An Experimental Study of the Effect of Using the Overhead Projector in a College Introductory Psychology Class

Lida Weed Myers
_Central Washington University_

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AN EXPERIMENTAL STUDY OF THE EFFECT OF USING
THE OVERHEAD PROJECTOR IN A COLLEGE
INTRODUCTORY PSYCHOLOGY CLASS

A Thesis
Presented to
the Graduate Faculty
Central Washington College of Education

In Partial Fulfillment
of the Requirements for the Degree
Master of Education

by
Lida Weed Myers
August 1960
It seems important to express sincere thanks to the members of my committee, Dr. A. Hamilton Howard, Dr. Emil E. Samuelson, and Mr. Charles W. Wright, for their assistance in the planning and execution of the experiment and their advice and encouragement in the writing of this report.

Equally important is the expression of appreciation to Dr. Elidon E. Jacobsen for his assistance in designing the experiment and computing t-scores, to Miss Mabel Anderson for her enthusiastic cooperation and her teaching ability in using the visual materials, and to Mr. Warren Dayton for his artistic skill and his willingness to work long hours to complete the transparencies on time.
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This is the report of an experiment in using visual materials in teaching an introductory psychology course at Central Washington College of Education in Ellensburg, Washington. This rather long name of the College is often shortened to "Central" in the body of this report. Miss Mabel Anderson, Associate Professor of Education, was the cooperating teacher. The time of the experiment was spring quarter, 1960.
CHAPTER I

PURPOSE OF THIS STUDY

I. STATEMENT OF THE PROBLEM

The purpose of this experiment was to investigate the possibility that visual materials "custom tailored" to a professor's specifications and integrated with his lectures might improve student achievement on standardized objective tests. The visual materials, transparencies projected by a 10x10 overhead projector, were designed and executed to meet the requirements of a professor teaching Psychology 100, an introductory course for freshmen. These visuals were used experimentally during the spring quarter. Students taking the same course taught by the same professor during the winter quarter acted as a control group. The same objective tests were used to measure the performance of both groups and their significant difference. Subjective evaluation of the effectiveness of the projected materials by both teacher and students was also determined.

II. JUSTIFICATION FOR THE STUDY

Four very closely related convictions were responsible for this study. First, the term "audiovisual" must include all teaching materials. These materials need to play
an integral part in the teaching-learning process since they are as essential to effective teaching as the textbook or the teacher's voice. Second, education needs to adapt and adopt the technological methods which have revolutionized other phases of our lives. The role of the teacher is changing; there is great need for imagination; and, in addition, this need for more effective teaching is being recognized in discussions of leaders in higher education. Third, words are not a perfect means of communication. Words can be more effective when combined with visual stimuli, as witness the television commercials and also the more recent and scholarly television teaching. Finally, while films and sound film strips are available, applying all the above principles to education, they are not a complete answer to the teacher's problem. These four convictions will be discussed in this section.

The use of equipment and materials to promote learning through concreteness, realism, and utilization of multisensory experience has gained acceptance rapidly during the last fifty years. In years past, these tools were considered as aids or crutches for other learning materials such as books and the teacher's voice, and the people who advocated their use were regarded as gadgeteers. Pictures, whether moving or still, flat or projected, were catalogued
under "visual education." Then with the advent of radio and the increasing importance of recorded sound, "audio" was added to form the term, "audiovisual." Displeasure with segmentizing the materials of learning into written vs. non-written or sensory vs. intellectual led to the use of the term "instructional materials" or "teaching materials." This evolution of terminology reflects the changing concept of the educational role played by machines and the audio and visual materials used by them. Audiovisual materials are now rather widely accepted as valuable in their own right and not merely as enrichment or aids for other learning materials. In keeping with this newer concept of audiovisual, this experiment was an attempt to explore the use of the overhead projector as the vehicle of communication, thereby measuring the contribution to learning made by the integration of visual illustrations with the professor's lectures.

Another reason for attempting this experiment was a firm belief that the technological advances which have transformed every facet of our lives needed to be applied to education. For this purpose imaginative people who know the principles of learning and the problems of education must explore the potentialities of scientific technology to try to discover superior ways for teaching. Many studies
and experiments are in progress seeking ways to help teachers in a technological age teach students who are the creations of the age. John W. Price writes:

The role of the teacher is changing radically today. Television, radio, and modern means of communication are not only offering new means of teaching, they are, by producing educational material in an extremely entertaining manner, also competing indirectly with the traditional ways of teaching. He further suggests that education can meet this competition. "By using some of these professional techniques, the modern instructor may make his contacts with the students stimulating and mutually rewarding" (15:180).

Professional literature is filled with similar convictions "that education can meet the enormously increased demands placed upon it only by making a concerted effort to catch up with the scientific and technical advances which have revolutionized other areas of our lives" (6:3). There is, also, belief that this effort will be made: "The promise is great for the teacher in new methods and machines to make the education process more effective" (9:129). In addition to these expressions of this need to apply the advances of technology to our educational scene, a plea is made for ". . . the open mind, the willingness to experiment, and the realization that the skills of both teaching and learning are still to a great extent undeveloped in education" (9:129).
This same lack of satisfaction with current educational methods was evident at the Fifteenth Annual National Conference on Higher Education held in Chicago, March 6-9, 1960. In summarizing the conference, William E. Porter included this statement:

There was a clear sentiment that more study of effective teaching needs to be undertaken.

There was, in short, a healthy concern which seems to be growing steadily with the problem of what might be described as professional skill. There was little complacency (it was repeatedly pointed out that the improvement of present teaching was a problem at least as great as that of training new college teachers) and a real eagerness to do something about a subject which traditionally has been little discussed in higher education (14:268).

The third point is concerned with an essential element in the teaching-learning process—communication. "There is little value in private concepts. Communication means shared meanings" (4:287). "Shared meanings" implies a common medium of exchange. Cronbach likens words to coins: "We offer a word as we offer a coin. If the value of the word is equal to the situation, the word is accepted (pocketed, as it were, by our audience)" (4:287-288). But if the word is unknown or its value (meaning) is questioned there can be no exchange of ideas.

