second, a three-screen and music presentation about Biochemistry at MSU, was designed as an introduction for the basic Biochemistry course at the University. This program had also received almost unanimous praise whenever it was shown for giving viewers a favorable impression of Biochemistry. Thus, it, too, seemed worthy of further consideration.

In order to select the more effective of the two presentations, a simple experiment was conducted with a graduate class in media. The class members were randomly assigned to one of two groups. Group one saw the Biochemistry presentation and group two received the Expo 67 presentation. Immediately after their respective treatments, both groups completed the same SD consisting of 18 bi-polar adjective scales for four concepts related to each presentation.[1] Thus, group one served as the control for group two with respect to the Expo 67 presentation and vice-versa.

Treating the sums of each subject's ratings for each concept as a distribution of scores, "t" tests between the means of the two groups were performed. The null hypothesis of no difference between the groups was rejected at the .05 level of confidence (one-tailed) for the concepts MICHIGAN STATE UNIVERSITY AND EXPERIMENT in favor of group one (which saw the Biochemistry program) and for the concept EXPO 67 in favor of group two (which saw the Expo 67 program).[2]

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[1]The SD instrument is shown in Appendix A. Scales thought to be relevant to the concepts of interest were chosen from the evaluation, activity, and potency dimensions. (See Charles Osgood and associates, The Measurement of Meaning, Urbana: University of Illinois Press, 1957). Concepts for the Expo 67 presentation were: EXPO 67, WORLD'S FAIRS, USA EXHIBIT AT EXPO 67, and CANADA; those for the other were: BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY, SCIENTIST, and EXPERIMENT.

[2]The routine for the "t" test with presumed unequal variances was used as given in the manual for the Marchant calculator.

Supported by these results, the "Biochemistry at MSU" presentation was selected for use in the actual experiment because its purpose seemed to be more sharply focused and because its content was judged to be more unfamiliar thus enhancing differential effects due to the treatment variable.

Phase Two

As noted previously, a form of the semantic differential was used as the criterion instrument in this study. Although they did not particularly emphasize the point at the time, Osgood and his associates recognized in their initial studies that a given bi-polar adjective scale shifts in meaning in relationship to the concept being judged and named the phenomenon "concept-scale interaction."[3] Twelve years and hundreds of studies later, in his introduction to a book of readings of SD techniques, Osgood singled out this and one other issue for special comment.

> I must confess that sometimes I feel like the Geppetto of a wayward Pinocchio who has wandered off into the Big City, and Lord knows what mischief he is getting into. Some people think Pinocchio is a specific standardized test; he is not, of course, being subject to concept/scale interaction. Some think he is a measure of meaning-in-general; he is not, of course, reflecting primarily affective meaning by virtue of the metaphorical usage of his scales. . . .[4]

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[3]See Osgood, <u>et al</u>., p. 187.

[4]James G. Snider and Charles E. Osgood, editors, <u>Semantic Differential Technique</u> (Chicago: Aldine Publishing Company, 1969), p. ix.

To avoid concept-scale interaction, Heise recommended that an SD should be validated and adjusted when it is applied in a new stimulus class.[5] One method of pre-checking and sharpening the instrument is the "Best-Worst" technique suggested by Darnell.

Darnell's study showed, ". . . that there may not be any non-evaluative dimensions of meaning . . ." and ". . . provided support for the contention that a scale is either evaluative or irrelevant to a particular concept."[6] Thus, the "Best-Worst" technique was invoked in a separate trial to select the scales for the SD to be used later in the actual experiment.

The detailed procedures, including decision rules, sample instruments, and data analysis are given in Appendix B but the highlights of the procedure are briefly described next.

First, forty scales which intuitively appeared to be appropriate for the "Biochemistry at MSU" presentation were selected from those appearing in Osgood's work.[7]

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[5]David R. Heise, "Some Methodological Issues in Semantic Differential Research," Psychological Bulletin, Vol. 72 (December, 1969), 418.

[6]Donald K. Darnell, "A Technique for Determining the Evaluative Discriminative Capacity and Polarity of Semantic Differential Scales for Specific Concepts" (unpublished Ph.D. dissertation, Michigan State University, 1967), p. 81.

[7]Osgood, *et al.*, pp. 37 and 52-61.

These scales were randomly ordered and alternated in polarity in preparing the SD response sheets for the concepts: BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY, SCIENTIST, EXPERIMENT, AND LABORATORY. Booklets were assembled so that an individual experimental subject would respond to three concepts but the booklets were carefully ordered for distribution to insure equal coverage of all concepts.

A senior-graduate class in the Department of Communication was used in this trial. There were 44 scoreable response booklets and an average of 24 subjects rated each concept on all forty scales. The experimental subjects indicated two judgments on each scale for each concept instead of the usual single checkmark. A "B" was to be placed at the scale position indicating the best imaginable example of the class of things named by the concept and, similarly, a "W" for "worst."

As shown in Figure 3, thirteen of the forty scales discriminated evaluatively and with the same polarity on all five concepts.[8] Seven additional scales discriminated

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[8]In Figure 3 the scales are ordered from first to last by the number of concepts for which each discriminated "best" from "worst." The concepts are ordered from left to right by the number of scales that discriminated for each concept. Only significant values are indicated--those showing a preference for the adjective on the left by a plus and those showing a preference for the adjective on the right by a minus. Several of the scales have been reversed to simplify the reading of the chart. (After Darnell, pp. 52-55.)

a. SCIENTIST c. LABORATORY e. MICHIGAN STATE UNIVERSITY
b. BIOCHEMISTRY d. EXPERIMENT

		a	b	c	d	e	
1.	bright	+	+	+	+	+	dark
2.	positive	+	+	+	+	+	negative
3.	fair	+	+	+	+	+	unfair
4.	reputable	+	+	+	+	+	disreputable
5.	interesting	+	+	+	+	+	boring
6.	good	+	+	+	+	+	bad
7.	active	+	+	+	+	+	passive
8.	important	+	+	+	+	+	unimportant
9.	true	+	+	+	+	+	false
10.	valuable	+	+	+	+	+	worthless
11.	beautiful	+	+	+	+	+	ugly
12.	timely	+	+	+	+	+	untimely
13.	nice	+	+	+	+	+	awful
14.	healthy	+	+	+		+	sick
15.	clear	+	+	+	+		hazy
16.	pleasant	+	+		+	+	unpleasant
17.	strong	+	+		+	+	weak
18.	happy	+	+		+	+	sad
19.	deep	+	+	+		+	shallow
20.	clean	+	+	+	+		dirty
21.	sharp	+	+		+	+	blunt
22.	new	+	+	+	+		old
23.	rational	+	+	+	+		intuitive
24.	free	+	+	+		+	constrained
25.	fast	+	+			+	slow
26.	poor		-	-	-		rich
27.	changeable			+		+	stable
28.	subjective	-	-				objective
29.	usual	-			-		unusual
30.	defensive	-				-	aggressive
31.	delicate			+			rugged
32.	light			+			heavy
33.	simple			-			complex
34.	hard						soft
35.	sacred						profane
36.	loud						soft
37.	cold						hot
38.	low						high
39.	serious						humorous
40.	small						large

Figure 3.--Evaluative Discrimination Capacity and Polarity of 40 Scales for 5 Concepts.

in the same way on all but one or another concept and missed significance on that remaining concept by only one case. Therefore, according to the decision rule adopted in advance (see Appendix B), the first twenty scales of Figure 3 were included in the final instrument as being relevant to the five concepts.

Phase Three: The Experiment

Design

The reader will recall that the experiment called for three groups to receive simultaneous treatments in three identical rooms as follows: Group 1--multi-image presentation, "Biochemistry at MSU; Group 2--single-image presentation, "Biochemistry at MSU"; Group 3--single-image control presentation, "Instructional Media and Technology."

In this posttest-only design (patterned after design number 6 suggested by Campbell and Stanley[9]), the scores of Group 3 (control group) provide base-line data, and between-group variance on the dependent variable can be ascribed to the independent treatment variable because of the random assignment of experimental subjects to the treatment and control groups.

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[9]Donald T. Campbell and Julian C. Stanley, "Experimental and Quasi-experimental Designs for Research on Teaching," in Handbook of Research on Teaching, ed. by N. L. Gage (Chicago: Rand McNally and Company, 1963), pp. 178 and 195-197.

Since it appeared likely that a multi-image presentation would be a novel experience for at least some of the experimental subjects, arrangements were made to show all of the members of the experimental population a different multi-image and audio presentation several weeks prior to the experiment, but as part of their regular class schedule of activities. While this pre-experiment presentation may not have entirely eliminated a "halo" or "Hawthorne" effect, it is felt that it did at least provide a common experience base and minimize the "strangeness" of the multi-image presentation for Treatment Group 1.

Treatment Presentations

Multi-Image Presentation.--Treatment Group 1 received a multi-image and audio presentation, "Biochemistry at MSU." The visual elements of this presentation were 280 35mm slides shown as simultaneous images on three adjacent ten-foot screens by three Kodak Carousel projectors under the control of a multi-unit programer.

Throughout the presentation all simultaneously displayed images complement each other; that is, images are not presented together for purposes of comparison or contrast nor are panoramic-type vistas thrown across the entire image area. This redundancy of images permitted the creation of a parallel single-image presentation.

It should also be mentioned that the presentation contained no titles or credits and only incidental verbal cues to Biochemistry occurred on just a few visuals.

The audio component consisted of a music tract of five selections without narration recorded on one channel of a stereo tape. Control signals recorded on the other channel of the stereo tape were fed into the multi-unit programer which decoded the signals and automatically advanced the three slide projectors independently.

Single-Image Presentation.--Treatment Group 2 saw a single-image and audio presentation composed of duplicates of 131 (slightly less than one-half) of the 35mm slides from the multi-image presentation and a dubbed copy of the same music track.

The visuals were shown sequentially on a ten-foot screen and included all of the slides with verbal cues to Biochemistry. Every effort was made to include the same essential "information" in this version as that in the multi-image version--something relatively easy to accomplish because of the "image redundancy" of the original three-screen program. A second multi-unit programer was used with a pre-programed audio tape to advance the slide projectors automatically.

Control Presentation.--Since some previous research studies have been criticized because they control groups completed the criterion instrument with no treatment whatsoever, it was decided that Group 3 should receive a single-image and audio presentation on "Instructional Media and Technology." The visuals--shown sequentially on a ten-foot screen--depicted all kinds of media being used by children and young adults.[10] The automatic timer of the projector was set on 8-second intervals so approximately 75 slides were shown. The audio component consisted of four recorded musical selections without narration.

Population

The experimental population consisted of 73 graduate students enrolled in two evening classes offered by the College of Education of Michigan State University. Lacking opportunity for a true sampling procedure, results are not generalizeable beyond the experimental population except insofar as those students are not unlike similar students at Michigan State University and elsewhere.

Following the pre-arranged procedures given in Appendix C, all of the subjects were randomly assigned to the three treatment groups. The original composition of the groups was 24, 24, and 23 respectively but two students who arrived between the randomization and the start of the presentation were put into Group 1 because it got started

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[10]These visuals were drawn from the "National Slide Library on Audio Visual Media in Education" available from the National Audio Visual Association, Fairfax, Virginia.

a little late and the responses from two students in Group 3 proved unuseable.

Instrumentation

The dependent variable, change in evaluative meaning, was measured with a special form (see Appendix D) of the semantic differential derived in a pre-experiment trial using Darnell's "Vest-Worst" technique. It consisted of the same twenty scales under each of the five concepts: EXPERIMENT, BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY, LABORATORY, and SCIENTIST.

The same SD instrument was used for all three groups except that Group 3 (the control group) also rated the concepts: SLIDE-TAPE PRESENTATIONS, INSTRUCTIONAL TELEVISION, and INDIVIDUALIZED INSTRUCTION. These concepts were added for masking purposes and in the hope that it would alleviate possible confusion caused by the unrelatedness of the five Biochemistry concepts to the control presentation. Free responses on the brief demographic questionnaire at the end of the test booklet indicated that the doubts were not removed for all subjects.

Rooms and Equipment

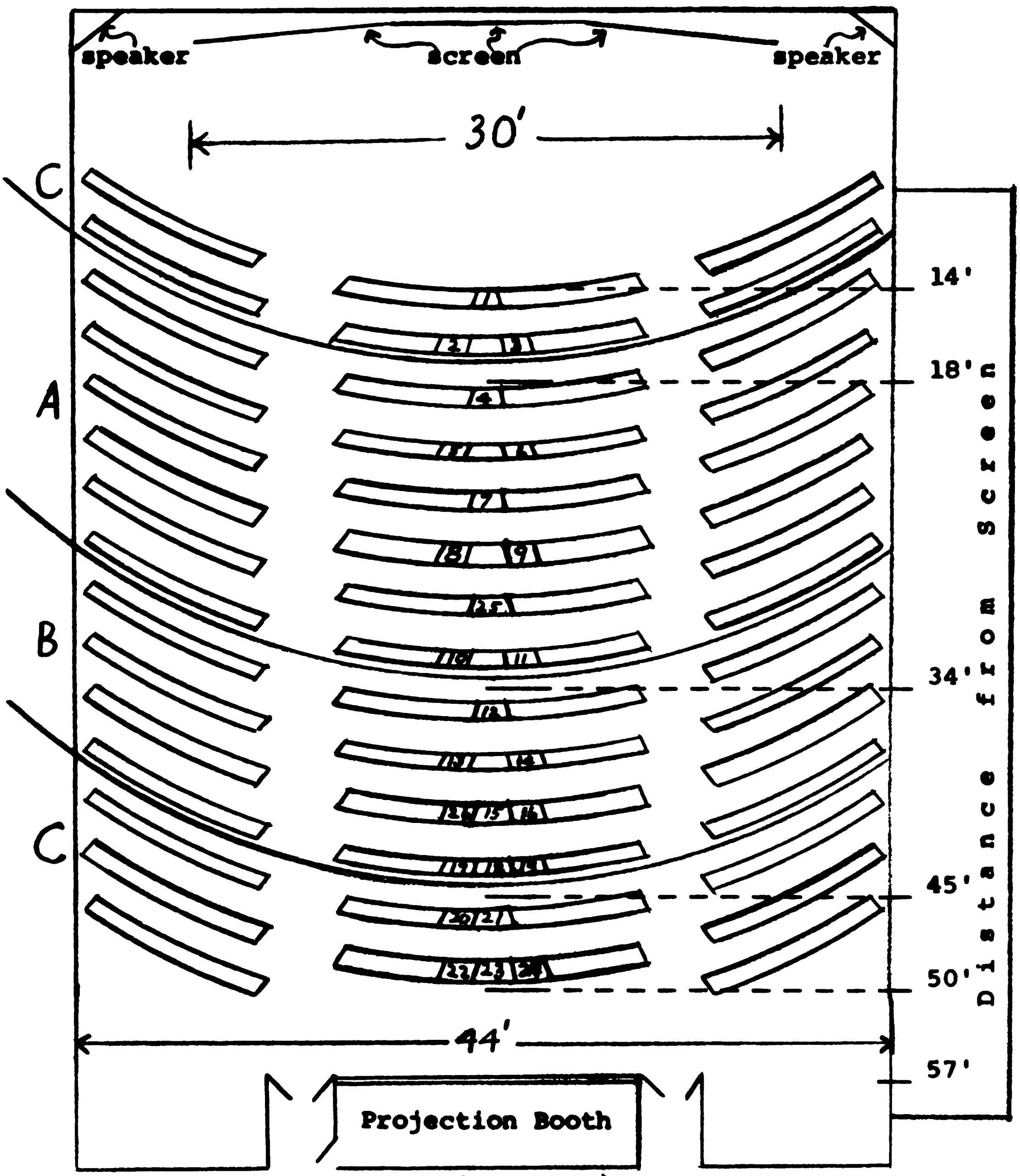
With the aid of five assistants, the three treatments were given simultaneously in three identical auditoriums in the same classroom building on the Michigan State University campus. All equipment was contained and operated from special projection booths so that machine noise was non-existent.

Kodak Carousel projectors adapted for xenon-arc light sources and ten-foot matte projection screens were used in all presentations. Audio tracts were fed into existing room amplification systems with adequate speakers.

Procedures

On the evening of the experiment, three of the six people running the presentations went to the separate rooms where the two classes were scheduled to meet. After an introductory statement about the experiment was read, the members of each class were randomly assigned to the treatment groups. The procedures (as shown in Appendix C) were designed to apportion equally the subjects of both sexes to the three groups. Unfortunately, an error was made in one class so that an even distribution by sex was not achieved across the groups. To insure that each person arrived at the correct room, the "presenters" escorted the subjects in three groups from the regular classrooms to the presentation rooms. As a further check, the randomization slips were checked and collected in all presentation rooms.

In the rooms for Groups 1 and 2, the subjects again drew slips for random assignment to the pre-selected seats shown in Figure 4. Although the presentation rooms had



LEGEND: Zone A = Optimum Seating Area
Zone B = Acceptable Seating Area
Zone C = Marginal Seating Area
Arabic numbers represent seats occupied for experiment in Treatment Groups 1 and 2.

Fig. 4--Diagram of Presentation Rooms.

sloping floors, these seats were chosen to minimize interference with each person's sight lines and to keep all subjects as close as possible to the center axis. Since the precise number of subjects for each group could not be determined in advance and since it was desired to keep the distribution as equal as possible within the three seating areas (optimum, acceptable, and marginal), slips for the seats were introduced into the drawing container according to the numbers shown in the diagram. After drawing a slip, each subject proceeded to the seat labeled with the number drawn.