Words are representational symbols which have no intrinsic meaning. Meaning is assigned by the listener or reader in terms of his past experience. If he lacks
experience with the situation or object represented by the word, he may not understand the symbolism. Or if the listener's past experience with the word is quite different from the speaker's, then he may assign it an unintended meaning.

The fluent use of words in a meaningful pattern is the mark of an educated man. But in the process of reaching this goal, many experiences, both real and vicarious, are necessary. If a teacher applies all that is known about the learning process, he will accept his students where they are in their educational development and encode his presentation of facts and ideas in a form which has meaning for his class. He may find that the various graphic media help to make his meanings clear. He will not prepare lesson plans in an ivory tower rationalizing that, "By the time students get to college they should be able to understand my lectures." Maybe they should, but if the facts show that they don't understand, then it is the responsibility of the teacher to select a method of presentation which they can comprehend. Where there is no communication there can be no teaching and no learning.

In discussing "New Directions for Communication Research," L. P. Greenhill interprets the "word communication" (italics his) to mean the presentation of auditory and visual
stimuli to students in such a way as to encourage them to acquire new information, skills, and attitudes of an academic type (7:245). This definition gives equal value to sights and sounds, or at least recognizes both as important. In applying this definition of communication to the classroom, the teacher can learn a lesson from television commercials. Vast sums of money are spent on these commercials because they are so successful in "encouraging" the viewer "to acquire... new attitudes"—not of an "academic type" perhaps, --but attitudes which certainly change behavior. It is not suggested that the teacher copy these commercials in the classroom. But if a carefully planned combination of "auditory and visual stimuli" can sell soap, cigarettes, Wheaties, beer, and deodorants, might not a judicious adaptation of these techniques "encourage students to acquire new information, skills, and attitudes of an academic type"?

And indeed, instructional television may be showing the classroom teacher the way to combine sight and sound for optimum effectiveness. Televised lessons require many and varied visual materials. Since a teacher simply lecturing from a television receiver is monotonous and dull, the television teacher has been forced to use pictures and graphics of all kinds. Barclay Leatham reports from Western Reserve University, Cleveland, Ohio:
Professors say, after reducing a 50-minute lecture to 28 minutes and using visual aids charts, moveable blocks, maps, blackboard illustrations, and flannel-board variable symbols, that they have found a new asset in teaching—visually illustrated exposition. Everyone who uses this method on television, takes the idea home to use in his classroom" (18:11).

These techniques, so essential and effective on television, may be even more useful used directly in the classroom, where they can appear in full color and three dimensions. There needs to be more research concerning the contribution of color to learning. However, countless graphics attest to the fact that color is valuable in organizing facts.

Finally, while films and sound-filmstrips are one useful answer to the problems discussed above, they are not the complete solution. In spite of their increasing quality and quantity, these commercially available materials cannot answer all the classroom teacher's needs in his job of developing understandings of a particular subject for a room full of unique individuals. Teaching is a highly personalized matter. Each teacher needs teaching materials as carefully constructed to fit the immediate occasion as the word he selects to convey meaning. This study was an attempt to visually illustrate Miss Anderson's lectures by tailoring transparencies for projection by the overhead projector and to measure the possible contribution these visuals might make to the understanding of Psychology 100.
III. LIMITATIONS OF THIS STUDY

Seventy-five transparencies were designed to illustrate the important concepts Miss Anderson wished to exchange in two subject units of her 1960 spring quarter class in Psychology 100. Objective tests were used to measure comprehension and retention and the results compared with the performance of her students on the same tests during the winter quarter. Also, the students were asked to state their reactions to the use of the transparencies. No attempt was made to structure this subjective evaluation. Also, no measure was taken of the quality of the transparencies themselves, other than that they pleased Miss Anderson.

Figure 1 shows Miss Anderson using the overhead projector. A transparency is in place on the 10x10 illuminated deck and shows on the screen behind her. This illustrates the advantages of this projector; the teacher keeps eye contact with her audience. This machine projects an image on the screen by transmitting light through a transparent substance—the same process as for showing slides or filmstrips. The difference is in size and direction of projection. The large size—up to 10x10 inches—makes it easy to locally produce the transparencies.
FIGURE 1

MISS ANDERSON USING THE OVERHEAD PROJECTOR
In this paper constant reference is made to "the transparencies." They are also called "visuals," "materials," and "teaching materials." Printed examples of these transparencies—both the foils and the carbon acetate—are reproduced in Chapter IV. Samples may be found in the appendix. The term "visualized exposition" will be explained in Chapter II in the discussion of Pictorial Communication.

IV. PREVIEW OF THE ORGANIZATION OF THIS REPORT

The next chapter will present a brief review of related research plus reference to present experimental use of the overhead projector. The last section of Chapter II will describe some of the uses now being made of cartoons, picture writing, diagrams, graphs, and color coding to illustrate academic tests and other scholarly books.

Chapter III will describe the design and procedure of this experiment, explaining first the criteria for selecting the experimental class. The design for statistical treatment will be outlined. Next will be a brief look at the production and use of the materials, and the chapter will close with a discussion of testing the achievement of the students. This section will include both the method of testing and obtaining the t-scores of significant difference.

Chapter IV is necessarily long because it gives the
results of the objective tests, and then, when these results are contradictory, conducts a search to explain the contradiction shown by the t-scores. It is divided into two parts; the analysis of the objective data and a subjective evaluation.

The final chapter is the summary. It will include the conclusions drawn from the experiment, together with implications inferred from these conclusions, and will close with a few suggestions for future research in the contribution an overhead projector can make to education.
CHAPTER II

HISTORY AND PRESENT STATUS OF THE PROBLEM

This chapter will review some of the research and examples of the use of overhead projector in classrooms. And, since a machine has no instructional value in its own right but is only as effective as the materials it uses, a few examples of cartooning, picture writing, diagrams, and the more common forms of graphic techniques used in visualizing ideas will be discussed briefly. This brief discussion will merely hint at the possibilities in graphic communication because, as explained in the Limitation of this Study, this experiment was restricted to a specific set of transparencies designed to fit a particular teacher's needs. Our concern with graphic communication is limited, necessarily to giving samples of what is meant by “illustrating” or “visualizing” exposition or lectures.

I. RELATED RESEARCH

The literature's replete with accounts of research into the effectiveness of the various teaching materials. William H. Allen, in reviewing research in audiovisual communication for the ten years ending April, 1956, summarizes:

A vast amount of research has accumulated during the past years, demonstrating conclusively that AV instructional materials, properly used, can make significant
contributions to learning over a wide range of conditions and subject matter content. There is a dearth of recent research on the effectiveness of pictorial illustration and graphic materials in aiding learning (8:149, 133).

He does mention several studies, notably those by M. D. Vernon in England. It is a temptation to discuss some of the findings of graphic and pictorial communication research, but the only comment pertinent to this study is that past research indicates the need for further exploration and imaginative experimentation in this promising area.

However, there is a singular lack of research involving the use of the overhead projector. Prior to 1959, no studies were found listing "overhead projector" in the title. Several studies of local production of instructional material and the use of photographic slides were read, but these applied to the present experiment only as background information.

In the Fall, 1959, issue of Audio Visual Communication Review, a list of the research grants under Title VII of the National Defense Act included one to Clayton W. Chance, University of Texas, for a study titled, "Experimentation in the adaptation of the Vu-Graph Overhead Projector, Utilizing 200 Transparencies and 800 overlays in Teaching Engineering and Descriptive Geometry Curricula" (13:301). Findings of this study have not yet been made available.
It is also apparent that the problems of using the overhead projector to teach engineering and geometry may differ—at least in the preparation of materials—from the problems incident to psychology instruction.

This dearth of research involving the educational use of the overhead projector is probably due not so much to its newness—television and teaching machines are of a similar age and these two account for nearly half of the recent audiovisual research (1:295-303)—but more to the fact that comparatively few commercial transparencies for use on the overhead are available for purchase. One of the greatest assets of the overhead projector, its versatility in displaying locally produced materials, is at the same time a hindrance to its rapid acceptance. It takes time, some artistic skill, and imagination to prepare materials for the overhead, and these qualities are not as plentiful in educational circles as might be desired. Of equal or even greater importance is the fact that, contrary to the situation in films, few commercial companies have transparencies for sale; therefore, industrial money is not backing research in this field, nor are there as yet many salesmen camping on school doorsteps.
II. RECENT EXPERIMENTS WITH THE OVERHEAD PROJECTOR

While there have been few formal research studies to determine the effectiveness of the use of the overhead projector, this machine has been much in evidence in the various experiments all over the U.S. exploring "improved teaching patterns." The most extensive group of experiments are those authorized by the Commission on the Experimental Study of the Utilization of the Staff in the Secondary School. The purpose of the Commission was:

To see if experimentation would reveal ways of meeting the teacher shortage and at the same time improve the quality of education through better utilization of the time and energies of staff and students, changes in curriculum design and teaching methods, and reorganization of administrative patterns (10:5).

These are important studies. They are assuming that the problems of education are all parts of one problem--that the teacher shortage, curriculum changes, teaching materials, salaries, teaching methods, and administration policies are all facets of the big problem of helping children learn. When educators have tackled the departmentalized problems in the context of their relationship to the teaching-learning transaction, some promising innovations have resulted, among them, establishing variations in class length and class size. With the aid of electronic equipment it was possible to teach some subjects to very large classes, thus releasing
some teachers for small group discussion and individual guidance.

The commission has sponsored experimentation involving the use of closed-circuit television, overhead projectors using specially prepared transparencies, (italics added) F. M. radio, teaching films, locally prepared teaching tapes, locally prepared slides, and recording devices (10:6).

Thus the overhead projector has been included, along with many other types of electronic equipment, in numerous experiments in all parts of the U. S. The evaluation of specific contributions of the overhead projector are scattered among other details in the results of those many experiments. It will be helpful to quote from one of the largest of the studies: The Newton Plan Studies.

In the high school at Newton, Massachusetts, their "...central concern is with the presentation of vivid, visually reinforced lessons to large groups." They call these presentations "lectures," but "they are traditional lectures only in the sense that pupils take notes." They believe that good teachers "...are preparing better lessons and giving them to more pupils than ever before" (2:105). This feature of the Newton plan has attracted most attention—the "large-group visualized lectures." These groups have varied in size from 60 to 1100. The lectures are "especially prepared and presented by overhead projection" (2:106). The report explains, "all lectures require meticulous preparation—-from
10 to 30 hours of research and visuals preparation for each hour of lecture" (2:107). The teachers are their own consultants. They know how to prepare materials for projection.

They know the tools with which they will teach. Thus the lectures are more than illustrated talks. The lecture visuals express just exactly what the lecturer had in mind - because he made the visual from the original conception through to the transparency (2:108).

The report by Mr. Bissex in the January, 1959, issue of The Bulletin indicates that "research team is in residence for anecdotal records, for spot evaluation, and for pulse-taking . . . . Traditional evaluation merely tells us whether the patient is alive or dead. Evaluators in residence, by virtue of their continuous checking and feeding back of information, can help the program grow" (2:118).

This, then, is the kind of imaginative program being undertaken with the overhead projector. Before describing the design of the experiment in Central's introductory psychology class, it will be helpful to examine briefly what is meant by pictorial communication.

III. PICTORIAL COMMUNICATION

Pictures were the first symbols used in written communication, the first means man used to express ideas. The oriental people still use written characters evolved from picture writing. With the development of alphabets, however,
words composed of letters became the medium for the exchange of thoughts and the recording of history. The accumulated knowledge of man was stored in books: "The process of learning through communication devices has been almost completely print-oriented in Europe and North America for 500 years" (9:90). This tradition has so penetrated the thinking of many scholars that they find it difficult to believe that pictorial representation can result in academic achievement.

In recent times, interest in the many contributions to understanding contributed by pictorial representation has revived.