The audio tape for all presentations began with the same short introductory statement which was immediately followed by the respective programs. In each of the rooms one of the presenters operated the equipment in the booth and the other remained in the room with the subjects and controlled the lights, monitored the audio level, handled the test booklets, and answered questions.

As soon as a presentation ended, the monitor raised the room lights and distributed the SD booklets. Then the audio tape was started again for the recorded reading of the instructions. After answering only procedural questions for clarification, the monitor instructed the subjects to begin working on the SD. The SD booklets from each booklet was checked to be sure that it was correctly labeled.

When all groups had completed the experiment, all subjects were assembled in one of the presentation rooms where the investigator briefly explained the nature of the experiment and answered questions.

Two slight anomalies which occurred in the room for Group 1 deserve mention. First, despite efforts to correct the situation in advance, a ventilator emitted a soft but somewhat penetrating whine during the entire experiment. This annoyance is of some concern since a few of the subjects commented about it. Second, the multi-unit programer malfunctioned and it was necessary to begin the presentation again after about twenty seconds had elapsed on the first try.

Hypotheses

Although it was not feasible to test (in the "classical" statistical manner) the two research questions as formally-stated hypotheses, for the sake of clarity and for ease of reference in the discussion later the two questions may be recast in the form of null hypotheses as follows:[11]

> H_o1: There will be no difference in the amount of shift in evaluative meaning of presentation-related concepts between subjects who receive a multi-image and audio presentation and those who receive a parallel single-image and audio presentation.

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[11]The reasons for not using omnibus tests in the conventional manner are set forth in Chapter IV.

H_o2: There will be no difference in the amount of shift in evaluative meaning of concepts related to a multi-image and audio presentation between subjects who sit in optimum, acceptable, and marginal locations from the screen.

Scoring and Analysis

The SD sheets were hand scored and recorded on computer coding sheets. Care was taken to reverse the scales which had been alternated by polarity on the sheets. Missed or doubtful ratings were scored as 4's (the neutral, center position).

The raw data on the coding sheets were then punched into computer cards and verified by trained operators. Random, spot checks comparing a printout of the data cards with the original SD sheets indicate that the error rate in preparing the cards was low or non-existent.

Existing computer routines were adapted by specialists to analyze the data. Raw scores were transformed by summing across scales for each subject on each concept and then determining the mean and within-group variance for each concept. Essentially, the statistical test was an F ratio derived from simple, one-way analysis of variance for each concept. Post-hoc "t" tests between group means were preformed for those analysis of variance runs which produced significant F ratios. Detailed scoring and calculational procedures are given in the next chapter.

CHAPTER IV

FINDINGS

This chapter is divided into two major sections in which the data generated by the experiment are reported, analyzed, and interpreted. In the first section, a prerequisite analysis of the semantic differential (SD) criterion instrument is presented. The second section is divided in turn into two parts, each dealing with the analysis and interpretation of the data for one of the two research questions.

Prerequisite Analysis

Rationale for the Factor Analysis

The reader will recall that the test instrument was a specially-developed semantic differential (SD). In Chapter III and Appendix B the procedures used in selecting the bi-polar adjective scales for the SD were explained. Those procedures followed the "Best-Worst" technique suggested by Darnell and produced a SD of twenty scales--thirteen which were shown to be relevant to and constant in polarity on all the concepts of interest and seven which were shown to have missed that criterion of relevance and polarity by no more than one concept/scale judgment by one respondent in a pilot trial.

Thus the twenty-scale SD was taken to be a unidimensional and relevant measure of evaluative meaning for the five presentation-related concepts. One way to check these assumptions about the SD is to factor analyze the data generated with it. If, in fact, the scales are relevant to the concepts (i.e., not subject to concept/scale interaction) the scales should have relatively high loadings. Furthermore, if the instrument is unidimensional, the scales should load on the same factor.

Since the "Best-Worst" technique was applied to each concept individually, it was decided to perform a factor analysis for each concept individually, also. And because Treatment Groups 1 and 2 saw a presentation related to the five concepts while Treatment Group 3 (the control group) saw a presentation unrelated to the five concepts, it was decided secondly to use only the SD judgments from Groups 1 and 2 in the factor analyses.

Computational Procedures

After the SD response sheets were scored, the raw data of 100 judgments per experimental subject (one response for each of twenty scales for each of five concepts) were punched into computer cards. The factor analysis for each of the five concepts was done for

Groups 1 and 2 combined and used a program[1] run on the CDC 6500 computer at Michigan State University.

The machine first calculated an intercorrelation matrix and then subjected that matrix to a principal axis solution with varimax rotations.[2] The five principal axis solutions and the loadings of the highest-order quartimax rotations are shown in photographically-reduced form in Appendix E. (For ease of comparison, all the principal axis solutions are placed first and the rotated factor loadings second.) Appropriate labels and the following information have been added to the rotated factor loadings to aid interpretation: communalities (h^2), percentage of total variance accounted for by each factor (% V_T), percentage of common factor variance accounted for by each factor (% V_C), and scale adjectives beneath the highest loading for each scale across the factors.

Results of the Factor Analysis

In looking at Tables 11 through 20 in Appendix E, it might be pointed out first that the scales were

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[1]The routine used was "FACTOR AA" developed by the Computer Institute for Social Science Research of Michigan State University and is described in the mimeographed CISSR Technical Report No. 34.1 dated May, 1969.

[2]With the varimax method the principal axis solution was rotated orthogonally until the Kiel-Wrigley criterion

relevant to the concepts as predicted by the "Best-Worst" technique. Evidence for this assertion comes from the following: all the communalities for the scales are at least .50 and many (35 out of 100) were .80 or higher; the proportion or percentage of total variance accounted for (% V_T) across the factors is remarkably high, ranging from 67.62% to 80.26% in toto for each of the five analyses.

However, it is also readily apparent in looking at the rotated factor loadings that the SD instrument was not, in fact, unidimensional. Three factors emerged across all five concepts, one additional factor appeared on each of two concepts, and several scales did not load consistently across the concepts. Since the SD instrument was shown by these prerequisite factor analyses not to be unidimensional, the analyses of variance to test for the main treatment effect should properly be based upon the factors which emerged.

In order to find the underlying factor structure in the data, one has to find rotations in each factor analysis which are similar. The ideal would be to find high loadings for an identical set of scales on a rotation in each analysis. Failing that, one sets out to find two or three "anchor" scales with sufficiently high loadings on

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was not reached. This criterion was set at 2, i.e., the rotation was stopped when a factor was encountered on which fewer than 2 scales had their highest loading.

one rotation within each analysis. Then other scales with high loadings on the same rotation as the "anchors" can be added to give a measure of reasonable depth, unidimensionality and "purity."

Factor I: Main Evaluative Factor.--The factor which generally had loadings for the most scales and accounted for the most common factor variance for all concepts is clearly evaluative in nature and for convenience is labeled Factor I. The scales which loaded on this factor are shown in Figure 5. The symbols (explained in the legend) represent the investigator's judgments of the strength of the loading for each scale, particularly in comparison to smaller, but contaminating, loadings on other rotations. All the highest loadings which occurred on the rotation within each factor analysis are entered; however, only scales whose loadings were judged to be satisfactory (all "X's" with and without asterisks) were used in the later analysis of variance tests on each concept.

Factor II: "Well-being" Factor.--The second factor (summarized in Figure 6) had loadings primarily from the scales clean-dirty, happy-sad, and healthy-sick and might be called the "well-being" factor. For the most part the three scales had quite high loadings across all five

	CONCEPTS Rotation Number	SCI (1)	LAB (1)	MSU (1)	BIO (1)	EXP (5)
	SCALES					
1.	timely-untimely	X	X*	X*		
2.	bright-dark			X		
3.	fair-unfair					
4.	good-bad	X	X*	X*	*X*	*X*
5.	beautiful-ugly			X*		
6.	valuable-worthless	*X*	X*		X*	
7.	true-false					
8.	active-passive	*X*	X*	X*	*X*	X*
9.	nice-awful			X*		X*
10.	positive-negative					X*
11.	reputable-disreputable		X*			
12.	important-unimportant	*X*	X*	X*	X*	
13.	interesting-boring	/	*X*	X		*X*
14.	healthy-sick					
15.	clear-hazy		X			
16.	pleasant-unpleasant			X*		X*
17.	strong-weak	X		/		
18.	happy-sad					
19.	deep-shallow			/		
20.	clean-dirty					

LEGEND: "Anchor" Scales are numbers 4, 8, and 12.

X means Excellent Scale. X* means Very Good Scale. X means Satisfactory Scale. / means Contaminated Scale.

Blank (non-entry) means Scale did not load on Factor.

Figure 5.--Scales Loading on Factor I.

CONCEPTS Rotation Number	SCI (4)	LAB (2)	MSU (2)	BIO (2)	EXP (1)
SCALES					
1. timely-untimely					
2. bright-dark		*X*		/	
3. fair-unfair					
4. good-bad					
5. beautiful-ugly				X*	X
6. valuable-worthless					
7. true-false					
8. active-passive					
9. nice-awful				X	
10. positive-negative					
11. reputable-disreputable					
12. important-unimportant					
13. interesting-boring					
14. healthy-sick		/	X	X	X*
15. clear-hazy					
16. pleasant-unpleasant				/	
17. strong-weak					/
18. happy-sad	X	/	*X*	*X*	X*
19. deep-shallow					
20. clean-dirty	X*	X*	X	*X*	*X*

LEGEND: "Anchor" Scales are numbers 14, 18, and 20.

X means Excellent Scale. X* means Very Good Scale. X means Satisfactory Scale. / means Contaminated Scale.

Blank (non-entry) means Scale did not load on Factor.

Figure 6.--Scales Loading on Factor II.

concepts and serve as the "anchor" scales with only a few other scales being added for some concepts.

Factor III: Second Evaluative Factor.--A second evaluative factor, labeled Factor III and summarized in Figure 7, emerged around the "anchor" scale true-false with the scales bright-dark, fair-unfair, and clear-hazy showing relatively strong association on two or three concepts.

"Extra" Factors.--A separate factor appeared on two concepts with sufficiently high loadings of enough scales to warrant attention. For the factor analysis for the concept LABORATORY (see Table 13 in Appendix E) the scales beautiful-ugly, nice-awful, positive-negative, and pleasant-unpleasant clustered together. In the analysis for the concept EXPERIMENT (see Table 14), the scales valuable-worthless, important-unimportant, and deep-shallow had high loadings. Since the scales of the two factors are different and do not show up on rotations for other concepts, they are handled as "extra" factors (labeled "A" and "B" for convenience). However, they need to be taken into consideration because they account for 15% and 12% of the total variance and 20% and 16% of the common factor variance respectively.

	CONCEPTS Rotation Number	SCI (2)	LAB (4)	MSU (3)	BIO (5)	EXP (4)
	SCALES					
1.	timely-untimely					
2.	bright-dark	*X*				*X*
3.	fair-unfair	/	*X*	*X*		
4.	good-bad					
5.	beautiful-ugly	*X*				
6.	valuable-worthless			X*		
7.	true-false	X	X*	X*	X*	X
8.	active-passive					
9.	nice-awful	X				
10.	positive-negative			*X*	X	
11.	reputable-disreputable					
12.	important-unimportant					
13.	interesting-boring					
14.	healthy-sick					
15.	clear-hazy	X		/		X*
16.	pleasant-unpleasant	/				
17.	strong-weak		/		/	
18.	happy-sad					
19.	deep-shallow				*X*	
20.	clean-dirty					

LEGEND: "Anchor" Scale is number 7.

X means Excellent Scale. X means Satisfactory Scale. X* means Very Good Scale. / means Contaminated Scale.

Blank (non-entry) means Scale did not load on Factor.

Figure 7.--Scales Loading on Factor III.

Summary of the Factors

The scales loading on each of the factors for each concept are shown in Figure 8. (The scales have been re-ordered for this figure to facilitate interpretation.) It is clear from this layout that no scale is accounted for on more than one factor for any one concept; that most of the scales have been used for every concept (only 19% of the total possible "assignments" to a factor have not been made); and that any given scale is reasonably well-related to the same factor across the concepts. The Roman numerals refer to the three main factors and the letters "A" and "B" indicate the "extra" factors on LABORATORY and EXPERIMENT.

A summary of the percentages of total variance (% V_T) and of common factor variance (% V_C) accounted for by the loadings of the scales on each factor is presented in Table 1. It is felt that these percentages, particularly that for % V_C, are sufficiently high to assert that tests for the main effects based on the scales as represented will adequately exhaust the useable data. Other loadings in the factor analyses appear to be uninterpretable and therefore of no use in the main data analysis.

Experimental Effects

Computational Procedures

The experiment was designed to test the differential effects of a multi-image presentation and a parallel

	SCALES	CONCEPTS Factor "Anchor"	SCI	LAB	MSU	BIO	EXP
4.	good-bad	I	I	I	I	I	I
5.	active-passive	I	I	I	I	I	I
12.	important-unimportant	I	I	I	I	I	B
1.	timely-untimely		I	I	I		
13.	interesting-boring			I	I		
6.	valuable-worthless		I	I	III	I	B
14.	healthy-sick	II		II	II	II	II
18.	happy-sad	II	II	II	II	II	II
20.	clean-dirty	II	II	II	II	II	II
7.	true-false	III	III	III	III	III	III
3.	fair-unfair		III	III	III		
2.	bright-dark		III	II	I	II	III
15.	clear-hazy		III	I	III		III
17.	strong-weak		I	III		III	II
10.	positive-negative			A	III	III	I
9.	nice-awful		III	A	I	II	I
5.	beautiful-ugly		III	A	I	II	II
16.	pleasant-unpleasant		III	A	I	II	I
19.	deep-shallow					III	B
11.	reputable-disreputable			I			
	"Unassigned" Scales		7	1	3	5	3

Figure 8.--Summary of Scale Loadings on All Factors

TABLE 1.--Percentage of V_T and V_C Accounted for.

FACTORS	Proportions of Variance				% of V_T	% of V_C	Total V_C
	I	II	III	"Extra"			
SCIence	.2522	.0935	.2169	-	56.26	70.09	.8026
LABoratory	.2632	.1221	.1413	.1549	68.15	91.61	.7439
MSU	.3075	.1195	.1714	-	59.84	88.49	.6762
BIOchemistry	.1508	.1890	.1555	-	49.53	63.63	.7783
EXPeriment	.2116	.1570	.1248	.1231	61.65	80.04	.7664
Averages					59.98	78.77	

single-image presentation upon evaluative meaning as measured by a specially-developed SD instrument. Assuming unidimensionality of the SD, it was originally intended to sum across all twenty SD scales to derive a total score for each subject on each concept and to perform a separate analysis of variance on these summed scores for each concept. However, in the preceding section it was shown with factor analytic techniques that the SD scales loaded on three main factors, eliminating the unidimensionality assumption.

Thus, sixteen (rather than five) analyses of variance were performed in relation to each of the two research questions. A separate one-way analysis of variance (ANOVA) was performed to correspond with each column in Figures 5, 6, and 7 plus an "extra" one for Factors A and B which emerged for the concepts LABORATORY and EXPERIMENT.

In each case, each subject's judgments for the scale/concept items designated with an "X" in Figures 5, 6, and 7 were summed to derive a total "factor" score on that concept. These summed scores were then used as transformed data for the ANOVA's by treatment groups.

Main Treatment Effect

ANOVA Results.--The first question posed in this study asked whether a large-screen, multi-image presentation would cause more positive shift in evaluating meaning of five concepts than a parallel single-image presentation. The data for each of the sixteen ANOVA's (one for each concept on each factor) are given in complete form in Appendix F and are summarized in Tables 2 through 5.

As shown in Table 2, the F ratios for the concepts MICHIGAN STATE UNIVERSITY (MSU) and EXPERIMENT on Factor I were significant at the .10 level of confidence or better. In Table 3 it is seen that the F ratios for MSU and BIOCHEMISTRY were highly significant (alpha equals .007 and .003 respectively) and that for EXPERIMENT was significant at better than the .10 level of confidence. (It should be noted that an ANOVA for SCIENTIST on Factor II was not performed because of the low scale loadings on that concept.) Table 4 shows that the F ratios for SCIENTIST and BIOCHEMISTRY were significant at the .056 and .04 levels of confidence respectively. Finally, the F ratio for the "extra" factor shown in Table 5 on LABORATORY was significant at little better than the .20 level of confidence.

Post-hoc Comparisons.--It would appear reasonable to determine which of the three treatments, if any, are associated with the F ratios significant at the .10 level of confidence or better--the underlined values in Tables

TABLE 2.--Group Means and Results of ANOVA's on Factor I.

Concept	Means			F Ratio	α_F
	Group 1 (n=26)	Group 2 (n=24)	Group 3 (n=21)		
SCI	36.15	33.29	32.76	1.87	.161
LAB	46.15	43.96	43.33	.726	.487
MSU	53.73	51.58	46.33	<u>3.396</u>	<u>.039</u>
BIO	23.42	23.04	20.81	1.96	.149
EXP	34.19	30.37	30.14	<u>2.48</u>	<u>.091</u>

TABLE 3.--Group Means and Results of ANOVA's on Factor II.

Concept	Means			F Ratio	α_F
	Group 1 (n=26)	Group 2 (n=24)	Group 3 (n=21)		
SCI[a]					
LAB	22.04	20.50	19.90	1.83	1.69
MSU	16.08	16.00	13.09	<u>5.39</u>	<u>.007</u>
BIO	38.35	34.42	31.38	<u>6.39</u>	<u>.003</u>
EXP	27.46	24.87	24.33	<u>2.65</u>	<u>.078</u>

[a]The low scale loadings on this concept for Factor II did not warrant an analysis of variance.