In the 1920's, Otto Neurath and his associates began developing a dictionary of picture symbols to serve as an international picture language. His symbols called "Isotype," for "International System of Typographic Picture Education," are widely used in pictorial graphs. An example of "Isotype" figures and Dr. Neurath's graphs, is found in figure 2. This illustration is from "Modern man in the Making," published in 1939. In the foreword is this explanation:

It, the visualization, shows connections between facts instead of discussing them. Impressive visual aids do not merely act as illustrations or as eye-bait in this book; they are parts of the explanations themselves. The reader may not understand the contents by reading the text only; he must "read" the pictures as carefully as the text (12:7-8).
Other examples of the use of pictorial communication are to be found in such modern textbooks as *Educational Psychology*, by Lee J. Cronbach. He uses cartoons, diagrams, charts, and graphs to help provide a base of meaning for verbal abstractions. Figure 3 is an example of one of his cartoon--diagram illustrations.

*Wisdom of the West*, by Bertrand Russell, is a very recent and scholarly use of pictorial communication. It was published late in 1959. Two of his geometric abstractions are reproduced in Figure 4. The author describes the book as a "conspectus of Western Philosophy from Thales to Wittgenstein." In the foreword he carefully explains his use of illustrations:

To support the account, there is a collection of pictures of men, places, and documents, which have been chosen as nearly as possible from sources belonging to the period to which they refer. Above all, an attempt has been made, wherever this seemed feasible, to translate philosophic ideas, normally expressed only in words, into diagrams that convey the same information by way of geometrical metaphor. There is little to fall back on here, and the results are therefore not always entirely successful. However, it seems that such methods of presentation are worth exploring. Diagrammatic exposition, so far as it can be achieved, has the further advantage of not being tied to any particular tongue (17:5).

It is interesting to note the terminology various authors have applied to their efforts in pictorial communication: Neurath--"isotype"; Russell--"diagrammatic exposition" and "geometrical metaphor"; Leatham--"visually illustrated

---

1Dr. Paul Foulkes devised most of the diagrams in *Wisdom of the West*. 
Can one visualize, in a single picture, basic changes in the life mode of modern man—that is, in elements which change not only his technical equipment, but also his hopes and fears? Of course one can. Modern people live longer than their forefathers did. Therefore improvement in public health is a characteristic feature of modern history.

**Mortality Rates in a Central European Town**

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<td>1591</td>
<td><img src="image1" alt="1591 Mortality Rate" /></td>
</tr>
<tr>
<td>1599</td>
<td><img src="image2" alt="1599 Mortality Rate" /></td>
</tr>
<tr>
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<tr>
<td>1936</td>
<td><img src="image14" alt="1936 Mortality Rate" /></td>
</tr>
</tbody>
</table>

Each cross represents 1 death per 100 population.

**FIGURE 2**

ISOTYPE (FROM OTTO NEURATH, *MODERN MAN IN THE MAKING*, p. 13)
FIGURE 3

CARTOON-DIAGRAM (LEE J. CRONBACH, EDUCATIONAL PSYCHOLOGY, pp. 52-53)
Change as rearrangement of atoms that remain themselves unchanged

The argument from design: order implies a designer, hence God exists

FIGURE 4
GEOMETRIC SYMBOLISM (FROM BERTRAND RUSSELL, WISDOM OF THE WEST, p.159)
"exposition." In this paper, this later phrase has been shortened to "visualized exposition." This may be less accurate, but it is easier to use and is more inclusive than Russell's terms.

The past decade has seen an increase in interest in pictorial communication research and attempts to formulate theories of pictorial perception. In one of the first such attempts, in 1954, James J. Gibson comments: "it is not uncommon to suppose that a person can learn to think in terms of drawings of graphs or models... as well as in terms of words. It may even be possible to infer,... that in certain respects such thinking is more easily performed than is verbal thinking" (5:9-10).

Karl U. Smith has developed scientific principles of artistic illustration of teaching materials. He uses the term, "'perceptual-geometric theory' of symbol learning." It is his belief that the "perceptual organization in the classroom can be aided by the nonverbal behavior of the teacher, by demonstrations, by graphs, by laboratory exercises, by object displays, and especially by artistically designed illustrative material" (italics added) (18:99). Dr. Smith further insists that this material "promotes understanding of the esthetic, moral, pragmatic, and emotional values in any situation, as well as the purely logical, scientific, or
abstract concepts of language." Thus he reinforces the belief that illustrations can be useful in psychology as well as in science and mathematics classes. Then he elaborates on the specific values obtaining from the use of "correlated" artistic design and symbolism:

We mean that different forms of artistic drawing—representative, abstract, and impressionistic—can be used to enhance the motivation and level of creative thought of the student. Representative illustrations clarify specific object relations. Abstract drawings, along with the line graphs, deepen understanding of interaction of events, especially human and social interactions which cannot be quantified. Impressionistic designs promote understanding of object relations in terms of individualized emotional and perceptual values (18:99).

The following chapter will describe the design and procedure of the experiment intended to measure the contribution of correlated and artistically designed transparencies to the achievement of college freshmen in understanding the concepts of introductory psychology.
CHAPTER III

THE DESIGN AND PROCEDURE OF THE EXPERIMENT

The overhead projector was selected as the mechanical means of presenting visuals to the class for three reasons. First, it was easy to make the materials for projection exactly fit the teacher's specifications, illustrating each point she considered important, and she could add additional information for emphasis while she lectured. Second, the projector is a most versatile tool and not difficult to operate. Third, the overhead projector is a relative newcomer in the field of audiovisual equipment, and while it has been used extensively in business and industry, schools and colleges have been hesitant in adapting it to classroom use.

The steps involved in planning an experiment to test the possible contribution to learning resulted from the visualized exposition technique were (1) selecting the class for study; (2) designing a study which could be treated statistically; (3) producing and using the desired materials; and (4) testing achievement. These four steps will be discussed in this chapter.

I. SELECTING THE CLASS FOR STUDY

Essential Requirements for Selection
The selection of a college class for this experiment in using the overhead projector meant finding a class which met four essential criteria: it had to fit the design of this study, treat an abstract subject, be sufficiently large, and have a cooperative teacher.