TABLE 4.--Group Means and Results of ANOVA's on Factor III.

Concept	Means			F Ratio	α_F
	Group 1 (n=26)	Group 2 (n=24)	Group 3 (n=21)		
SCI	38.88	35.12	34.24	3.01	.056
LAB	16.42	15.12	14.95	1.52	.225
MSU	26.96	27.04	24.71	1.17	.316
BIO	22.35	19.83	19.38	3.277	.044
EXP	15.65	13.71	13.95	2.238	.114

TABLE 5.--Group Means and Results of ANOVA's on Factors A and B.

Concept	Means			F Ratio	α_F
	Group 1 (n=26)	Group 2 (n=24)	Group 3 (n=21)		
LAB (A)	22.54	20.79	20.71	1.68	.193
EXP (B)	15.46	14.75	14.43	.51	.601

2, 3, and 4. The Sheffe method of post-hoc comparisons of the differences between the means was used in this secondary analysis. Details concerning the derivation of the necessary formula and its application are given in Appendix G.

Since it was not possible to perform an omnibus test via analysis of variance at a pre-specified alpha level for the main effect and since the computer results of the analyses of variance provided the specific alpha level of each F ratio, it was decided to use the Sheffe method to determine for each comparison the minimum value for significance at the specific alpha level of each F ratio. The minimum value (absolute difference between two means) for each comparison is entered in Table 6 in parentheses below those differences which by initial inspection appeared to be great enough to warrant a post-hoc comparison. As shown in Table 6, none of the post-hoc comparisons was significant at the alpha level for the corresponding F ratio.

<u>Interpretation of Results</u>.--When Table 6 is compared with Tables 2 through 5, it is seen that seven of the total of fourteen analyses of variance performed on the three most important factors produced F ratios significant at the .10 level of confidence or better. (Since this study is rather exploratory in nature and since there are

TABLE 6.--Post-hoc Comparisons of Group Means.

Concept	F Ratio	α_F	MS_{within}	Differences Between Group Means 1-2	1-3	2-3
Factor I						
MSU	3.40	.039	96.73	2.1	7.4 (7.5)[a]	5.2 (7.6)
EXP	2.48	.091	51.24	3.8 (4.5)	4.0 (4.7)	.2
Factor II						
MSU	5.39	.007	11.91	.08	2.99 (3.3)	2.9 (3.4)
BIO	6.39	.003	44.89	3.9 (6.7)	6.97 (7.0)	3.0 (7.1)
EXP	2.65	.078	25.64	2.6 (3.2)	3.1 (3.4)	.54
Factor III						
SCI	3.01	.056	49.07	3.8 (4.8)	4.6 (5.0)	.9
BIO	3.28	.044	19.00	2.5 (3.1)	2.97 (3.3)	.4

[a]Minimum absolute difference for comparison to be significant at α_F in the same row.

no dire consequences to result from making a Type I error, it did not seem unreasonable that alpha levels up to .10 warranted further investigation with post-hoc comparisons.) It is also seen that of the "significant" F ratios, two were for each of the concepts MICHIGAN STATE UNIVERSITY, BIOCHEMISTRY, and EXPERIMENT and that the most significant F ratios were obtained for the concepts MICHIGAN STATE UNIVERSITY and BIOCHEMISTRY.

It may be that F ratios with more significant alpha levels did not result for all the concepts because not all the concepts are equally related to the treatment presentations. The investigator simply selected those concepts for testing which he felt sure were embodied in the presentation--a customary procedure in studies using the semantic differential technique. It is felt that MICHIGAN STATE UNIVERSITY and BIOCHEMISTRY are the most likely of the five concepts which would have been shown to be most strongly related to the presentations if a pre-experiment trial had attempted to select the concepts empirically.

Granted the assumption that MICHIGAN STATE UNIVERSITY and BIOCHEMISTRY are the most centrally related to the presentation, one can say that there is evidence for a systematic treatment effect in the experiment. Further support for this assertion is gained from the fact that the Group means are ordered as predicted with but one minor exception. That is, as shown in Tables 2 through 5, the means are arranged across the rows from high to low from Group 1 (multi-image) to Group 3 (control), respectively.

But the crucial theoretical prediction was that there would be a significant difference between the means of the two treatment groups which received the Biochemistry presentations thus showing conclusively the superior effect of the multi-image version. Unfortunately, the post-hoc comparisons of the Group means failed to show at the necessary levels of confidence that whatever systematic treatment effect was present can be ascribed to the multi-image treatment.

Furthermore, the difference between the means of Groups 1 and 3 were consistently greater than either the differences between Groups 1 and 2 or that between Groups 2 and 3. Had the difference between Groups 1 and 3 been significant, it could be concluded only that the multi-image presentation was more effective than the parallel single-image presentation when both are compared to the control presentation. Lacking even that finding, it is clear that there is no statistical support for a positive answer to the first research question: will a multi-image presentation cause more positive shift in evaluative meaning of presentation-related concepts than a parallel single-image presentation?

Effect of Viewer Location

The reader will recall that the second research question asked if the amount of the observer's visual field covered by the overall image (as determined by his distance from the screen) would influence the amount of shift in evaluative meaning for those subjects who received the multi-image presentation. It was convenient to deal with this question with respect to Treatment Group 1 only so that its investigation is not dependent upon a positive answer to the first research question about treatment effect per se.

ANOVA Results.--In order to get at this question, the subjects in Treatment Group 1 were divided into Subgroups A, B, and C which were located at presumed optimum, acceptable, and marginal distances from the screen. Thus, analyses of variance were performed across the three Subgroups in the same way as for the three Treatment Groups. Since the same responses to the SD instrument were used in this second analysis, the ANOVA's were again performed on scores summed over scales with high loadings on the factors for each concept. Thus, sixteen ANOVA's were performed exactly parallel to the treatment-effect analysis but with data only from Treatment Group 1.

The complete layout of each ANOVA is given in Appendix H and the results are recapitulated and summarized in Tables 7 through 9. Looking at these tables, it is seen that only four of the sixteen ANOVA's produced F ratios significant at least at the .10 level of confidence and only three of the remaining F ratios were significant at the .25 level or better. Three of the F ratios significant at the .10 level were obtained in ANOVA's for Factor III, one for Factor II, and none for Factor I.

Post-hoc Comparisons.--The Sheffe post-hoc comparison method was applied to the Subgroup means for the F ratios significant at or below .10. The results of these comparisons are given in Table 11 where it is seen that none of the differences between the Subgroup means was significant at the same alpha level as the corresponding F ratio. Again in this table the minimum absolute value is entered in parentheses below the obtained arithmetical difference which appeared large enough by inspection to warrant a comparison.

Interpretation of Results.--The data bearing on the question of the effect of viewer location contain two surprising findings. As shown in Tables 7 through 9, none of the four F ratios significant at the .10 level of confidence was for the concept BIOCHEMISTRY. It was anticipated that the effect of viewer location would be most pronounced on it, the concept presumed most central

TABLE 7.--Subgroup Means and Results of ANOVA's on Factor I.

Concept	Means			F Ratio	α_F
	Subgroup A (n=9)	Subgroup B (n=9)	Subgroup C (n=8)		
SCI	36.55	35.11	36.87	.212	.810
LAB	46.89	44.55	47.12	.301	.743
MSU	53.89	51.22	56.37	1.024	.375
BIO	23.00	23.33	24.00	.109	.897
EXP	33.44	31.78	37.75	1.827	.183

TABLE 8.--Subgroup Means and Results of ANOVA's on Factor II.

Concept	Means			F Ratio	α_F
	Subgroup A (n=9)	Subgroup B (n=9)	Subgroup C (n=8)		
SCI[a]					
LAB	22.22	22.22	21.62	.049	.952
MSU	16.22	14.67	17.50	1.507	.243
BIO	39.44	36.55	39.12	.612	.551
EXP	28.33	24.55	29.75	2.739	.086

[a]The low scale loadings on this concept for Factor II did not warrant an analysis of variance.

TABLE 9.--Subgroup Means and Results of ANOVA's on Factor III.

Concept	Means: Subgroup A (n=9)	Subgroup B (n=9)	Subgroup C (n=8)	F Ratio	α_F
SCI	38.11	35.67	43.37	2.83	.079
LAB	16.55	15.22	17.62	1.03	.373
MSU	26.33	23.22	31.87	6.50	.006
BIO	23.89	20.33	22.87	1.647	.215
EXP	14.22	14.55	18.50	3.32	.054

TABLE 10.--Subgroup Means and Results of ANOVA's on Factors A and B.

Concept	Means: Subgroup A (n=9)	Subgroup B (n=9)	Subgroup C (n=8)	F Ratio	α_F
LAB (A)	23.00	22.33	22.25	.103	.902
EXP (B)	15.67	14.22	16.62	1.202	.319

TABLE 11.--Post-hoc Comparisons of Subgroup Means.

Concept	F Ratio	α_F	MS_{within}	Differences Between Subgroup Means		
				A-B	A-C	B-C
Factor I[b]						
Factor II						
EXP	2.74	.086	22.77	3.8 (5.2)[a]	-1.4	-5.2 (5.5)
Factor III						
SCI	2.83	.079	45.86	2.4	-5.3 (7.9)	-7.7 (7.9)
MSU	6.50	.006	24.80	3.1	-5.5 (8.8)	-8.6 (8.8)
EXP	3.32	.054	14.16	-.3	-4.3 (4.7)	-3.9 (4.7)

[a]Minimum absolute difference for comparison to be significant at α_F in the same row.

[b]Alpha levels for F ratios in the analyses on Factor I did not justify post-hoc comparisons.

to the presentation and the absence of this finding is the first unexpected, and unexplained, result.

Inspection of the ordering of the Subgroup means in Tables 7 through 10 provides the second unexpected result. With but one exception the highest means (most positive scale/concept judgments) were obtained from the subjects in the locations presumed to be most marginal. Furthermore, although the post-hoc comparisons were not significant at the alpha level of the corresponding F ratio, they were consistently closest in favor of Subgroup C. And had a tabled F value (instead of the values actually obtained) been used in the Sheffe formula, three of the four comparisons in column B-C would have been significant in favor of Subgroup C.

Thus, it is clear that there is no statistical support for a positive answer to the second research question and that there is some evidence to suggest that the best viewer locations were those closest and farthest away from the screen for the multi-image presentation, the locations of the subjects in Subgroup C.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Purpose of the Study

This study explored the gross, affective impact of a multi-image presentation upon human subjects. The experimental data were intended to shed light on two general questions:

1. Will a multi-image and audio presentation cause greater positive shift in evaluative meaning than a parallel single-image and audio presentation?
2. Is the magnitude of shift in evaluative meaning related to the amount of the viewer's visual field which is covered by the projected image area as determined by the viewer's distance from the screen?

Design and Procedures

Seventy-one students from two graduate classes in the College of Education at Michigan State University were randomly assigned to two treatment groups and a control group. Treatment Group 1 received a ten-minute multi-image and audio (music) presentation on Biochemistry at Michigan State University. Treatment Group 2 received a parallel ten-minute single-image and audio (music) presentation on Biochemistry at Michigan State University. All of the 35mm slides for the parallel single-image presentation were drawn from the multi-image program and the music track was identical for both presentations. The Control Group received a single-image and audio (music) presentation on instructional technology using 35mm slides and audio component different than the other two presentations.

Treatment Groups 1 and 2 were also randomly assigned to pre-selected seats in order to investigate the second research question on the effect of viewer location for those viewers experiencing the multi-image presentation.

All treatments were administered simultaneously in three identical lecture-auditoriums. All equipment (including automatic programers and xenon-arc slide projectors) was housed in projection booths. Since all images were ten feet wide, the total horizontal screen area for the multi-image presentation was thirty feet. The same criterion instrument was administered to all groups immediately after the presentation treatment.

The criterion semantic differential (SD) instrument was derived in a pre-experiment trial and consisted of twenty bi-polar adjective scales of seven positions. All twenty scales were shown in this trial to be relevant to and constant in polarity on the concepts BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY, SCIENTIST, LABORATORY, and EXPERIMENT. However, unidimensionality of the scales was not supported by factor analyses of the combined SD ratings of Treatment Groups 1 and 2 on each of the five concepts. The analysis of the data with respect to the two research questions was performed in accordance with the three main and two "auxiliary" factors which emerged in the preprequisite factor analyses.

Analysis of Results

Seven of the sixteen one-way analyses of variance performed with respect to the first research question produced F ratios significant at the .10 level of confidence or better. However, none of the post-hoc comparisons of the Group means for those analyses were significant at the same alpha level as the corresponding F ratio.

Sixteen one-way analyses of variance were performed similarly on the SD ratings of the three Subgroups in Treatment Group 1 to deal with the second research question. Only four of these analyses produced F ratios significant at the .10 level of confidence or better and none of the associated post-hoc comparisons were significant at the alpha level of the corresponding F ratios.

Findings

The findings based on the experimental data can be summarized as follows:

1. There is considerable evidence that a systematic main effect was operating on at least some of the concepts but the effect cannot be ascribed specifically to the multi-image presentation.
2. There is some evidence of a systematic influence of viewer location for those subjects who received the multi-image presentation but the influence cannot be ascribed specifically to those locations initially presumed to be optimum. If anything, those locations presumed to be marginal were the best.

Discussion and Recommendations

The findings summarized above indicate that this experiment did not produce compelling statistical evidence for positive answers to the two research questions. Nevertheless, there are two reasons for concluding the report with a section on implications for further research.

First, even had the results been more conclusive, the issues would be far from settled. Without further testing, the results would not be generalizable to other multi-image presentations nor to other populations. Each experiment, of course, must stand or fall on its own merits and each finding supported by experimental evidence is just that--a separate finding. Only after many mutually supportive findings have appeared can a principle of design be enunciated and perhaps integrated into existing theory.

The second justification for this concluding section follows from the first. If further research is warranted (and the present investigator feels strongly that it is), it seems salutary, using the hindsight of experience, to suggest some ways for modifying the assumptions and improving the methodology so that a replication of the experiment might obtain more conclusive results.

Size of Experimental Population

First and most routinely, the experiment should be replicated with a larger experimental population. Measures of central tendency perform best statistically when samples contain at least thirty subjects, more than were available for the groups in this experiment and nearly three times the size of the subgroups.

Selection of SD Concepts

The second improvement concerns the SD instrument. Great care was taken to select the adjective scales which were relevant to the concepts of interest. Had similar precautions been taken in selecting the concepts which were relevant to the treatment presentations, the results might have been much more conclusive. As pointed out previously, the concepts were arbitrarily chosen by the investigator--a customary procedure in studies using the SD technique. With hindsight it is suggested that all but the concept MICHIGAN STATE UNIVERSITY (MSU) are very similar and that they may have represented, in fact, essentially one larger concept--perhaps an overarching idea like SCIENCE--to the experimental subjects. If such were the case, the results obtained would assume greater importance, for significant F ratios were obtained for MSU on two of the three main factors and for at least one of the four "science-related" concepts on all of the main factors. In a replication, then, much more care should be used to select mutually exclusive concepts shown to be related to the treatment presentation.

Selection of Experimental Population

The relatedness of the concepts just discussed suggests yet another way to improve a replication of the experiment. It was initially assumed that the experimental population of graduate education students would not be substantially unlike the sophomore, beginning Biochemistry students for whom the presentation was originally designed with respect to knowledge of and feeling for

Biochemistry. However, if as now suggested, four of the concepts represented substantially the same idea for the experimental subjects, it can be argued that the graduate students had quite hardened meanings for the SD concepts because of their additional experience with and exposure to science courses. Previous research has shown repeatedly that firmly held beliefs and attitudes are very presistent and the between-group variances obtained in this experiment would then appear quite remarkable. Accordingly, it is suggested in future research that the experimental population and the intended audience for a given presentation/treatment should be matched as carefully as possible.

Viewer Location

The second research question concerned only one of many independent variables which may be involved with the effect of multi-image presentations. Although the small N and the weakness of the finding bode extreme caution in interpretation, the experimental evidence found is quite surprising. How might it be explained?

Inundation and Normal Viewing.--To begin with, there were no apparent differences between the subjects who sat the closest to and those who sat the farthest from the multi-image screens.[1] If, then, the differences on the

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[1]That is, there are no discernible differences statistically nor demorgaphically as revealed by data on

dependent variable between those subjects taken together as a Subgroup and the other two Subgroups was due to their respective locations, it may be that those who sat close to the screen were "inundated" by the presentation and those farthest from the screen simply received more impact because they experienced the presentation at the "normal" two-screen-widths distance.

Audience Dynamic.--There are other possibilities as well. For example, there may be an "audience dynamic" of the nature that those who sat more in the middle of the seating area perceived themselves as part of a cohesive group experiencing just another class presentation while those seated at the extremes reacted more individually, feeling more like guinea pigs than part of a group having a common experience.

Viewer Preference.--Or perhaps the impact of a presentation is related to whether or not a viewer is able to sit where he prefers to be seated. Such a notion might be checked with an experiment designed around matched groups, one which is allowed to choose seats and the other for which seats are assigned.

Visual Acuity.--There also may be interactions among the visual acuity of the subjects, seat location, and size

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the questionnaire completed by the subjects. Neither were there noteworthy differences in kind nor degree on the free response items on the questionnaire.

of image. In this experiment the variable of visual acuity was assumed to be randomly distributed throughout the experimental population but it might be sell to control for it with a pre-experiment, individually-administered test.