Adaptable to the design. To satisfy the requirements of statistical treatment of data, the subject selected must include classes to serve both as an experimental unit and as a control group. As will be shown in the description of the design, these groups did not need to be matched but merely randomly selected, tested by the same tests and taught by the professor, with an equal amount of time spent on each unit, and as nearly as possible with the same methods except for the inclusion of the visual materials in the experimental units. Psychology 100 met these requirements. Miss Mabel Anderson had taught two winter sections totaling one hundred students. The test papers and all records of these students were available to serve as a control group. Miss Anderson, scheduled to teach Psychology 100 during the spring quarter, was willing to conduct the class to meet the demands of the experiment.

Should be an "abstract" subject. Much evidence has been gathered concerning the value of visualization in teaching skills, mathematics, science, and the operation of
equipment. This experiment was a quest for information concerning the value of cartooned, diagrammed, and outlined ideas projected by an overhead projector.

**Should be a reasonably large class.** A large number of students would give a better test of the experimental materials. Also large classes are of necessity taught primarily by the lecture method. This was important to the nature of the experiment.

**Must have a teacher eager to cooperate.** No teaching method can be successful without the wholehearted, imaginative enthusiasm of the teacher. It is obvious that any possibility of improving performance of the experimental group lay in satisfying this requirement. For the cooperating professor, conducting the experiment meant extra time and energy spent outlining the important concepts to be visualized, approving the preliminary sketches and the final transparencies, learning to use the overhead projector, and rehearsing lectures by adding notes to the margins of the transparencies. Miss Anderson, willing to spend this extra time, proved also to be the imaginative and enthusiastic teacher required.

**Additional benefit from selection of Psychology 100**

Very few teaching materials were available at Central for the instruction of this beginning psychology class.
Also, this is a course required for all freshmen. If the visual materials proved of value, their use would be continued. Visualized exposition might even make it possible for one professor to teach larger sections of Psychology 100, releasing other professors for small group discussion sessions with these freshmen.

II. DESIGNING THE EXPERIMENT

Psychology 100 as taught by Miss Anderson during the winter quarter was divided into six\(^1\) units, each culminating in a test. It was proposed to make transparencies to visualize the lectures in units II and IV to be used during the spring quarter. Unit I, III, and V were to be taught in the same manner as they had been presented in the winter. This experiment was designed to test the null hypothesis that the use of the overhead projector in units II and IV would result in no significant difference in achievement measured by standardized tests over the winter group taught without the projected visuals.

The achievement of the spring students on units II and IV was compared with records of the winter group on the same units—using the same objective tests. Also, the sum of the

\(^1\)Only five units were in this study. Unit VI was not used because the spring test was not identical to the winter test.
scores of units II and IV were compared—spring vs. winter. The tests used were standardized tests furnished by the publishers of the text, *Psychology and Life*, by Floyd L. Ruch (16). Then the performance of the spring and winter classes on the other units—I, III, and IV—was compared to establish equivalence of the two groups.

Figure 5 is a diagram of this design. It will be noted that the sum of the scores for winter "Units I, III, and V, without Visuals" was compared with the sum of the scores of spring "Units I, III, and V without Visuals." Winter "Unit II, without Visuals" was compared with spring "Unit II, with Visuals." Winter "Unit IV, without Visuals," was compared with spring "Unit IV, with Visuals." And finally, the two experimental spring units, "Unit II with Visuals" plus "Unit IV with Visuals" were compared with the same winter units, "Unit II without Visuals" plus "Unit IV without Visuals."

This comparison was made by subjecting the raw scores made on the standardized tests to the statistical formulae for t-test of significance of difference between the means of the raw scores of randomly selected groups of unequal size.

III. PRODUCING AND USING THE DESIRED MATERIALS

The first step in preparing the materials for the experiment was a consultation with Miss Anderson to show
her samples of transparencies and explain some of the ways concepts could be cartooned and diagrammed. Miss Anderson then outlined the specific points she planned to emphasize in lectures. Thumbnail sketches were prepared, suggesting ideas for visualizing each point she had outlined. To assure accuracy, each sketch was approved by Miss Anderson before it was turned over to an art student, Warren Dayton, for artistic execution. Many of the illustrations were cartoons drawn directly on acetate carbon. The resulting white outline on a dark background was hand colored with special inks. Most of the illustrations were planned for reproduction by the diazo process—development in ammonia fumes. For these, Dayton used India ink on tracing paper to make the master copy. The projector foils were exposed through the master, developed, and mounted. These foils come in a wide range of colors which added desirable variety. Usually, additional color was added by hand. An attempt was made to structure each transparency to best portray the specified concept. In some cases this meant the addition of several overlays. For others, movable or manipulative devices were added. Opaque covers were hinged to many of the mounts so that Miss Anderson could uncover one idea at a time, thus focusing attention. In a few cases, foil and carbon acetate were combined in the same mount. Thus every effort was made to make the transparencies accurate and attractive.
TO ESTABLISH EQUIVALENCE

UNIT I WITHOUT VISUALS
UNIT III WITHOUT VISUALS
UNIT V WITHOUT VISUALS

UNIT I WITHOUT VISUALS
UNIT III WITHOUT VISUALS
UNIT V WITHOUT VISUALS

TO MEASURE EFFECT OF USING THE OVERHEAD PROJECTOR

UNIT II WITHOUT VISUALS
UNIT IV WITHOUT VISUALS
UNIT II WITHOUT VISUALS
UNIT IV WITHOUT VISUALS

UNIT II WITH VISUALS
UNIT IV WITH VISUALS
UNIT II WITH VISUALS
UNIT IV WITH VISUALS

FIGURE 5
DESIGN OF THE EXPERIMENT
During the spring quarter Miss Anderson used these "custom-tailored" transparencies in teaching units II and IV. The same number of days was devoted to each unit as has been the case during the winter. Also, the film, "Gateways to the Mind" was shown in unit IV in the spring, the same as it had been in the winter. Units I, III, and V were taught in the spring in the manner they had been taught during the winter quarter.

IV. TESTING ACHIEVEMENT

The Tests

Standardized tests furnished by the publishers of the text, Psychology and Life, Scott, Foresman and Company, were used to measure performance objectively. These tests had sixty multiple choice questions each. The identical tests were administered spring and winter quarters.