Experimentation with Individuals

Passing on to another matter, it should also be mentioned that experimentation using individual subjects as the unit of analysis may be very useful for determining the most fruitful independent variables for further investigation. Some of the variables which would seem to be of interest are: image size; viewing angle; placing multiple images on one screen versus individual screens for each image; pacing and rhythm imparted by independently-changing, simultaneously-presented images; and previous knowledge and attitudes of the viewer.

Also, individual experimentation offers the possibility of using autonomic nervous system responses, such as galvanic skin response and pulse rate, as affective measures both for separate analysis and for correlation with indirect measures such as the SD technique.

Again, a caution about generalizing may be in order. Any variables found to be of special interest with experiments using individuals as the unit of analysis should be checked in experiments with groups. One should no more generalize to groups the findings from experimentation with individuals than one should generalize from an isolated presentation/treatment to all such presentations or from a given population to all other populations.

Some Larger Issues

The suggestions for additional research given thus far have dealt with quite ordinary and obvious variables. There yet remain some larger issues which deserve discussion even though it is not easy to suggest ways of dealing with those issues experimentally.

Suppose for the moment that multi-image presentations are actually a new medium rather than an extension of a simpler and older medium. Such a state of affairs would elevate the level of discourse for it would seem necessary then to devise completely new presentation and design principles. Existing principles, crude and intuitively based as they are, would be inadequate.

For example, if Marshall McLuhan is right that, ". . . in the electronic age, data classification yields to pattern recognition . . ."[2] perhaps multi-image presentations should be organized (or disorganized according to conventional standards) to train the viewer to recognize patterns rather than to arrange the images (as was done

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[2]Marshall McLuhan, _Understanding Media: The Extensions of Man_ (2nd ed.; New York: The New American Library, Inc., 1966), p. viii.

in this experiment) in ready-made groups like plants, animals, laboratories, equipment and so forth.

McLuhan's distinction between hot and cool media may have even more relevance for multi-image displays. He contends that media which present high-definition images are "hot" and non-involving whereas media with low-definition images are "cool" and force the viewer to become involved by completing the display.[3] Could it be that "hot" high-definition images (in this case projected transparencies) in effect become "cool" and involving when they are changed rapidly or when many of them are presented simultaneously?

McLuhan has predicted that we have seen only the beginning of the school dropout problem because many of today's youth simply find no correspondence between their school experiences and the "electrically configured" world in which they live.[4] Although it would be foolish to surmise that multi-image presentations may be a panacea for returning relevance to the school program, it does not seem too much to say that some of the possibilities should at least be investigated.

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[3]For a fuller discussion of this distinction see Understanding Media and Marshall McLuhan and Quentin Fiore, The Medium is the Massage (New York: Bantam Books, 1967).

[4]McLuhan, p. ix.

Conclusion

In conclusion, it can be stated that this study has provided sufficient experimental evidence of the affective impact of multi-image presentations to warrant additional experimentation. Also, the rather surprising results with respect to viewer location should certainly be verified with new experiments.

However, to prevent dissipation, fragmentation and duplication of effort in additional multi-image research, it would be well for future investigations to be coordinated in some way. To that end, this investigator stands ready to share information, ideas and results with all others who also hold a belief in the importance of exploring the effects of multi-image presentations. With such frequent and frank exchanges the day may be hastened when multi-image presentations might make a substantial contribution in improving affective as well as cognitive learning which is, after all, the ultimate goal.

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APPENDICES

APPENDIX A

SEMANTIC DIFFERENTIAL FOR PILOT EXPERIMENT

INSTRUCTIONS

The purpose of this instrument is to measure the meanings of certain things to various people by having them judge them against a series of descriptive scales. (It has absolutely nothing to do with the grading in this course.)

Each page contains a concept at the top followed by eighteen adjective pairs which are separated by a scale containing seven positions. You are to check at one of the positions along each scale to indicate where you rate the concept at the top.

Here is an illustration -

```
        3 : 2 : 1 : 0 : 1 : 2 : 3
NICE ___:___:___:___:___:___:___ AWFUL
```

This rating scale is bounded by the words "NICE" and "AWFUL". The more "NICE" you feel the concept is, the farther to the left of the scale you would place your check; the more "AWFUL" you feel the concept is, the farther to the right you would place your check. If it is hard to decide if it is "NICE" or "AWFUL", or you feel the adjective pair is not relevant to the particular concept, place a check in the central space, under the zero (0). This means "undecided" or "irrelevant".

There are no right or wrong answers. The best response is what you feel is appropriate RIGHT NOW. Do not spend too much time on any one item. PUT DOWN YOUR FIRST IMPRESSION. Please be sure to place a check in one of the seven positions on each scale. Do not go back to pages you have already completed. When you finish a page, please continue to the next.

Remember, even though some of the items may not seem to make much sense, this measurement technique has proven to be very valuable when the respondents do the best they can in honestly indicating their first impressions.

(Concept)

3 : 2 : 1 : 0 : 1 : 2 : 3

KIND ___:___:___:___:___:___:___ AWFUL

BAD ___:___:___:___:___:___:___ GOOD

STRONG ___:___:___:___:___:___:___ WEAK

TRUE ___:___:___:___:___:___:___ FALSE

DIRTY ___:___:___:___:___:___:___ CLEAN

SERIOUS ___:___:___:___:___:___:___ HUMOROUS

UGLY ___:___:___:___:___:___:___ BEAUTIFUL

PASSIVE ___:___:___:___:___:___:___ ACTIVE

HARMONIOUS ___:___:___:___:___:___:___ DISSONANT

SIMPLE ___:___:___:___:___:___:___ COMPLEX

POSITIVE ___:___:___:___:___:___:___ NEGATIVE

MEANINGFUL ___:___:___:___:___:___:___ MEANINGLESS

OLD ___:___:___:___:___:___:___ NEW

ATTRACTING ___:___:___:___:___:___:___ REPELLING

WISE ___:___:___:___:___:___:___ FOOLISH

SOFT ___:___:___:___:___:___:___ HARD

UNSUCCESSFUL ___:___:___:___:___:___:___ SUCCESSFUL

USUAL ___:___:___:___:___:___:___ UNUSUAL

APPENDIX B

DERIVATION OF SEMANTIC DIFFERENTIAL WITH "BEST-WORST" TECHNIQUE

DEVELOPMENT OF SD INSTRUMENT

INTRODUCTION

As noted in the text of the proposal, the criterion instrument to be used in measuring the dependent variable, connotative meaning, will be a specially prepared form of the Semantic Differential. In order to minimize the possible interaction between scales and concepts and in order to maximize the discriminability of the SD, the scales to be used will be determined with the Best-Worst technique with Population B prior to the actual experiment. Most of the ideas and material given below is drawn from Darnell's 1964 dissertation.

PREPARATION OF SD MATERIALS

The steps to be followed in preparing the SD booklets to determine the discriminability and polarity of scales on the concepts BIOCHEMISTRY, MICHIGAN STATE UNIVERSITY, SCIENTIST, EXPERIMENT, and LABORATORY are:

1. Choose forty scales (which intuitively appear to be appropriate) from Osgood's lists. Write scales in polar position as given by Osgood.
2. Number scales for purposes of random drawing for order.
3. Prepare individual slips for the numbers 1-40.
4. Draw for order of presentation according to following decision rules:
    a. Flip coin to see if 1st draw should be "+" or "-" in polarity where "+" polarity is order given by Osgood and "-" is the reverse.
    b. Draw slips at random, one at a time and record the numbers in order drawn.
    c. Write scales, alternating each in polarity after the first as given in a. above.
5. Prepare sheets of scales in order determined as in 4. with 20 scales per page. There will be 2 sheets of scales for each concept.
6. Assemble booklets of sheets so that each booklet contains sheets for 3 concepts. The first booklet, then, would have sheets for concepts 1,2, and 3; the second booklet sheets for concepts 2,3, and 4; and so on.--5 "kinds" of booklets for the 5 concepts: 1,2,3; 2,3,4; 3,4,5; 4,5,1; 5,1,2.

ADMINISTRATION

The prepared SD booklets will be distributed randomly (but in the sequential order shown above in step 6) to students in two regular classes in the College of Education (MSU) with a total N of 50. Thus there will be approximately thirty people making ratings on each scale-concept item.

$$(50 \text{ subjects}) \div \left[\left(\begin{array}{l}5 \text{ "kinds" of booklets}\\ \text{with 3 concepts each}\end{array}\right) \times \left(\begin{array}{l}3 \text{ appearances}\\ \text{per concept}\\ \text{across kinds}\\ \text{of booklets}\end{array}\right)\right] = \begin{array}{l}30\\ \text{subjects}\\ \text{per}\\ \text{concept}\end{array}$$

The instructions for the exercise are given in Exhibit 1. Essentially, S's are told to mark a "B" for "Best imaginable" example of the concept <u>and</u> "W" for the "Worst imaginable" example of the concept on each scale.

ANALYSIS OF THE DATA

Scales for which the null hypothesis given below can be rejected will be judged to be evaluatively discriminative for a given concept.

H_o: The number of subjects who placed their response to the "best example of the concept" to the left of their response to the "worst example of the concept" is equal to the number of subjects who indicated the opposite direction of preference.

<u>Scoring</u> Looking at a set of responses to a scale-concept item, each subject who places "B" on the left of "W" but not in the same scale interval scores a "plus". Each subject who places both marks in the same cell scores zero and drops out of the sample. A subject who places a "W" on the left of "B" scores a minus.

The ratings (raw scores) will be entered on scoring tally sheets set up as shown in Exhibit 2 so that the ratings of all subjects on a given scale-concept item will appear in the same row.

<u>Analysis</u> The sign test will be used to determine the significance of the ratings across subjects on each scale-concept item. Actually, a null hypothesis of no difference between the number of "plus" and "minus" ratings will be tested for each scale-concept item or row on the scoring tally sheets.

A scale will be said to have an evaluative discrimination capacity for a concept if, and only if, the null hypothesis of the sign test is rejected at the 95% level of confidence. The statistic to be used in each case is the exact binominal probability of the entered data.

Since there will be about 50 subjects involved in this rating exercise and each subject will rate 3 of the 5 concepts on all scales, there will be a maximum of 30 ratings per scale-concept item. The effect of a "B" and a "W" in the same scale position is scored 0 and reduces the N for a given item. Therefore, in preforming the sign test, the number of "pluses" or "minuses" necessary for significance given the total "N" of "+" and "-" scores for a given item is as shown in Table 1.

TABLE 1

N of +'s AND -'s on an item	To be significant at .95 level of confidence EITHER +'s OR -'s must ≤
* 5-8	0
9-11	1
12-14	2
15-16	3
17-19	4
20-22	5
23-24	6
25	7

*Based on two-tailed binomial probabilities given by Helen W. Walker and Joseph Lev, Statistical Inference (New York: Holt, Rinehart and Winston, 1953), p. 458.

Rejection of the null hypothesis will be shown on the scoring tally sheets by entering a "+" if there are significantly more "pluses" tallied or by entering a "-" if there are significantly more "minuses" tallied. No entry in the last column will mean that the null hypothesis could not be rejected and that therefore the given scale does not exhibit evaluative discrimination for that concept.

The results of all the sign tests will then be entered in the matrix shown in Exhibit 3. A "+" will indicate that the subjects showed a preference for the adjective on the left and a "-" will indicate subjects' preference for the adjective on the right. Thus, when this matrix is completed, it will show which scales evaluate on a given concept and the polarity of each such scale.

The scales for the criterion instrument for use in the experiment can then be selected from this matrix on the basis of their evaluative discriminability. The decision rules which are contemplated are:

1. A scale must discriminate on at least 4 concepts to be considered for use.
2. Every concept must be discriminated by at least 4 scales.

A Survey of Judgment Criteria

This study is part of a larger experiment concerned with a specific media design and presentation technique. This exercise is designed to find out what criteria people use for making judgments about a specific set of things--what kinds of questions would they want to ask about one of those things before they could decide whether it was a "better" or "worse" thing of its kind. For example, you probably don't care whether your friends are large or small, but that's the first question you would ask about a pay check. You may not care whether your automobile is red or green, but it makes a difference in apples. If we had a hundred years to spare, we might be able to answer this question by discussion, but this study is an attempt to get an answer more quickly than that.

On the following pages are scales with adjectives at each end that look like this:

left ___: ___: ___: ___: ___: ___: ___ right

The intervals on these scales may be interpreted as <u>extremely</u> left, <u>quite</u> left, <u>slightly</u> left, neither or both, <u>slightly</u> right, <u>quite</u> right, and <u>extremely</u> right. Of course you are to substitute whatever words occur at the left and right ends of the scales.

At the top of each page is a concept, such as DOG. What you are to do is to think of the <u>best imaginable</u> and the <u>worst imaginable</u> examples of the class of things named by that concept (in this case, the <u>best imaginable</u> DOG and the <u>worst imaginable</u> DOG) and indicate where <u>you think</u> the best and the worst examples fall on each of the scales on that page. For example, if you happen to like large DOGS, and you don't care much for small DOGS, you might indicate that the <u>best imaginable</u> DOG is <u>extremely large</u> and the <u>worst imaginable</u> DOG is <u>quite small</u>. Of course, your best DOG may be "gentle" and your worst DOG "mean," but you will have an opportunity to indicate that on another scale.

Indicate your feeling for the "best" example by marking a "B" on the scale in the appropriate place. Indicate "worst" by marking a "W" in the appropriate place. Your responses might look like this:

DOG

large _B_: ___: ___: ___: ___: ___: ___ small

mean _W_: ___: ___: ___: ___: ___: ___ gentle

green ___: ___: ___: BW_: ___: ___: ___ red

The latter mark indicates that you don't really care whether a DOG is green or red or that this scale just doesn't apply to DOGS. With concepts such as ELEPHANT, MONSTER, or RUBY you might feel that one of the extreme positions on the scale describes all the members of the class, in which case you should mark "BW" in the extreme position. Just make sure that you have two marks on every scale.

You will find two different sheets of scales for each concept, or stated the other way, you will find each concept on two different sheets of scales.

(Concept)

subjective ____:____:____:____:____:____:____ objective

bright ____:____:____:____:____:____:____ dark

worthless ____:____:____:____:____:____:____ valuable

healthy ____:____:____:____:____:____:____ sick

poor ____:____:____:____:____:____:____ rich

positive ____:____:____:____:____:____:____ negative

light ____:____:____:____:____:____:____ heavy

fair ____:____:____:____:____:____:____ unfair

sad ____:____:____:____:____:____:____ happy

reputable ____:____:____:____:____:____:____ disreputable

old ____:____:____:____:____:____:____ new

hard ____:____:____:____:____:____:____ soft

ugly ____:____:____:____:____:____:____ beautiful

clear ____:____:____:____:____:____:____ hazy

simple ____:____:____:____:____:____:____ complex

interesting ____:____:____:____:____:____:____ boring

intuitive ____:____:____:____:____:____:____ rational

sharp ____:____:____:____:____:____:____ blunt

untimely ____:____:____:____:____:____:____ timely

sacred ____:____:____:____:____:____:____ profane

(Concept)

awful	____:____:____:____:____:____:____	nice
loud	____:____:____:____:____:____:____	soft
delicate	____:____:____:____:____:____:____	rugged
good	____:____:____:____:____:____:____	bad
cold	____:____:____:____:____:____:____	hot
constrained	____:____:____:____:____:____:____	free
shallow	____:____:____:____:____:____:____	deep
fast	____:____:____:____:____:____:____	slow
usual	____:____:____:____:____:____:____	unusual
active	____:____:____:____:____:____:____	passive
defensive	____:____:____:____:____:____:____	aggressive
important	____:____:____:____:____:____:____	unimportant
changeable	____:____:____:____:____:____:____	stable
pleasant	____:____:____:____:____:____:____	unpleasant
low	____:____:____:____:____:____:____	high
serious	____:____:____:____:____:____:____	humorous
dirty	____:____:____:____:____:____:____	clean
true	____:____:____:____:____:____:____	false
small	____:____:____:____:____:____:____	large
strong	____:____:____:____:____:____:____	weak

Questionnaire

The information requested below will be helpful in analyzing and using the results of this survey. Thank you for supplying the information and for your cooperation with the survey.

Please indicate your Sex: ____Male ____Female

and your Age: ____years.

Please indicate with an X on the appropriate line whether or not you are currently enrolled (Winter term, 1970) in the following courses:

ED 431	Educ. Media in Instruction (Mr. Bruce Miles, Instructor)	___Yes	___No
Ed 831-A	Educ. Media in Instruction (Dr. James Page, Instructor)	___Yes	___No
ED 831-B	Educ. Graphics in Instruc. (Mr. Don Wilkening, Instructor)	___Yes	___No
ED 821-A	Curriculum Construction (Dr. Charles Blackman, Instructor)	___Yes	___No

A G A I N -- T H A N K Y O U ! ! !

APPENDIX C

RANDOMIZATION PROCEDURES

RANDOMIZATION INSTRUCTIONS

1. Count number of men present. Count out that number of slips coded _Blue__ and place in container marked MEN. Write that number here _______.

2. Count number of women present. Count out that number of slips coded _Black__ and place in container marked WOMEN. Write that number here________.

3. Keep each stack of slips in order, both before and after depositing appropriate number in container.

4. Shake each container thoroughly before drawing starts and between draws. Let men draw only from "MEN" and women only from "WOMEN".

5. Read the following to the class:

    This evening, thanks to the cooperation of _______________________, you are asked to participate in a short experiment. Your assistance will be invaluable and in return it is hoped that you will find the experience interesting.

    For the experiment this class and _________ taught by ________________________ must be divided randomly into three equal groups. In a moment you will be asked to draw a slip to accomplish the randomization-- the men drawing from one container and the women from another.

6. After each class member has drawn (each container should be empty) read the following:

    All men should have a slip with a _Blue____ diagonal mark and all women should have a slip with a _Black_____ diagonal mark.

    Everyone's slip is also marked with the group he is to join and the room for that group. To avoid confusion, we will move to the appropriate rooms in three separate groups, beginning now with group 1.

7. Lead the group to room 106-B.

APPENDIX D

SEMANTIC DIFFERENTIAL

FOR EXPERIMENT

Group_______

Seat_______

INSTRUCTIONS

The purpose of this instrument is to measure the meanings of certain things to various people by having them judge them against a series of descriptive scales. (It has absolutely nothing to do with the grading in this course.)

Each page contains a concept at the top followed by twenty adjective pairs which are separated by a scale containing seven positions. You are to check at one of the positions along each scale to indicate where you rate the concept at the top.

Here is an illustration -

NICE ___:___:___:___:___:___:___ AWFUL

This rating scale is bounded by the words "NICE" and "AWFUL". The more "NICE" you feel the concept is, the farther to the left of the scale you would place your check; the more "AWFUL" you feel the concept is, the farther to the right you would place your check. If it is hard to decide if it is "NICE" or "AWFUL", or you feel the adjective pair is not relevant to the particular concept, place a check in the central space. This means "undecided" or "irrelevant". You are to rate the concept at the top of the page on all the scales on that page.

There are no right or wrong answers. The best response is what you feel is appropriate RIGHT NOW. Do not spend too much time on any one item. PUT DOWN YOUR FIRST IMPRESSION. Please be sure to place a check in one of the seven positions on each scale. Do not go back to pages you have already completed. When you finish a page, please continue to the next.

If you have any questions, please ask them of the monitor now. He will tell you when to begin making your ratings on the first page.

(Concept)

timely ____:____:____:____:____:____:____ untimely

dark ____:____:____:____:____:____:____ bright

fair ____:____:____:____:____:____:____ unfair

bad ____:____:____:____:____:____:____ good

beautiful ____:____:____:____:____:____:____ ugly

worthless ____:____:____:____:____:____:____ valuable

true ____:____:____:____:____:____:____ false

passive ____:____:____:____:____:____:____ active

nice ____:____:____:____:____:____:____ awful

negative ____:____:____:____:____:____:____ positive

reputable ____:____:____:____:____:____:____ disreputable

unimportant ____:____:____:____:____:____:____ important

interesting ____:____:____:____:____:____:____ boring

sick ____:____:____:____:____:____:____ healthy

clear ____:____:____:____:____:____:____ hazy

unpleasant ____:____:____:____:____:____:____ pleasant

strong ____:____:____:____:____:____:____ weak

sad ____:____:____:____:____:____:____ happy

deep ____:____:____:____:____:____:____ shallow

dirty ____:____:____:____:____:____:____ clean

QUESTIONNAIRE

The analysis of your responses will be much more meaningful if you will provide us with a little additional information. Therefore, please answer the following questions.

1. What is your age? ______

2. What is your sex? ______

3. What was your undergraduate major? ______________________

4. What, if any, is your graduate major? ____________________

5. Please indicate the number of courses (College level and above) which you have had in the following:

   Chemistry ________
   Biochemistry ________
   Other Sciences ________

6. Are you a teacher? _______ If yes, what grade or level? __________________

7. In a few words please state what you think the presentation you have seen this evening was originally created for. That is, what might its purpose have been <u>outside of</u> this experiment?

8. Before this evening, how many multi-image presentations had you seen? ________

9. Please write below any other comments about the experiment or presentation which you would care to make.

10. Please check below any of the entertainment films which you have seen:

    ________ The Thomas Crown Affair
    ________ The Boston Strangler
    ________ Charley

NOW--please turn your set of papers over. Do NOT go back and change any responses. Please remain seated until you receive further instructions.

THANK YOU FOR YOUR COOPERATION !!!

APPENDIX E

FACTOR LOADING MATRICES AND VARIMAX ROTATIONS FOR FIVE CONCEPTS

	1	2	3	4	5	6	7	8	9	10
1	0,6602	-0,3958	0,2583	0,1864	-0,1102	0,2578	0,0312	0,3562	0.0525	0,1395
2	0,6541	0,4553	0,1829	-0,1403	-0,2954	0,0894	-0,0286	-0,0189	0.1644	-0,1954
3	0,7518	0,0777	-0,1117	-0,3665	-0,2283	0,1341	-0,0046	-0,1505	-0.0418	0,3662
4	0,6907	-0,1809	0,0635	0,0327	0,1285	0,0931	0,0220	0,0192	-0.0605	-0,1554
5	0,7063	0,3883	0,1932	-0,1743	0,1447	0,1399	-0,1971	0,1565	-0.2007	-0,1349
6	0,7287	-0,4662	-0,0240	-0,0474	0,1090	0,0900	0,0239	-0,0427	-0.1726	-0,0592
7	0,6175	0,1221	-0,0236	-0,3794	-0,2161	-0,0616	-0,0753	0,0538	-0.1308	0,1556
8	0,7254	-0,4686	-0,0275	-0,0385	0,2628	-0,1639	0,0399	-0,0916	-0.1304	0,0547
9	0,7017	0,4514	-0,0013	-0,0182	0,1636	-0,2474	-0,0888	0,2103	0.0825	0,1406
10	0,7185	0,0706	-0,1491	0,0425	-0,1109	-0,5853	-0,1200	0,0368	-0.1233	-0,1171
11	0,4890	-0,4775	0,0368	0,3766	-0,3458	-0,0518	-0,4557	0,0408	0.1178	0,0193
12	0,7705	-0,4737	-0,0334	-0,1082	0,0933	0,0105	0,0232	-0,0575	-0.1678	-0,1129
13	0,7636	-0,0721	0,3639	0,1434	0,1214	0,0460	0,0532	-0,3359	0.1201	0,1481
14	0,6157	0,1867	0,0414	0,3091	-0,3817	-0,0201	0,5020	0,0958	-0.2338	-0,0506
15	0,7592	0,3062	0,3413	-0,0009	0,2168	0,1256	-0,0744	0,0781	0.0852	-0,0947
16	0,8543	0,1088	0,1423	0,1836	0,0050	-0,2095	0,1184	-0,2196	0.2285	0,0596
17	0,7754	-0,0698	-0,1698	-0,1630	0,1151	-0,0734	0,2278	0,0827	0.3536	-0,1154
18	0,6263	0,3582	-0,3797	0,1779	-0,0966	0,2738	-0,1506	-0,3233	-0.0729	-0,1770
19	0,5964	-0,2470	-0,6148	-0,0946	-0,0191	0,1522	0,0432	0,1445	0.2380	-0,0416
20	0,4735	0,4772	-0,3637	0,4487	0,2936	0,0946	-0,0256	0,0928	-0.1054	0,2248

TABLE 12.--Factor Loading Matrix for Concept SCIENTIST

	11	12	13	14	15	16	17	18	19	20
1	-0,1625	0,0010	0,0132	-0,1047	0,1116	-0,1472	-0,0588	-0,0180	±0.0363	-0,0258
2	-0,3074	0,0076	0,1568	0,0027	-0,0190	0,0889	0,0204	0,0275	0.0743	-0,0530
3	0,0078	-0,1658	-0,0076	0,0552	-0,0506	0,0397	-0,0589	0,0752	±0.0901	-0,0346
4	0,0373	0,0394	-0,0157	0,0865	0,1550	0,1984	-0,1914	0,0233	±0.0277	0,0516
5	0,1726	-0,1126	-0,0480	-0,2198	0,0199	0,0688	0,1057	-0,0252	±0.0382	-0,0386
6	0,0592	0,1434	-0,1291	0,0823	-0,0800	-0,0294	-0,0284	0,0396	0.0931	-0,1392
7	0,1190	0,1485	0,0462	0,0682	0,1058	-0,0535	0,0283	-0,1271	0.1003	0,0630
8	-0,2131	-0,0811	0,1111	-0,0942	-0,1405	0,0566	-0,0299	-0,1702	±0.0094	0,0105
9	-0,1947	0,0922	-0,2725	-0,0357	-0,0882	0,0249	-0,0249	0,0546	0.0239	0,0500
10	0,0489	0,0093	0,1419	-0,0568	0,0414	-0,1028	-0,0810	0,0828	±0.0482	-0,0357
11	0,1095	-0,1078	-0,0412	0,0556	-0,0798	0,0764	0,0391	-0,0176	0.0299	0,0229
12	-0,1798	-0,0832	-0,0205	0,0989	0,0715	-0,0469	0,2004	0,1163	±0.0149	0,0694
13	0,1264	0,0896	0,0869	-0,1999	-0,0170	-0,0214	-0,0054	0,1038	0.0637	0,0507
14	0,0870	-0,0147	-0,0393	-0,0105	-0,1081	0,0359	0,0266	-0,0076	±0.0057	0,0337
15	0,1861	0,0594	0,1117	0,2248	-0,1605	-0,1080	-0,0106	-0,0180	±0.0769	0,0287
16	0,0036	0,0823	-0,1027	0,0626	0,1345	0,0355	0,1157	-0,0998	±0.0862	-0,0690
17	0,1411	-0,2978	-0,0476	0,0067	0,0164	-0,0650	-0,0336	-0,0173	0.0778	0,0034
18	-0,0899	-0,0171	-0,1205	-0,0576	0,0086	-0,1389	-0,0723	-0,0588	±0.0154	0,0291
19	0,0719	0,2322	0,0858	-0,1008	-0,0625	0,0537	0,0651	0,0220	±0.0592	0,0124
20	-0,0077	-0,0776	0,1501	0,0871	0,0623	0,0347	0,0444	0,0199	0.0632	-0,0294

TABLE 12(cont'd.)

	1	2	3	4	5	6	7	8	9	10
1	0,5955	-0.2938	-0,4541	-0,2624	-0,0689	0,0082	-0,2872	-0,0269	-0.1381	-0,2263
2	0,5602	0.3712	-0,1100	-0,4104	-0,3503	-0,2004	0,2624	-0,1210	0.2733	0,0221
3	0,6552	0.0451	-0,3814	0,4495	-0,1737	-0,1257	0,0454	0,0896	-0.3137	0,0523
4	0,8465	-0.3069	-0,0410	-0,0812	0,0031	-0,1042	0,0759	-0,0602	-0.0465	0,0731
5	0,6177	0.1414	0,1727	0,2463	0,0048	-0,6094	-0,2040	-0,0590	0.0639	0,0766
6	0,7584	-0.4686	0,0419	-0,0435	-0,0290	-0,1037	-0,0541	-0,2422	0.1206	0,1076
7	0,7443	0.0534	-0,1234	0,5170	0,0349	-0,0326	0,1923	0,0641	0.0654	0,0969
8	0,6769	-0.2507	0,0745	-0,2123	0,1200	0,2103	0,3086	-0,0680	-0.3674	0,1482
9	0,7540	0.2672	0,4030	-0,1218	0,0156	-0,0690	0,0898	-0,0735	-0.0247	-0,2019
10	0,7659	0.1034	0,3050	0,2142	-0,0240	0,1872	0,2749	0,1509	0.0630	-0,1109
11	0,6809	-0.1721	0,0467	-0,0861	-0,2487	0,3231	-0,2104	0,2547	0.2877	0,2079
12	0,7823	-0.4173	0,1600	0,0543	0,0257	0,0623	-0,1264	-0,1183	0.0332	0,2288
13	0,7724	-0.3717	-0,0808	-0,0954	0,0138	-0,1139	0,2318	-0,0162	0.0777	-0,2769
14	0,4644	0.5448	-0,3279	0,0358	-0,1381	0,2762	-0,0589	-0,4914	-0.0327	0,0526
15	0,7409	0.0028	0,0952	-0,0672	-0,3950	-0,0047	-0,2030	0,2495	-0.1879	-0,1734
16	0,6509	0.2037	0,5828	0,0578	0,0432	0,1702	-0,2413	-0,1592	-0.1328	-0,0658
17	0,8130	0.0956	-0,2737	0,0869	0,1582	0,1928	0,0155	0,1775	0.2152	-0,0586
18	0,6436	0.6265	-0,1134	0,0892	0,1934	0,0905	-0,1221	0,0643	0.0236	-0,0350
19	0,6523	-0.0536	-0,1517	-0,1162	0,6177	-0,0337	-0,1137	-0,0045	0.1048	-0,0811
20	0,4738	0.4479	-0,0296	-0,5017	0,1521	-0,1816	0,0125	0,2752	-0.1837	0,2660

TABLE 13.--Factor Loading Matrix for Concept LABORATORY

	11	12	13	14	15	16	17	18	19	20
1	0,1553	-0,2669	0,0823	0,1066	0,0804	-0,0472	0,0452	-0,0054	0.0377	-0,0082
2	-0,0706	0,0781	0,0203	0,0902	0,1439	0,0348	0,0320	-0,0034	0.0186	-0,0590
3	-0,0718	0,0610	-0,1302	0,1107	0,0731	-0,0057	-0,0576	0,0586	-0.1142	-0,0279
4	-0,0229	0,1187	0,2193	0,1562	-0,1721	-0,0567	-0,0760	-0,1629	-0.0297	-0,0066
5	-0,1411	-0,1888	0,0829	0,0084	-0,0911	0,0641	0,0096	0,0697	0.0521	0,0101
6	0,1122	0,0430	0,0850	-0,1830	0,1671	0,0381	-0,0767	0,0105	-0.0793	0,0746
7	0,1930	-0,0847	-0,1182	-0,0869	0,0673	0,0110	0,0296	-0,1457	0.1045	-0,0088
8	-0,2582	-0,1616	0,0624	-0,0812	0,0375	0,0658	0,0222	0,0200	0.0542	-0,0052
9	-0,0531	-0,1492	-0,1742	-0,0682	0,0081	-0,2239	-0,1098	-0,0172	-0.0199	-0,0004
10	0,1453	-0,0098	0,1596	0,2230	0,0217	0,0040	0,0043	0,1070	0.0223	0,0680
11	-0,1513	-0,1786	-0,1679	0,0809	-0,0374	0,0411	-0,0253	-0,0317	-0.0316	0,0237
12	0,0543	0,1652	-0,0546	0,0160	-0,0171	-0,1770	0,1448	0,0916	0.0324	-0,0444
13	0,0333	0,0096	-0,1861	-0,0749	-0,1620	0,1003	0,1299	0,0109	-0.0704	0,0102
14	0,0445	0,0270	-0,0758	-0,0005	-0,1391	0,0234	-0,0370	0,0375	0.0417	0,0416
15	-0,0733	0,2788	0,0049	-0,1339	-0,0011	0,0261	-0,0215	-0,0098	0.0975	0,0286
16	0,1277	0,0003	0,0022	0,0466	0,0362	0,1584	0,0098	-0,0452	-0.0501	-0,0770
17	0,0264	-0,0202	0,1875	-0,1959	-0,0701	0,0006	-0,0983	0,0870	-0.0083	-0,0827
18	-0,1730	0,0255	0,1491	-0,0674	0,0586	-0,0615	0,1688	-0,0701	-0.0792	0,0426
19	-0,1203	0,1768	-0,1619	0,1395	0,0781	0,0546	-0,0682	0,0062	0.0590	0,0127
20	0,2749	-0,0007	-0,0672	-0,0319	-0,0549	0,0156	-0,0026	0,0223	-0.0237	0,0192

TABLE 13 (cont'd.)