In addition to the objective tests, it was decided to ask each student to give his opinion of the transparencies' value. These comments and a statement by Miss Anderson comprise a subjective evaluation of the use of the overhead projector in Psychology 100.
Method of Comparing Test Scores

The means of the test scores for all the units, spring and winter, were figured. The comparative achievement, summer vs. winter, was determined by running t-tests of significance of difference between randomly selected groups of unequal size. In this way, comparisons of performance on the objective tests were made to find out whether or not the use of the transparencies in the two spring units aided comprehension, retention, or feedback of concepts in psychology.
CHAPTER IV

INTERPRETATION OF RESULTS

The evidence obtained from the objective test scores of the two experimental units was contradictory, results of unit IV supporting the null hypothesis that the use of the overhead projector does not result in improved performance on tests, results of unit II refuting the hypothesis.

I. COMPARISON OF OBJECTIVE TEST SCORES

The combined scores of the tests for units I, III, and V were compared, spring class against the winter class. The mean for the three tests for the winter group was 42.31 as contrasted with a mean of 43.11 for spring class. A t-test of significance of difference was run resulting in a value of .7521 in favor of the spring group. For the number of students involved, however, a t-value of 1.97 is required to indicate a significant difference at the 5 percent level of confidence. Thus the test results of the three units, presumably taught in the same manner both winter and spring quarters, show no significant difference
between the two groups, indicating their equivalence for the purposes of this study.

In unit II the mean of the test scores for the spring group was 49.91; winter, 45.32. The t-value computed from these figures was 4.59 in favor of the class taught with materials for the overhead projector supplementing the lecture. Since a t-value of only 2.61 was needed to indicate significance at the 1 per cent level of confidence, 4.59 is highly significant, being a forceful refutation of the null hypothesis of this thesis.

This pattern, however, is not continued in the results of the test for unit IV. Here the mean score for the spring class was 43.69 compared with 43.34 for the winter. Running the t-test for significance of a difference with these figures gives a result similar to the value derived from the t-test of the three control units—a mere .2736 in favor of the spring section. This means no significant difference in the performance of the students who experienced the materials of unit IV over the winter quarter students. However, when the scores of the two experimental spring units are added and compared with the sum of the
same winter units the result is a $t$-value of 2.97 which is significant at the 1 per cent level of confidence. Thus it would be possible to claim that the total experiment refuted the null hypothesis. In other words, the conclusion of this study could be that the use of the overhead projector in psychology 100 resulted in improved achievement significance at the 1 per cent level of confidence. There is, however, little value in such a claim. It is much more important to try to explain why the use of the overhead projector improved learning in one unit and not in the other.

This chapter will conduct a search for facts to account for this contradiction and will conclude with a subjective evaluation of the visual material used in the experiment. The search for explanatory facts will include the analysis of three principal areas—the tests, the visual materials, and the methods of use—plus a brief suggestion regarding three other possible factors.

II. SEARCH FOR EXPLANATION OF CONTRADICTION

Analysis of Tests

The first question pertinent to the quest for an
explanation of why visuals improved performance in unit II and not in unit IV are concerned with the instrument of measurement. Their nature and acceptance as valid indicators of achievement have been established in Chapter III. Now we are concerned with individual test items. Can we find a relationship between the percentage of error on particular questions and the presentation—or the lack of presentation—of visuals to illustrate the concept needed to answer the question correctly?

Method of analysis. The procedure of analysis began with tabulating every student's errors, question by question, on a large sheet of paper. The total number of errors for each question was translated into percentage of the class failing to answer the question correctly. Then, graphs (Figures 6 and 9) were drawn to present a picture of the percentage of error on each question. Winter and spring performance on each question is compared by using black lines for winter errors and red for spring. Thus it is easy to identify the questions causing the greatest percentage of error and to separate the items on which performance of the spring group improved, remained unchanged, or decreased.
It was then possible to examine the test items showing exceptional increase and exceptional decrease of errors of the spring group over the winter section, referring back to the transparencies which illustrated the points to be learned.

**Summary of analysis of tests.** In unit II, where a highly significant difference was found in favor of the spring group, a study of the relationship between visuals and decrease in percentage of error reveals few complications. As might be expected from the t-value, the evidence on individual items reveals a direct correlation between decrease in percentage of error and the use of illustrative transparencies. The spring group had fewer errors on 51 of the 60 items. Of the nine questions where the spring class failed to improve or actually increased in percentage of errors over the winter section, five items—numbers 15, 18, 21, 37, and 55—were not illustrated by the materials used. On three other questions—13, 17, and 42—where performance favored the winter group, the actual number of errors was very small. Number 13 caused 4 mistakes in the winter, 3 in the spring; 17—3 mistakes winter, 5 mistakes, spring;
PERCENTAGE OF ERRORS ON TEST ITEMS TEST II

WINTER

SPRING

FIGURE 6

PERCENTAGE OF ERROR ON EACH TEST ITEM, UNIT II
42-5 in each. When all but 3 or 5 students in a class of 58 give the correct answer, an effective presentation of the lesson has been given. In a class of normal college freshmen, it is difficult to improve performance beyond the winter record of 96, 97, and 95 students out of 100 answering the questions correctly.

The only other question on which performance did not improve was number 31:—"With regard to human motivation, it may be accurately said that motives: (A) are particularly important in simple reflex behavior; (B) are inborn and are little affected by learning; (C) often lead to aimless activity; (D) may cause the individual to seek objects not present at the time." "D" is the correct answer. Eleven students missed this question,—3 more than in the winter. Three gave "A" as the answer; five gave "B" and three gave "C." An explanation is not apparent.

It is interesting to note the four questions which show exceptional decrease in percentage of errors—49: 41 to 8.6 per cent, 48: 49 to 20.7 per cent, 44: 38 to 13.8 per cent, 40: 45 to 24.1 per cent. These four questions covered the findings of recent research studies. This might indicate
Children from the slums tend to excel children from higher socioeconomic levels in sensory discrimination.