	1	2	3	4	5	6	7	8	9	10
1	0.7309	-0.1886	-0.1644	0.1324	0.1172	0.0319	-0.2305	0.1874	0.0604	0.2694
2	0.6360	0.1815	-0.3472	-0.3697	-0.2110	0.0240	-0.2856	-0.0628	-0.1819	0.1703
3	0.5716	0.4840	0.2825	-0.0599	0.2248	0.1322	0.2558	-0.2418	-0.0453	-0.2090
4	0.6422	-0.3280	0.1648	-0.0223	-0.1078	0.0750	-0.0937	0.0039	0.0182	-0.0402
5	0.6429	-0.3890	0.0207	-0.1663	-0.0809	0.4116	0.2138	0.1498	0.1938	-0.1416
6	0.6714	-0.0764	0.5118	0.1066	0.0738	-0.0700	-0.0454	0.2604	-0.3590	0.0377
7	0.6119	0.4478	0.1152	-0.0122	-0.4248	-0.2926	-0.0248	-0.2224	-0.0627	-0.0909
8	0.7445	-0.0984	-0.1693	-0.1992	0.4694	-0.1654	0.0215	-0.1640	0.1497	0.0195
9	0.8081	-0.0923	-0.0888	-0.1708	-0.1033	-0.0003	-0.2402	-0.1994	0.0719	-0.1394
10	0.6231	0.3553	0.5036	0.0962	0.1978	-0.0585	-0.0322	0.0300	-0.0119	0.0616
11	0.4149	-0.3772	0.2299	0.5111	-0.1825	0.1849	0.0441	-0.4434	0.0676	0.2977
12	0.7556	-0.4659	-0.1064	0.1249	0.1159	-0.0925	0.0045	0.0973	-0.2270	-0.0864
13	0.8316	-0.0431	0.1034	-0.2429	0.1982	0.0866	0.0040	0.0124	0.0694	0.0853
14	0.3527	0.5262	-0.0332	0.4431	0.0374	0.2208	-0.4523	0.1647	0.2723	-0.2207
15	0.7310	0.1795	0.2218	-0.2631	-0.1649	-0.2399	0.0318	0.1639	0.2299	0.1539
16	0.8180	-0.2338	-0.1840	-0.0322	-0.0808	0.1559	-0.0127	-0.1402	-0.1852	-0.2485
17	0.7457	0.0795	-0.1461	0.1264	-0.0949	-0.1992	0.2790	0.0571	0.2364	0.0375
18	0.4541	0.4213	-0.5150	0.2449	0.3062	-0.0180	0.0992	-0.1226	-0.1359	0.1148
19	0.6088	-0.1565	-0.2888	0.3665	-0.1556	-0.3185	0.2174	0.2021	0.0052	-0.1603
20	0.4500	0.5351	-0.1854	-0.0292	-0.2131	0.4110	0.2884	0.1982	-0.1225	0.1742

TABLE 14.--Factor Loading Matrix for Concept MICHIGAN STATE UNIVERSITY

	11	12	13	14	15	16	17	18	19	20
1	0,1563	0.3226	-0,1732	-0,0564	0,0226	-0,0683	0.1019	0,0306	0.0642	0,0171
2	0,0497	-0,1747	-0,2414	0,0147	-0,0865	-0,0199	-0,0906	-0,0215	-0.0530	-0,0529
3	0,1340	0.1626	-0,1780	-0,0669	0,0964	-0,1374	-0,0653	0,0350	-0.0364	-0,0522
4	-0,0318	-0,1300	-0,0356	0,1577	0,1872	-0,0756	0,0067	0,1452	-0.0774	0,1255
5	0,0742	0,0411	-0,0757	0,2465	-0,1177	0,0583	0,0544	-0,1004	-0.0260	-0,0310
6	0,1255	-0,0254	0,0437	0,0472	0,0625	0,0022	-0,0969	-0,1509	0.0377	0,0376
7	0,0471	0,1576	-0,0164	0,0315	0,0068	0,1578	0,1525	-0,0555	-0.0411	0,0452
8	-0,0941	0,0410	0,0107	-0,0940	-0,1348	0,0452	-0,0669	-0,0854	-0.0629	0,1205
9	-0,2562	0,0275	0,1525	0,0298	0,0866	-0,2197	0,0287	-0,0976	0.0862	-0,0358
10	-0,2236	-0,1624	-0,0914	0,0767	-0,2432	-0,0317	0,1139	0,0720	0.0510	-0,0193
11	-0,0267	-0,0028	0,0190	-0,0316	-0,0380	0,0293	-0,0776	-0,0264	-0.0210	-0,0269
12	0,0148	-0,0056	0,1567	-0,1477	-0,0544	-0,0445	0,1166	0,0262	-0.1436	-0,0903
13	-0,1467	-0,0769	-0,0072	-0,1061	0,2442	0,2681	0,0236	0,0184	0.0400	-0,0713
14	0,0554	-0,0502	0,0440	-0,0651	-0,0042	0,0606	-0,0534	-0,0219	-0.0502	-0,0043
15	0,1084	0,1302	0,2418	0,0690	-0,0736	-0,0113	-0,1347	0,0877	-0.0198	-0,0515
16	0,1650	-0,0004	0,0845	-0,0986	-0,1525	0,0979	-0,0515	0,1109	0.1313	0,0357
17	0,2780	-0,3062	-0,0273	-0,1460	0,0480	-0,0924	0,0654	-0,0491	0.0484	0,0095
18	0,0835	-0,0264	0,1422	0,3275	0,0606	0,0259	0,0179	0,0131	0.0136	-0,0186
19	-0,2996	0,0701	-0,1876	0,0383	0,0117	0,0292	-0,1196	0,0145	0.0166	-0,0235
20	-0,2180	0,0406	0,1147	-0,1578	-0,0115	-0,0448	0,0100	-0,0054	-0.0199	0,0621

TABLE 14 (cont'd.)

	1	2	3	4	5	6	7	8	9	10
1	0,4852	0,2790	-0,1275	-0,5805	0,1058	0,2227	-0,3479	-0,1570	-0.1468	0,2235
2	0,7857	-0,2313	-0,0052	-0,0521	-0,0192	0,1864	0,2069	-0,3052	-0.0196	-0,2090
3	0,6964	-0,1133	-0,3228	-0,1657	-0,2456	0,1723	0,0387	-0,2987	0.1940	0,0905
4	0,8033	0,1818	0,0885	-0,0267	-0,1845	-0,1951	-0,0922	0,1203	0.1187	0,1527
5	0,7410	-0,3504	-0,0009	0,1436	0,1720	-0,0839	-0,3611	-0,0068	0.1377	-0,1452
6	0,6605	0,3855	0,0830	-0,2686	-0,1472	-0,3255	0,0919	-0,1605	-0.0565	-0,1307
7	0,7310	0,0130	-0,2491	0,4049	-0,1086	0,1075	0,1778	0,0149	-0.0032	0,1143
8	0,6516	0,2744	0,3515	0,1382	-0,1360	-0,2126	0,0226	-0,3250	0.0652	0,0579
9	0,7437	-0,3005	0,3042	-0,1094	-0,1374	-0,0973	-0,2543	0,0854	-0.2394	-0,1098
10	0,8270	0,0975	-0,1321	0,2729	-0,1950	-0,0707	0,0978	0,1282	0.0871	0,1707
11	0,4973	0,2609	-0,5940	-0,3345	-0,0469	-0,1881	-0,0195	0,3283	0.1729	-0,0856
12	0,6504	0,5731	0,0238	0,0744	0,1863	-0,1919	0,0822	0,0862	-0.1815	-0,1737
13	0,6487	0,3791	0,3432	-0,0093	0,4809	0,0715	0,1629	-0,0114	0.1239	0,1094
14	0,5746	-0,3804	-0,3502	-0,1623	0,2130	-0,0947	0,3389	0,0065	-0.3616	0,0527
15	0,6613	0,1420	0,2090	-0,0003	-0,3396	0,4309	0,0261	0,2185	-0.0935	-0,2650
16	0,6590	-0,1899	0,5145	-0,2475	0,0731	0,0942	0,1475	0,2604	0.1294	0,1408
17	0,7789	0,0456	-0,1585	0,0574	0,2907	0,3053	-0,0249	0,0520	0.1290	-0,0842
18	0,5740	-0,6684	0,0894	0,0749	-0,0767	-0,0542	-0,0329	0,0959	-0.1675	0,2469
19	0,6499	0,1584	-0,2093	0,5099	0,1697	0,0041	-0,3017	-0,0583	-0.1284	0,0094
20	0,3438	-0,7792	-0,0086	-0,1198	0,1539	-0,2162	0,0178	-0,0517	0.2268	-0,1751

TABLE 15.--Factor Loading Matrix for Concept BIOCHEMISTRY

	11	12	13	14	15	16	17	18	19	20
1	0,1589	0.0652	-0,0357	0,0633	0,1116	0,0386	-0,0068	0,0182	-0.0140	-0,0539
2	0,1598	0.1080	-0,1117	-0,1598	0,0993	0,0519	0,0980	-0,1149	-0.0201	0,0794
3	-0,2322	0,0011	-0,0011	0,0933	-0,2100	-0,0818	0,0421	0,0090	-0.0546	-0,0066
4	0,0868	0,0679	-0,2663	-0,2600	-0,0916	-0,1219	-0,0322	0,0523	0.0535	-0,0072
5	-0,0617	-0,0291	-0,0555	0,0078	-0,1642	0,2288	-0,0660	-0,0956	0.0306	-0,0523
6	-0,3022	0,0640	0,0879	-0,0427	0,1591	0,0852	-0,0900	0,0158	0.0869	-0,0226
7	0,1566	0.3093	0,0666	0,1347	-0,0036	0,0394	-0,1562	0,0317	0.0311	0,0239
8	0,2715	-0.2656	0,1448	0,0649	-0,0257	-0,0667	-0,0593	-0,0366	-0.0242	0,0064
9	0,0145	0,0379	0,1474	0,0303	-0,1162	0,0101	0,0791	0,1316	-0.0154	0,1199
10	0,0196	-0.0910	0,0200	-0,0078	0,1146	0,1955	0,1860	0,0863	-0.0407	-0,0592
11	0,0933	-0,0919	0,0460	0,0807	0,0341	-0,0254	0,0017	-0,0909	-0.0008	0,1045
12	0,0287	0.1713	0,0071	0,0743	-0,1128	-0,1101	0,1030	-0,0752	-0.0677	-0,1098
13	-0,0843	-0.0380	-0,1439	0.1585	-0,0331	0,0269	0,0558	0,0412	0.0970	0,0844
14	0,0217	-0.1994	-0,0692	-0,0583	-0,1092	0,0466	-0,0813	0,0589	-0.0216	-0,0145
15	-0,0034	-0,1662	-0,1440	0,1156	0,0347	-0,0306	-0,0512	0,0160	0.0399	-0,0452
16	-0,0966	0.0486	0,0772	-0,0578	0,0363	0,0285	-0,0935	-0,0652	-0.1649	0,0017
17	0,0090	-0.0510	0,3072	-0,2017	0,0008	-0,0948	0,0085	0,0578	0.0750	-0,0408
18	-0,0835	-0.0143	0,0537	0,0643	0,0730	-0,1127	0,0674	-0,1625	0.1228	-0,0217
19	-0,1987	-0,0830	-0,0960	-0,0228	0,1649	-0,0931	-0,0526	0,0008	-0.1032	0,0597
20	0,0821	0.0424	-0,0836	0,1346	0,1564	-0,1202	-0,0021	0,1173	-0.0232	-0,0601

TABLE 15. (cont'd.)

	1	2	3	4	5	6	7	8	9	10
1	0,4379	0.0707	0,3316	-0,0423	0,0659	0,0858	-0,3057	-0,0344	0.0838	0,2519
2	0,5437	-0,0259	-0,5323	0,2590	0,2128	0,2305	-0,2797	0,2121	-0.0354	-0,2267
3	0,6684	-0,0066	-0,3638	-0,3085	0,1929	-0,1449	-0,0203	0,0584	-0.4015	0,1047
4	0,8400	0,0216	0,1369	-0,1781	0,2834	-0,0513	0,0438	0,1762	-0.0697	-0,0900
5	0,7762	-0,2349	0,1711	0,1613	-0,1318	-0,1295	-0,0742	-0,1707	0.0151	-0,0557
6	0,6285	0,4442	0,2584	-0,0592	0,0509	0,1591	0,0395	-0,3476	-0.1346	-0,2788
7	0,5455	0,0667	-0,5983	-0,0059	0,0073	-0,1797	-0,0595	-0,4003	0.1658	0,0388
8	0,6465	0,2562	0,1933	-0,1522	-0,0095	-0,3279	-0,4378	-0,1375	-0.0206	0,1254
9	0,8192	-0,2564	0,1086	0,1940	0,3114	0,0452	0,1248	-0,1013	0.0445	-0,0343
10	0,7808	0,1507	-0,0635	-0,0891	0,2715	-0,0233	0,1574	0,1090	0.4047	-0,1391
11	0,4060	0,2272	-0,3770	-0,5534	-0,2496	0,1994	0,2927	0,0100	0.1857	0,1668
12	0,5582	0,6446	-0,0455	-0,0219	-0,2766	0,0085	-0,1343	0,2054	-0.0340	-0,0631
13	0,7637	0,1902	0,3608	-0,0859	0,0350	-0,2226	0,1311	0,1968	-0.0910	0,1991
14	0,6161	-0,4272	0,0182	-0,2801	-0,2576	0,2444	0,1190	-0,1935	-0.2270	-0,1300
15	0,5529	0,1192	-0,2779	0,5527	0,1312	0,0783	0,1746	-0,0954	-0.1024	0,3876
16	0,6039	-0,3574	0,1880	-0,1319	0,2616	0,0022	0,1119	0,0784	0.0371	0,0064
17	0,7809	0,0182	-0,1585	0,1748	-0,2949	-0,0355	-0,1294	0,1243	0.0644	-0,1064
18	0,7260	-0,3175	0,2683	0,0752	-0,2713	-0,1831	-0,0777	-0,0123	0.2242	0,0811
19	0,5427	0,2891	0,1481	0,4293	-0,3136	0,0484	0,3465	0,0484	-0.1040	-0,0877
20	0,5674	-0,5399	-0,1922	0,0014	-0,3482	0,0558	-0,0955	0,1787	-0.0444	0,0359

TABLE 16.--Factor Loading Matrix for Concept EXPERIMENT

	11	12	13	14	15	16	17	18	19	20
1	0,0835	-0.1826	-0,0512	0,0620	-0,0061	0,0059	0,0358	0,0059	-0.0193	-0,0036
2	-0,0327	0.1602	-0,0798	-0,0604	-0,1859	-0,0141	0,0315	-0,0521	0.0410	0,0463
3	0,0547	-0,2359	-0,0582	0,0584	-0,0481	0,1125	0,0146	0,0337	0,0573	-0,0804
4	0,0395	-0,1573	0,0276	-0,1887	0,0843	-0,0812	-0,0600	-0,1330	-0.1300	-0,0011
5	-0,2782	-0,2517	-0,1167	-0,1595	0,1001	-0,0292	0,1196	-0,0016	0.0889	0,0446
6	0,0186	0.1731	-0,0290	-0,0237	0,0659	0,2294	-0,0405	-0,0294	0.0080	0,0084
7	0,2238	-0,1535	0,0380	0,0680	-0,0247	-0,0156	0,0235	0,0084	-0.0722	0,0784
8	0,0393	0,2594	-0,1187	0,0199	0,0249	-0,1824	-0,0326	-0,0164	0.0245	-0,0476
9	-0,0212	0,0933	-0,0189	-0,1279	-0,0741	-0,0402	-0,0178	0,2142	-0.0646	-0,0486
10	0,0423	0,0237	0,0722	0,1223	0,0938	-0,0019	0,1402	-0,0327	0.0549	-0,0817
11	-0,1478	0,0992	-0,1692	-0,1387	-0,0428	-0,0156	-0,0550	0,0043	0.0173	0,0064
12	0,0418	-0,0866	0,3022	-0,0979	0,0371	-0,0427	-0,0246	0,1083	0.0434	0,0284
13	-0,0613	0.1381	-0,0170	0,0890	-0,1113	0,0798	0,1610	0,0119	-0.0601	0,0944
14	-0,0659	0,0983	0,2205	0,0935	-0,0777	-0,1598	0,0698	-0,0409	-0.0100	-0,0186
15	-0,1303	0.1322	0,1491	-0,0294	0,0928	0,0071	-0,0330	-0,0747	0.0223	-0,0205
16	0,0536	-0.0009	0,0142	0,1463	0,0590	-0,0397	-0,1861	0,0204	0.1023	0,0986
17	-0,3354	-0.0710	-0,0665	0,2249	0,0477	0,0538	-0,1000	0,0207	-0.0961	-0,0298
18	0,0946	-0,0471	0,1166	-0,0916	-0,2351	0,1496	-0,0751	-0,0707	0.0276	-0,0459
19	0,2727	-0,0970	-0,2085	0,0566	-0,0616	-0,1286	-0,0098	-0,0186	0.0196	-0,0195
20	0,2699	0,1890	-0,0483	-0,0618	0,2296	0,0982	0,0520	0,0267	-0.0205	0,0034

TABLE 16 (cont'd.)

OTATED FACTOR LOADINGS.

	1	2	3	4	5	6	h^2
1	0.6259 timely-untimely	0.2521	-0.0376	0.0139	-0.4533	0.1367	.7724
2	0.0754	0.8077 bright-dark	-0.1956	0.1128	-0.2724	-0.1339	.7967
3	0.3148	0.5866 fair-unfair	-0.5566	0.0060	-0.1300	-0.1347	.7881
4	0.7183 good-bad	0.4197	-0.1742	0.2267	-0.1837	-0.1419	.8568
5	0.2567	0.7766 beautiful-ugly	-0.0779	0.2581	0.0554	-0.0892	.7579
6	0.8565 valuable-worthless	0.1932	-0.2791	0.0612	-0.1569	-0.1055	.8781
7	0.3193	0.6529 true-false	-0.4602	-0.0407	-0.1255	-0.3233	.8619
8	0.8426 active-passive	0.0884	-0.1460	0.0576	-0.0189	-0.3194	.8439
9	0.1709	0.6024 nice-awful	-0.0491	0.3904	0.0269	-0.4856	.7844
10	0.2444	0.2751	-0.1862	0.1529	-0.2411	-0.7920 positive-negative	.9000
11	0.5916	-0.0857	-0.0869	-0.0163	-0.6701 reputable-disreputable	-0.1293	.7326
12	0.8226 important-unimportant	0.1774	-0.2937	-0.0038	-0.1236	-0.1735	.8398
13	0.6248 interesting-boring	0.5000	0.1492	0.1598	-0.2418	-0.1071	.7582
14	0.1236	0.4001	-0.1121	0.2540	-0.6004 healthy-sick	-0.2107	.6573
15	0.4051	0.7579 clear-hazy	0.1159	0.3009	-0.0334	-0.0781	.8497
16	0.4510	0.4980 pleasant-unpleasant	0.0179	0.2790	-0.3090	-0.4251	.8058
17	0.5354 strong-weak	0.3528	-0.3591	0.1904	-0.0012	-0.3222	.6804
18	0.0853	0.3831	-0.4365	0.6117 happy-sad	-0.2467	-0.0327	.7807
19	0.4513	-0.0216	-0.7201 deep-shallow	0.2923	-0.0729	-0.1174	.8273
20	0.0503	0.2134	-0.0735	0.8946 clean-dirty	-0.0506	-0.1559	.8807
FACTOR	I	III		II			
% V_T	25.22	21.69	8.60	9.35	7.41	7.99	.8026
% V_C	31.42	27.02	10.71	11.65	9.23	9.95	.9998

TABLE 17.--Varimax Rotation for Concept SCIENTIST

	1	2	3	4	5	h^2
1	0,7157 timely-untimely	0.2995	-0,2268	0,2236	0,1313	.7207
2	0,2779	0.7861 bright-dark	0,1741	0,1246	-0,1198	.7548
3	0,3511	0.1086	0,0798	0,8164 fair-unfair	-0,0321	.8089
4	0,7277 good-bad	0.1501	0,2641	0,2536	0,1617	.8190
5	0,2356	0.1053	0,5126 beautiful-ugly	0,3952	0,0810	.4921
6	0,8362 valuable-worthless	-0.0161	0,2556	0,1661	0,0818	.7992
7	0,3367	-0.0101	0,3569	0,7622 true-false	0,1371	.8405
8	0,6533 active-passive	0.2519	0,2748	0,0337	0,2440	.5861
9	0,3592	0.3977	0,7289 nice-awful	0,1095	0,1424	.8174
10	0,3593	0.1267	0,6735 positive-negative	0.3601	0,0636	.7368
11	0,6198 reputable-disreputable	0.2243	0,2839	0,1920	-0,1128	.5647
12	0,7743 important-unimportant	-0.0768	0,3980	0,1971	0,1123	.8152
13	0,7786 interesting-boring	0,0996	0,1778	0,2138	0,1595	.7505
14	-0,0236	0.5900 healthy-sick	0,0878	0,5302	0,0535	.6404
15	0,5492 clear-hazy	0,3684	0,3951	0,2642	-0,2352	.7185
16	0,2182	0.1643	0,8480 pleasant-unpleasant	0,0889	0,0916	.8101
17	0,4604	0.3063	0,1988	0,5554 strong-weak	0,3518	.7776
18	-0,0362	0,5360 happy-sad	0,3919	0,5326	0,3730	.8649
19	0,4433	0.1419	0,1699	0,2076	0,7556 deep-shallow	.8595
20	0,1185	0,7167 clean-dirty	0,2221	-0,0442	0,3491	.7008
% V_T	26.32	12.21	15.49	14.13	6.24	.7439
% V_C	35.38	16.41	20.82	18.99	8.39	.9999
FACTOR	I	II	A	III		

TABLE 18.--Varimax Rotation for Concept LABORATORY

	1	2	3	4	h^2	Scale
1	0.6435	0.2834	0.1463	0.2740	.6440	timely-untimely
2	0.6166	0.3569	0.2157	-0.3749	.6947	bright-dark
3	0.1589	0.2856	0.7316	-0.0474	.6443	fair-unfair
4	0.7764	-0.0309	0.3708	0.3215	.8446	good-bad
5	0.7311	-0.1108	0.1603	0.1421	.5928	beautiful-ugly
6	0.3702	-0.0812	0.6363	0.4077	.7300	valuable-worthless
7	0.2394	0.3954	0.6109	-0.0386	.5883	true-false
8	0.7550	0.1938	0.2294	-0.0431	.6322	active-passive
9	0.7515	0.1835	0.3163	0.0157	.6986	nice-awful
10	0.1533	0.1636	0.8251	0.2148	.7773	positive-negative
11	0.2896	-0.0042	0.1077	0.7301	.6286	reputable-disr.
12	0.8047	0.0807	0.0504	0.3978	.8149	important-unimportant
13	0.7151	0.0769	0.4958	0.0011	.7631	interesting-boring
14	-0.0745	0.6441	0.3577	0.2167	.5987	healthy-sick
15	0.5045	0.1005	0.6426	-0.0859	.6850	clear-hazy
16	0.8036	0.2143	0.1604	0.1583	.7425	pleasant-unpleasant
17	0.5493	0.4300	0.2922	0.1667	.5998	strong-weak
18	0.2253	0.8088	0.0473	-0.0420	.7089	happy-sad
19	0.5220	0.4316	-0.0258	0.3917	.6128	deep-shallow
20	0.1587	0.5638	0.3680	-0.2135	.5240	
% V_T	30.75	11.95	17.14	7.78	.6762	
% V_C	45.47	17.67	25.35	11.50	.9999	
FACTOR	I	II	III			

TABLE 19.--Varimax Rotation for Concept MICHIGAN STATE UNIVERSITY

	1	2	3	4	5	6	h^2
1	0,1516	-0,0175	-0,6594 timely-untimely	-0,4058	-0,0749	0,3144	.7273
2	0,1762	-0,5312 bright-dark	-0,2434	-0,2047	0,3398	0,4229	.7087
3	0,1517	-0,3501	-0,5242 fair-unfair	0,0661	0,3356	0,4333	.7194
4	0,6451 good-bad	-0,2538	-0,2644	-0,1140	0,3232	0,2547	.7591
5	0,2028	-0,6673 beautiful-ugly	-0,0875	-0,2036	0,4311	0,0878	.7291
6	0,7522 valuable-worthless	-0,0722	-0,4163	-0,1577	0,0878	0,1210	.7915
7	0,2072	-0,2355	-0,1605	-0,0014	0,7680 true-false	0,2643	.7838
8	0,7284 active-passive	-0,1180	0,0472	-0,1970	0,2783	0,2081	.7063
9	0,4587	-0,6426 nice-awful	-0,0468	-0,1227	0,0994	0,3546	.7763
10	0,4710	-0,2588	-0,2162	0,0030	0,6517 positive-negative	0,2611	.8284
11	0,2326	-0,0310	-0,8716 reputable-disreputable	0,0412	0,2377	-0,0551	.8078
12	0,6098 important-unimportant	0,1158	-0,2776	-0,4273	0,4285	-0,0270	.8292
13	0,4012	-0,0473	-0,0524	-0,7963 interesting-boring	0,2451	0,0910	.8684
14	-0,0272	-0,6254 healthy-sick	-0,4537	-0,1006	0,2614	-0,0455	.6783
15	0,3076	-0,0821	-0,0940	-0,1569	0,2801	0,7674 clear-hazy	.8022
16	0,3791	-0,5309 pleasant-unpleasant	0,0201	-0,4449	-0,0783	0,4249	.8106
17	0,0367	-0,2873	-0,3331	-0,4806	0,5536 strong-weak	0,2852	.8156
18	0,0986	-0,8412 happy-sad	0,0477	0,0664	0,2151	0,2274	.8220
19	0,2184	-0,1234	-0,0754	-0,2035	0,8135 deep-shallow	0,0090	.7800
20	-0,0637	-0,8998 clean-dirty	-0,0454	0,0307	-0,0179	-0,0859	.8244
% V_T	15.08	18.90	11.02	8.36	15.55	8.92	.7783
% V_C	19.37	24.28	14.16	10.74	19.98	11.46	.9999
FACTOR	I	II			III		

TABLE 20.--Varimax Rotation for Concept BIOCHEMISTRY

	1	2	3	4	5	6	h^2
1	0,1399	0.1727	-0,0587	0,0611	0,1921	0,8324 timely-untimely	.7863
2	0,1470	0,0287	-0,2004	0,8051 bright-dark	0,1316	0,1305	.7451
3	0,1924	-0,0157	-0,5035	0,3698	0,5432 fair-unfair	-0,0995	.7325
4	0,2401	0,1553	-0,1782	0,2221	0,7973 good-bad	0,2026	.8395
5	0,6145 beautiful-ugly	0,3065	0,0837	0,2129	0,4707	0,0404	.7472
6	-0,0267	0,5162 valuable-worthless	-0,1674	0,0814	0,4887	0,3859	.6905
7	0,1305	0,1458	-0,4418	0,5809 true-false	0,2355	-0,2694	.7146
8	0,1317	0,4372	-0,1690	-0,0163	0,6376 active-passive	-0,0888	.6518
9	0,4216	0,0577	0,1426	0,4593	0,6431 nice-awful	0,2434	.8853
10	0,1178	0,2093	-0,2473	0,3785	0,6591 positive-negative	0,1482	.7185
11	0,1303	0,1515	-0,8370 reputable-disreputable	0,0572	0,0880	0,1239	.7669
12	-0,0522	0,7575 important-unimportant	-0,3892	0,1427	0,2212	0,0946	.8062
13	0,2241	0,4598	-0,0460	-0,0134	0,7324 interesting-boring	0,0856	.8079
14	0,7279 healthy-sick	-0,0280	-0,3179	0,0349	0,2289	0,2857	.7670
15	0,1985	0,3336	0,1154	0,7481 clear-hazy	0,1583	0,0691	.7259
16	0,5180	-0,0748	-0,0272	0,2033	0,7317 pleasant-unpleasant	0,2325	.8951
17	0,5049 strong-weak	0,4866	-0,1985	0,3995	0,2518	0,0010	.7541
18	0,7238 happy-sad	0,3034	0,0822	0,0302	0,4347	-0,0033	.8127
19	0,2433	0,7296 deep-shallow	0,1160	0,2570	0,1166	0,1499	.7071
20	0,8227 clean-dirty	-0,0038	-0,1805	0,2464	0,0671	-0,0024	.7747
% V_T	15.70	12.31	8.65	12.48	21.16	6.34	.7664
% V_C	20.48	16.06	11.29	16.28	27.61	8,27	.9999
FACTOR	II	B		III	I		

TABLE 21.--Varimax Rotation for Concept EXPERIMENT

APPENDIX F

ANALYSES OF VARIANCE LAYOUTS FOR MAIN TREATMENT EFFECT

ANALYSES OF VARIANCE HOLLMANN

CURRENT TIME 1613 - 18 DATE 06/19/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(120) SCIENCE
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	162.46724581	2	81.23362290	1.87495	0.161
WITHIN CATEGORIES	2946.15247464	68	43.32577169		
TOTAL	3108.61972046	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2286	0.0523

TABLE 22.--ANOVA For SCIENTIST Across Groups on Factor I.

CURRENT TIME 1613 - 19 DATE 06/18/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	106.31432831	2	53.15716416	0.72628	0.487
WITHIN CATEGORIES	4977.00961578	68	73.19131788		
TOTAL	5083.32394409	70			

MULTIPLE CORRELATION COEFFICIENT
R SQUARED (R2) = ETA
0.1446 0.0209

TABLE 23.--ANOVA For LABORATORY Across Groups on Factor I.

A N A L Y S I S   O F   V A R I A N C E   T A B L E   (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(122) MSU
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
ETWEEN CATEGORIES	657.00433376	2	328.50216688	3.39609	0.039
ITHIN CATEGORIES	6577.61538672	68	96.72963804		
OTAL	7234.61972046	70			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.3014	0.0908

TABLE 24.--ANOVA For MICHIGAN STATE UNIVERSITY Across Groups on Factor I.

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(123) BIOCHEM
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
ETWEEN CATEGORIES	89.17572745	2	44.58786373	1.96049	0.149
ITHIN CATEGORIES	1546.54253195	68	22.74327326		
OTAL	1635.71833940	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2335	0.0545

TABLE 25.--ANOVA For BIOCHEMISTRY Across Groups on Factor I

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	254.55384225	2	127.27692113	2.48400	0.091
WITHIN CATEGORIES	3484.23489028	68	51.23874839		
TOTAL	3738.78873253	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2609	0.0681

TABLE 26.--ANOVA For EXPERIMENT Across Groups on Factor I.

CURRENT TIME 0240 - 55 DATE 06/22/70
ELAPSED SINCE LAST CURRENT TIME 0.10 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	58.32752928	2	29.16376464	1.82816	0.169
WITHIN CATEGORIES	1084.77106252	68	15.95251563		
TOTAL	1143.09859180	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2259	0.0510

TABLE 27.--ANOVA For LABORATORY Across Groups on Factor II.

CURRENT TIME 0240 - 55 DATE 06/22/70
ELAPSED SINCE LAST CURRENT TIME 0.10 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(122) MSU
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	128.31615334	2	64.15807667	5.38840	0.007
WITHIN CATEGORIES	809.65567750	68	11.90670114		
TOTAL	937.97183084	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.3699	0.1368

TABLE 28.--ANOVA For MICHIGAN STATE UNIVERSITY Across Groups on Factor II.

ROTATED FACTOR LOADINGS.

	1	2	3	4	5	6	h^2
1	0,1516	-0,0175	-0,6594 timely-untimely	-0,4058	-0,0749	0,3144	.7273
2	0,1762	-0,5312 bright-dark	-0,2434	-0,2047	0,3398	0,4229	.7087
3	0,1317	-0,3501	-0,5242 fair-unfair	0,0661	0,3356	0,4333	.7194
4	0,6651 good-bad	-0,2538	-0,2644	-0,1140	0,3232	0,2547	.7591
5	0,2028	-0,6673 beautiful-ugly	-0,0875	-0,2036	0,4311	0,0878	.7291
6	0,7522 valuable-worthless	-0,0722	-0,4163	-0,1577	0,0878	0,1210	.7915
7	0,2072	-0,2355	-0,1605	-0,0014	0,7680 true-false	0,2643	.7838
8	0,7284 active-passive	-0,1180	0,0472	-0,1970	0,2783	0,2081	.7063
9	0,4587	-0,6426 nice-awful	-0,0468	-0,1227	0,0994	0,3546	.7763
10	0,4710	-0,2538	-0,2162	0,0030	0,6517 positive-negative	0,2611	.8284
11	0,2326	-0,0310	-0,6716 reputable-disreputable	0,0412	0,2377	-0,0551	.8078
12	0,6098 important-unimportant	0,1158	-0,2776	-0,4273	0,4285	-0,0270	.8292
13	0,4012	-0,0473	-0,0524	-0,7963 interesting-boring	0,2451	0,0910	.8684
14	-0,0272	-0,6254 healthy-sick	-0,4537	-0,1006	0,2614	-0,0455	.6783
15	0,3076	-0,0821	-0,0940	-0,1569	0,2801	0,7674 clear-hazy	.8022
16	0,3791	-0,5309 pleasant-unpleasant	0,0201	-0,4449	-0,0783	0,4249	.8106
17	0,0567	-0,2873	-0,3331	-0,4806	0,5536 strong-weak	0,2852	.8156
18	0,0986	-0,8412 happy-sad	0,0477	0,0664	0,2151	0,2274	.8220
19	0,2184	-0,1234	-0,0754	-0,2035	0,8135 deep-shallow	0,0090	.7800
20	-0,0637	-0,8998 clean-dirty	-0,0454	0,0307	-0,0179	-0,0859	.8244
% V_T	15.08	18.90	11.02	8.36	15.55	8.92	.7783
% V_C	19.37	24.28	14.16	10.74	19.98	11.46	.9999
FACTOR	I	II			III		

TABLE 20.--Varimax Rotation for Concept BIOCHEMISTRY

ROTATED FACTOR LOADINGS.

	1	2	3	4	5	6	h^2
1	0,1399	0,1727	-0,0587	0,0611	0,1921	0,8324 timely-untimely	.7863
2	0,1470	0,0287	-0,2004	0,8051 bright-dark	0,1316	0,1305	.7451
3	0,1924	-0,0157	-0,5035	0,3698	0,5432 fair-unfair	-0,0995	.7325
4	0,2401	0,1553	-0,1782	0,2221	0,7973 good-bad	0,2026	.8395
5	0,6145 beautiful-ugly	0,3965	0,0837	0,2129	0,4707	0,0404	.7472
6	-0,0267	0,5162 valuable-worthless	-0,1674	0,0814	0,4887	0,3859	.6905
7	0,1305	0,1458	-0,4418	0,5809 true-false	0,2355	-0,2694	.7146
8	0,1317	0,4372	-0,1690	-0,0163	0,6376 active-passive	-0,0898	.6518
9	0,4216	0,0577	0,1426	0,4593	0,6431 nice-awful	0,2434	.8853
10	0,1178	0,2093	-0,2473	0,3785	0,6591 positive-negative	0,1482	.7185
11	0,1303	0,1515	-0,8370 reputable-disreputable	0,0572	0,0880	0,1239	.7669
12	-0,0522	0,7575 important-unimportant	-0,3892	0,1427	0,2212	0,0946	.8062
13	0,2241	0,4598	-0,0460	-0,0134	0,7324 interesting-boring	0,0856	.8079
14	0,7279 healthy-sick	-0,0280	-0,3179	0,0349	0,2289	0,2857	.7670
15	0,1989	0,3336	0,1154	0,7481 clear-hazy	0,1583	0,0691	.7259
16	0,5180	-0,0748	-0,0272	0,2033	0,7317 pleasant-unpleasant	0,2325	.8951
17	0,5049 strong-weak	0,4866	-0,1985	0,3995	0,2518	0,0010	.7541
18	0,7238 happy-sad	0,3034	0,0822	0,0302	0,4347	-0,0033	.8127
19	0,2433	0,7296 deep-shallow	0,1160	0,2570	0,1166	0,1499	.7071
20	0,8227 clean-dirty	-0,0038	-0,1805	0,2464	0,0671	-0,0024	.7747
% V_T	15.70	12.31	8.65	12.48	21.16	6.34	.7664
% V_C	20.48	16.06	11.29	16.28	27.61	8,27	.9999
FACTOR	II	B		III	I		

TABLE 21.--Varimax Rotation for Concept EXPERIMENT

APPENDIX F

ANALYSES OF VARIANCE LAYOUTS

FOR MAIN TREATMENT EFFECT

A N A L Y S I S   O F   V A R I A N C E   T A B L E   (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(120) SCIENCE
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	162.46724581	2	81.23362290	1.87495	0.161
WITHIN CATEGORIES	2946.15247464	68	43.32577169		
TOTAL	3108.61972046	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2286	0.0523

TABLE 22.--ANOVA For SCIENTIST Across Groups on Factor I.