Children who are born prematurely tend to be equal in intelligence but inferior in emotional adjustment to other children.
<table>
<thead>
<tr>
<th>Occupation Group</th>
<th>Range of IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountants</td>
<td>80-125</td>
</tr>
<tr>
<td>Lawyers</td>
<td>90-125</td>
</tr>
<tr>
<td>Engineers</td>
<td>100-124</td>
</tr>
<tr>
<td>Teachers</td>
<td>110-121</td>
</tr>
<tr>
<td>Stenographers</td>
<td>120-125</td>
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<tr>
<td>Book Keepers</td>
<td>130-125</td>
</tr>
<tr>
<td>Clerk-Typists</td>
<td>140-115</td>
</tr>
<tr>
<td>Radio Repairmen</td>
<td>150-113</td>
</tr>
<tr>
<td>Receiving/Shipments Clerks</td>
<td>160-108</td>
</tr>
<tr>
<td>Sales Clerks</td>
<td>170-101</td>
</tr>
<tr>
<td>Auto Mechanics</td>
<td>180-98</td>
</tr>
<tr>
<td>Painters (General)</td>
<td>190-95</td>
</tr>
<tr>
<td>Barbers</td>
<td>200-91</td>
</tr>
<tr>
<td>Farm Hands</td>
<td>210-89</td>
</tr>
<tr>
<td>Teamsters</td>
<td>220-87</td>
</tr>
</tbody>
</table>

**FIGURE 8**

RANGE OF IQ IN OCCUPATION GROUPS
range of I.Q. is: (A) accountants; (B) stenographers; (C) mail carriers; (D) auto mechanics." The drop in errors was 25.2 points, from 39 to 13.8 per cent.

In the winter, seven of the 60 questions were missed by more than 50 per cent of the class. On each of these questions the spring class lowered the percentage of error: number 2, from 65 to 51 per cent; 12, from 52 to 32.8 per cent; 16, from 67 to 20.7 per cent; 39, from 56 to 48.3 per cent; 45, from 55 to 13.8 per cent; 59, from 52 to 34.5 per cent. In the spring, only two questions of the 60 were missed by 50 per cent of the class: number 2 missed by 51 per cent, number 37 missed by 50 per cent. On question number 2 this was a 14 point improvement over the winter group and for number 37 there was no visualization of the information needed for the answer.

For further information concerning the individual test items, see Appendix. The tests for unit II and unit IV are reproduced. Number of errors on each question is indicated. The difference between the two groups is listed in percentage points in the column of the group with lowest percentage of errors. Whether or not the answers were
illustrated by transparencies is also shown. Detailed examination of this test is interesting. Actually, it would be difficult to devise a more perfect correlation between the use of the transparencies and improved performance on this test.

Reporting this experiment would be much simpler if the records for unit IV continued in this same perfect correlation. The t-score for unit IV, however, indicates that the visual materials made no significant difference in the scores of the spring group over the scores for the winter group. The spring group showed fewer errors on 32 of the 60 items, the difference ranging from a mere fraction of a percentage point on several items to 14 plus percentage points on three questions. On 36 of the questions (17 favoring the winter and 19 the spring) less than 3 points separated the performance. Thus the spring and winter profiles of the chart (see Figure 9) depicting percentage of errors show great similarity, further testifying to no significant difference between the two groups as to retention of facts covered in the test.

On the other hand, the three questions mentioned
PERCENTAGE of ERRORS on TEST ITEMS TEST IV

WINTER  
SPLING

FIGURE 9

PERCENTAGE OF ERROR ON EACH TEST ITEM, UNIT IV
above as showing more than 14 points improvement by the spring group lend support to the case for using visuals in the classroom. Figure 10 is a copy of the transparency presented to illustrate facts about light which would help a student answer question 17—"The physical stimulus responsible for the sensation of brightness of color is the: (A) amplitude of the light waves; (B) frequency of the light waves; (C) complexity of the light waves; (D) length of the light waves." It also gives information to help answer question 25—"On the basis of wave characteristics, sound timbre corresponds to which quality of color: (A) hue; (B) shade; (C) saturation; (D) brightness." The third question, 20, was also illustrated. In fact, all of the questions on color vision, between 17 and 25, inclusive, were visualized. Only one question failed to show improvement from use of these visuals, and that question asked about the mixing of yellow and green light. To demonstrate the additive combinations of light, a separate light source for each color would be needed. This experiment was limited to use of the overhead projector—a one light source unless two or three projectors were used. This would be a cumbersome arrangement. A transparency was made to simulate the additive
SIMILARITY OF SOUND AND COLOR WAVES

FIGURE 10

PHYSICAL CHARACTERISTICS OF SOUND AND COLOR

SOUND

BASIC WAVE

Pitch

LOUDNESS

Timbre (Quality)

AMPLITUDE

Complexity

COLOR

Frequency

Hue

Brightness

Saturation
process. As a teaching technique this was obviously less enlightening than the verbal drill that "yellow light plus green light makes grey light." The maxim of selecting the audio-visual tool best fitted to do each job seems to be underscored by the test results on this question.

An examination of the thirteen test items showing more than 3 percentage points reduction in errors for the spring group, (see Appendix), reveals that the information for answering all of the questions was illustrated in the transparencies. This fact collaborates the evidence presented on unit II and is an argument refuting the null hypothesis of this thesis. But when attention is turned to the 26 questions on which the spring group made more errors than the winter, the formula—"use of transparencies equals better learning"—no longer applies. In fact, there were carefully prepared visuals for all except 2 of the 9 questions showing the greatest increase in percentage of errors in the spring over the winter group: numbers 33, 16, 44, 2, 45, 12, and 48 had visuals; 4 and 28 did not. (See Appendix). On the other 17 questions, the difference in percentage of error between the two groups was less than three percentage points.
To sum up performance on unit IV: On 36 items there were no significant differences, 19 favoring the spring group slightly, 17 favoring the winter group by an equally small margin. On 13 questions the spring class decreased errors by more than 3 percentage points; all these items were visualized. On 9 questions the spring class increased errors by more than 3 per cent; seven were visualized, two were not. Thus it is evident that while some of the transparencies may have helped improve performance on the test, others did not. In other words, this analysis of the test answers our question in the negative—on the fourth unit there is no clear-cut relationship between the percentage of error on particular questions and the presentation—or lack of presentation—of visuals to illustrate the concept needed to answer the question correctly.