ANALYSIS OF VARIANCE   PULLMANN

CURRENT TIME 1613 - 19 DATE 06/10/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S   O F   V A R I A N C E   T A B L E   (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	106.31432831	2	53.15716416	0.72628	0.487
WITHIN CATEGORIES	4977.00961578	68	73.19131788		
TOTAL	5083.32394409	70			

MULTIPLE CORRELATION COEFFICIENT
R   SQUARED (R2) = ETA
0.1446   0.0209

TABLE 23.--ANOVA For LABORATORY Across Groups on Factor I.

ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(122) MSU
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	657.00433376	2	328.50216688	3.39609	0.039
WITHIN CATEGORIES	6577.61538672	68	96.72963804		
TOTAL	7234.61972046	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.3014	0.0908

TABLE 24.--ANOVA For MICHIGAN STATE UNIVERSITY Across Groups on Factor I.

ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(123) BIOCHEM
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	89.17572745	2	44.58786373	1.96049	0.149
WITHIN CATEGORIES	1546.54253195	68	22.74327326		
TOTAL	1635.71831940	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2335	0.0545

TABLE 25.--ANOVA For BIOCHEMISTRY Across Groups on Factor I

CURRENT TIME 1613 • 19 DATE 06/18/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	254.55384225	2	127.27692113	2.48400	0.091
WITHIN CATEGORIES	3484.23489028	68	51.23874839		
TOTAL	3738.78873253	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2609	0.0681

TABLE 26.--ANOVA For EXPERIMENT Across Groups on Factor I.

ANALYSES OF VARIANCE

CURRENT TIME 1613 - 19 DATE 06/18/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	254.55384225	2	127.27692113	2.48400	0.091
WITHIN CATEGORIES	3484.23489028	68	51.23874839		
TOTAL	3738.78873253	70			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.2609	0.0681

TABLE 26.--ANOVA For EXPERIMENT Across Groups on Factor I.

ANALYSES OF VARIANCE BOLLMANN CURRENT TIME 0240 - 55 DATE 06/22/70
ELAPSED SINCE LAST CURRENT TIME 0.10 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	58.32752928	2	29.16376464	1.82816	0.169
WITHIN CATEGORIES	1084.77106252	68	15.95251563		
TOTAL	1143.09859180	70			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.2259	0.0510

TABLE 27.--ANOVA For LABORATORY Across Groups on Factor II.

CURRENT TIME 0240 - 55 DATE 06/22/70
ELAPSED SINCE LAST CURRENT TIME 0.10 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(122) MSU
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	128.31615334	2	64.15807667	5.38840	0.007
WITHIN CATEGORIES	809.65567750	68	11.90670114		
TOTAL	937.97183084	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.3699	0.1368

TABLE 28.--ANOVA For MICHIGAN STATE UNIVERSITY Across Groups on Factor II.

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(123) BIOCHEM
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	574.20290966	2	287.10145483	6.39535	0.003
WITHIN CATEGORIES	3052.67033178	68	44.89221076		
TOTAL	3626.87324142	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.3979	0.1583

TABLE 29.--ANOVA For BIOCHEMISTRY Across Groups on Factor II.

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	136.13411883	2	68.06705941	2.65437	0.078
WITHIN CATEGORIES	1743.75320551	68	25.64342949		
TOTAL	1879.88732433	70			

MULTIPLE CORRELATION COEFFICIENT
R 0.2691
SQUARED (R2) = ETA 0.0724

TABLE 30.--ANOVA For EXPERIMENT Across Groups on Factor II.

ELAPSED SINCE LAST CURRENT TIME 0.10 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(120) SCIENCE
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS, OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX, SIGNIFICANCE PROBABILITY OF F STAT;
BETWEEN CATEGORIES	295,84120744	2	147,92060372	3,01418	0,056
WITHIN CATEGORIES	3337,08836943	68	49.07482896		
TOTAL	3632,92957687	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0,2854	0,0814

TABLE 31.--ANOVA For SCIENTIST Across Groups on Factor III.

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	31,65392999	2	15,82696499	1,52458	0,225
WITHIN CATEGORIES	705.92353459	68	10,38122845		
TOTAL	737,57746458	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0,2072	0,0429

TABLE 32.--ANOVA For LABORATORY Across Groups on Factor III.

CURRENT TIME 1354 - 53 DATE 06/19/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(122) MSU
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	77.34370970	2	38.67185485	1.17281	0.316
WITHIN CATEGORIES	2242.20558572	68	32.97361155		
TOTAL	2319.54929543	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.1826	0.0333

TABLE 33.--ANOVA For MICHIGAN STATE UNIVERSITY Across Groups on Factor III.

CURRENT TIME 1354 - 53 DATE 06/19/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S   O F   V A R I A N C E   T A B L E   (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(123) BIOCHEM
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	124.56206469	2	62.28103235	3.27752	0.044
WITHIN CATEGORIES	1292.17052954	68	19.00250485		
TOTAL	1416.73259422	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2965	0.0879

TABLE 34.--ANOVA For BIOCHEMISTRY Across Groups on Factor III.

CURRENT TIME 1354 - 54 DATE 06/19/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	55.95114920	2	27.97557460	2.23858	0.114
WITHIN CATEGORIES	849.79532984	68	12.49699014		
TOTAL	905.74647903	70			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2485	0.0618

TABLE 35.--ANOVA For EXPERIMENT Across Groups on Factor III.

ANALYSES OF VARIANCE   BOLLMANN   CURRENT TIME 1430 - 36   DATE 06/19/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	52.44934351	2	26.22467175	1.68439	0.193
WITHIN CATEGORIES	1058.70558661	68	15.56919980		
TOTAL	1111.15493011	70			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.2173	0.0472

TABLE 36.--ANOVA For LABORATORY Across Groups on Factor A.

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(1) GROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	13.38856214	2	6.69428107	0.51256	0.601
WITHIN CATEGORIES	888.10439545	68	13.06035876		
TOTAL	901.49295759	70			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.1219	0.0149

TABLE 37.--ANOVA For EXPERIMENT Across Groups on Factor B.

APPENDIX G

DERIVATION OF POST-HOC

COMPARISON FORMULAS

Derivation of the Formula for Post-hoc Comparisons

The formula to be used in making post-hoc comparisons among the treatment group means is based on a method suggested by Sheffe. In commenting upon the Sheffe technique, Hays says,

> [The] method has advantages of simplicity, applicability to groups of unequal sizes, and suitability for any comparison. This method is also known to be relatively insensitive to departures from normality and homogenity of variance.[1]

The characteristics listed by Hays make the method admirably suited for the present study. In giving the formula Hays continues, [2]

> Given any comparison *g* made on the data after a significant F has been found for the relevant factor, the significance of the comparison value $\hat{\psi}_g$ may be found by use of the following confidence interval:
>
> $$\hat{\psi}_g - S\sqrt{V(\hat{\psi}_g)} \leq \hat{\psi}_g \leq \hat{\psi}_g + S\sqrt{V(\hat{\psi}_g)} \qquad (1)$$
>
> where $$\sqrt{V(\hat{\psi}_g)} = \sqrt{MS_{error}\, w_g} = \sqrt{\text{est. var}(\hat{\psi}_g)} \qquad (2)$$
>
> and $$S = \sqrt{(J-1)\, F} \qquad (3)$$

In the comparisons to be made we are only interested in those arithmetical differences which are greater than the minimum value rather than a confidence interval derived from that value by adding to and subtracting from the tabled F ratio at a predetermined alpha level. Therefore, a comparison between two means will be significant

---

[1] William L. Hays, Statistics for Psychologists (New York: Holt, Rinehart and Winston, 1963), p. 484.

[2] Hays, p. 484.

if it is equal to or greater than

$$S\sqrt{V(\Psi_g)} \qquad (4)$$

Substituting (2) and (3) into (4)

$$g = \left(\sqrt{(J-1)F_\alpha}\right)\left(\sqrt{(MS_{error})w_g}\right) \qquad (5)$$

and since J=number of groups=3

and $MS_{error}=MS_{within}$

$$g = \left(\sqrt{(2)F_\alpha}\right)\left(\sqrt{(MS_{within})(w_g)}\right) \qquad (6)$$

Earlier, Hays defines w_g as follows:

$$w_g = \sum_j \frac{c_j^2}{n_j} \qquad (7)$$

where = weighted constant for a given comparison from the following table:

Comparisons	Means I	II	III
I with II	1	-1	0
I with III	1	0	-1
II with III	0	1	-1

The n for each group is as follows:

$n_I = 26$

$n_{II} = 24$

$n_{III} = 21$

so, substituting into (7) for each respective comparison between the group means:

$$w_{g_{I,II}} = \frac{(+1)^2}{26} + \frac{(-1)^2}{24} = \frac{(26 + 24)}{(26)(24)} = \frac{50}{624} = .08$$

$$w_{g_{I,III}} = \frac{(+1)^2}{26} + \frac{(-1)^2}{21} = .086$$

$$w_{g_{II,III}} = \frac{(+1)^2}{24} + \frac{(-1)^2}{21} = .089$$

Substituting these values, then, into (6)

$$g_{1,2} = \left(\sqrt{(2)(F_\alpha)}\right)\left(\sqrt{(MS_{within})(.08)}\right)$$

$$g_{1,3} = \left(\sqrt{(2)(F_\alpha)}\right)\left(\sqrt{(MS_{within})(.086)}\right)$$

$$g_{2,3} = \left(\sqrt{(2)(F_\alpha)}\right)\left(\sqrt{(MS_{within})(.089)}\right)$$

where $g_{1,2}$ = minimum absolute difference between the means of Groups 1 and 2 for significance at same alpha as F

$g_{1,3}$ = the same for Groups 1 and 3

$g_{2,3}$ = the same for Groups 2 and 3.

F = F ratio from given ANOVA

MS_{within} = mean square within from given ANOVA.

For the post-hoc comparisons among the Subgroups A, B, and C, the same equations hold except for the w_g quantities based on the n's of 9, 9 and 8 respectively. Accordingly, the formulas are:

$$g_{A,B} = \left(\sqrt{(2)(F_\alpha)}\right)\left(\sqrt{(MS_{within})(.22)}\right)$$

$$g_{A,C} = \left(\sqrt{(2)(F_\alpha)}\right)\left(\sqrt{(MS_{within})(.24)}\right)$$

$$g_{B,C} = \left(\sqrt{(2)(F_\alpha)}\right)\left(\sqrt{(MS_{within})(.24)}\right)$$

APPENDIX H

ANALYSES OF VARIANCE LAYOUTS FOR

EFFECT OF VIEWER LOCATION

ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(120) SCIENCE
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	15.39850427	2	7.69925214	0.21233	0.810
WITHIN CATEGORIES	833.98611067	23	36.26026568		
TOTAL	849.38461494	25			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.1346	0.0181

TABLE 38.--ANOVA For SCIENTIST Across Subgroups on Factor I.

ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	35.39850429	2	17.69925214	0.30155	0.743
WITHIN CATEGORIES	1349.98611066	23	58.69504829		
TOTAL	1385.38461494	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.1598	0.0256

TABLE 39.--ANOVA For LABORATORY Across Subgroups on Factor I.

ELAPSED SINCE LAST CURRENT TIME 0.10 SECONDS

A N A L Y S I S   O F   V A R I A N C E   T A B L E   (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(122) MSU
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	112.79594018	2	56.39797009	1.02435	0.375
WITHIN CATEGORIES	1266.31944486	23	55.05736717		
TOTAL	1379.11536506	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2860	0.0818

TABLE 40.--ANOVA For MICHIGAN STATE UNIVERSITY Across Subgroups on Factor I

A N A L Y S I S   O F   V A R I A N C E   T A B L E   (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(123) BIOCHEM
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	4.34615385	2	2.17307692	0.10961	0.897
WITHIN CATEGORIES	455.99999989	23	19.82608695		
TOTAL	460.34615374	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.0972	0.0094

TABLE 41.--ANOVA For BIOCHEMISTRY Across Subgroups on Factor I.

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	158.76068376	2	79.38034188	1.82707	0.183
WITHIN CATEGORIES	999.27777794	23	43.44685991		
TOTAL	1158.03846169	25			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.3703	0.1371

TABLE 42.--ANOVA For EXPERIMENT Across Subgroups on Factor I.

ANALYSES OF VARIANCE BOLLMANN

CURRENT TIME 0240 - 57 DATE 06/22/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	1.97542735	2	0.98771367	0.04907	0.952
WITHIN CATEGORIES	462.98611096	23	20.12983091		
TOTAL	464.96153831	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.0659	0.0042

TABLE 43.--ANOVA For LABORATORY Across Subgroups on Factor II.

ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(122) MSU
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	34.29059828	2	17.14529914	1.50768	0.243
WITHIN CATEGORIES	261.55555546	23	11.37198067		
TOTAL	295.84615374	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.3405	0.1159

TABLE 44.--ANOVA For MICHIGAN STATE UNIVERSITY Across Subgroups on Factor II.

SEPARATE MEAN FOR EACH CATEGORY)

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(123) BIOCHEM
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	44.56517095	2	22.28258547	0.61287	0.551
WITHIN CATEGORIES	837.31944495	23	36.40519326		
TOTAL	881.88461590	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.2248	0.0505

TABLE 45.--ANOVA For BIOCHEMISTRY Across Subgroups on Factor II.

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	124.73931624	2	62.36965812	2.73905	0.086
WITHIN CATEGORIES	523.72222207	23	22.77053139		
TOTAL	648.46153831	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.4386	0.1924

TABLE 46.--ANOVA For EXPERIMENT Across Subgroups on Factor II.

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(120) SCIENCE
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	259.88995730	2	129.94497865	2.83356	0.079
WITHIN CATEGORIES	1054.76388943	23	45.85929954		
TOTAL	1314.65384674	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.4446	0.1977

TABLE 47.--ANOVA For SCIENTIST Across Subgroups on Factor III.

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	24.69337606	2	12.34668803	1.03019	0.373
WITHIN CATEGORIES	275.65277791	23	11.98490339		
TOTAL	300.34615397	25			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.2867	0.0822

TABLE 48.--ANOVA For LABORATORY Across Subgroups on Factor III.

ANALYSES OF VARIANCE BOLLMANN

CURRENT TIME 1354 - 56 DATE 06/19/70
ELAPSED SINCE LAST CURRENT TIME 0.11 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(122) MSU
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	322.53098293	2	161.26549146	6.50229	0.006
WITHIN CATEGORIES	570.43055539	23	24.80132850		
TOTAL	892.96153831	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.6010	0.3612

TABLE 49.--ANOVA For MICHIGAN STATE UNIVERSITY Across Subgroups on Factor III.

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(123) BIOCHEM
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	60.12072651	2	30.06036326	1.64709	0.215
WITHIN CATEGORIES	419.76388891	23	18.25060387		
TOTAL	479.88461542	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.3540	0.1253

TABLE 50.--ANOVA For BIOCHEMISTRY Across Subgroups on Factor III.

A N A L Y S I S O F V A R I A N C E T A B L E (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS, OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT;
BETWEEN CATEGORIES	94.10683760	2	47,05341880	3,32198	0,054
WITHIN CATEGORIES	325.77777782	23	14.16425121		
TOTAL	419.88461542	25			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0,4734	0,2241

TABLE 51.--ANOVA For EXPERIMENT Across Subgroups on Factor III.

ANALYSES OF VARIANCE BOLLMANN

CURRENT TIME 1430 - 38 DATE 06/19/70
ELAPSED SINCE LAST CURRENT TIME 0.10 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(121) LAB
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	2,96153846	2	1,48076923	0.10336	0,902
WITHIN CATEGORIES	329,49999985	23	14,32608695		
TOTAL	332,46153831	25			

MULTIPLE CORRELATION COEFFICIENT R	SQUARED (R2) = ETA
0.0944	0,0089

TABLE 52.--ANOVA For LABORATORY Across Subgroups on Factor A.

ANALYSES OF VARIANCE   BOLLMANN   CURRENT TIME 1430 = 38 DATE 06/19/70
ELAPSED SINCE LAST CURRENT TIME 0.12 SECONDS

ANALYSIS OF VARIANCE TABLE (ALLOWS A SEPARATE MEAN FOR EACH CATEGORY)

DEPENDENT VARIABLE IS X(124) EXPER 1
CATEGORY VARIABLE IS X(2) SUBGROUP

SOURCE OF VARIANCE	SUM OF SQUARES	DEGS. OF FREEDOM	MEAN SQUARE	F STATISTIC	APPROX. SIGNIFICANCE PROBABILITY OF F STAT.
BETWEEN CATEGORIES	25.03098291	2	12.51549145	1.20295	0.319
WITHIN CATEGORIES	239.43055553	23	10.41002415		
TOTAL	264.46153843	25			

MULTIPLE CORRELATION COEFFICIENT

R	SQUARED (R2) = ETA
0.3077	0.0946

TABLE 53.--ANOVA For EXPERIMENT Across Subgroups on Factor B.