Analysis of the Transparencies

The close look at individual test items did not reveal any reasons to explain the contradiction in results of the experiment. So perhaps factors inherent in the materials would account for the discrepancy in results. It seems important to examine at least three such factors, novelty,
characteristics of subject matter, and quality of the transparencies.

**Novelty of the projected material.** Visualized exposition was a completely new teaching technique to the students in the spring class. Few of them had seen an overhead projector in a classroom. Miss Anderson had no previous experience with this method of presenting transparencies, yet, as has been mentioned, she was enthusiastic and most eager to cooperate in the illustration of her lectures. She commented on her renewed interest created by this new teaching method. It is possible that this factor of newness may have tended to exaggerate the effectiveness of the materials in unit II. This initial novelty may have had the attention-demanding quality of a trumpet fanfare in unit II—a factor no longer operative in unit IV.

**Characteristics of the subject matter illustrated.** Unit IV was comprised of chapters on "The Special Senses" and "Perception." In comparison with unit II, unit IV was longer and more technical; the concepts were more complex and the details more numerous. It seemed more difficult
to translate unit IV into visuals. This was at least partially due to the more complex nature of the concepts to be illustrated, although fatigue may have compounded the difficulty.

Quality of the transparencies. Preparation of the transparencies for unit II presented no particular problems. Ideas for visualizing the concepts came to mind easily. The finished visuals were completed in time for Miss Anderson to practice with them and make notes in the margins of the mounts.

In contrast, lack of sufficient time to prepare the materials needed to adequately cover unit IV created problems in production, which in turn created problems for the teacher. Because of this pressure of time the ideas for the transparencies were more hastily conceived, with the result that perhaps they were less perfectly organized. Further use and analysis by psychology teachers will be needed to determine this last point. Certainly, it is true that all of the transparencies were not fully colored and were therefore less attractive than those of unit II.

From the teacher's point of view, the rush job on
unit IV meant that the materials were not ready in time for her to become completely familiar with them. This was an especially difficult problem for her because the illustrations had been gathered from various sources, many of which were new to Miss Anderson. She had authorized the inclusion of these illustrations, but they should have been completed early enough to give her ample time to make her lecture notes on each one.

Maybe fewer transparencies would have been more effective. An attempt was made to visualize all the important concepts in the unit, when what was needed was a realistic appraisal of the number of visuals which could be completed in the time available. Too much was attempted, with the result that nothing was accomplished—no significant difference shown by the test.

The characteristics of the subject matter of unit IV discussed above dictated certain characteristics of the transparencies. They were not as self-explanatory as the transparencies of unit II. They presented more technical information. Fewer words were included to explain the drawings and diagrams, simply because any approach to an
adequate explanation would require too many words. This complexity of the descriptions meant that more classroom time would be needed for presentation than was needed for unit II, whereas, the opposite was the case—as will be shown in an analysis of the way the transparencies were used in the two units.

Analysis of Methods of Using the Transparencies

The points discussed so far under analyses of the tests and of the transparencies, while raising minor questions, still have not presented sufficient evidence to account for the degree of contradiction shown by unit II and unit IV. It appears important, therefore, to look at the materials in use in the classroom. Here a variation of presentation is seen, a variation not intended but which simply developed. Some of the variables could have been avoided by a more realistic appraisal of the classroom time available and the time necessary for production of the visuals; others, such as the intervention of "Sweecy Day," were unavoidable.

Methods of unit II. Unit II was presented according
to plan—visualized exposition plus class discussion. A few transparencies were used each day by Miss Anderson to illustrate her lecture. Discussion was encouraged. On the day before the examination, the important concepts were reviewed by a second look at the transparencies.

**Methods of unit IV.** Unit IV was introduced by lecture alone on Tuesday. Miss Anderson, greatly concerned about the all-night sessions required to finish the transparencies, was trying to adapt her plan to relieve a little of the pressure by allowing one more day to complete production. The transparencies were used Wednesday and Friday mostly as a quick review of points made by the introductory lecture.

On Monday and Tuesday, the film "Gateways to the Mind" was shown. (This film had been used in the winter class). Wednesday was "Sweezy Day." The Thursday class session was used to present the final 18 transparencies and a quick review. The test was on Friday.

**Interpretation of methods.** The design of the experiment called for the same number of spring quarter class
sessions to be spent on each unit as had been spent during the winter quarter. This may be a basic fault of the design. It seems clear as an afterthought that effective use of the materials might require more time than had been spent in the winter. Or, to turn to the suggestion made in the discussion of the quality of the transparencies, the number of transparencies should have been geared to the amount of classroom time available.

Comparison of unit II with unit IV shows that more class hours were spent with the transparencies in the first unit than were spent in the second: unit II, 6 days; unit IV, 3 days. In other words, in unit II, 6 days were spent covering 30 transparencies, while in unit IV only 3 days were available to use 45 transparencies depicting complex details. This seems important. Less class time was spent in unit IV to view more transparencies. And, not only was the actual number greater than for unit II, each transparency was also more detailed, technical, and less self-explanatory.

The effect of "Sweezy Day" cannot be ignored. There were 8 absentees on Tuesday when the last half of the film
was shown. Thus they missed the important concept on perception which the film presented. (It might be interesting to discover if there is a direct correlation between the absences on Tuesday and perception questions missed, but such a search did not seem essential to this study). Here it is probably sufficient to note that "Sweezy Day" meant an interruption of two nights of study and tired students on Thursday. And Thursday was the day when the transparencies on perception were used and a brief review given, a class session overflowing with important and difficult concepts. Alert minds and devoted attention were needed to understand the material presented.

It appears that this analysis of the variables in methods of using the transparencies is the answer to explain the contradiction in the test results. In unit IV the materials were not used in the manner for which they had been designed—to visualize exposition. This variable resulted from a defect in the design of the experiment, or perhaps merely a failure to adapt the amount of material to the number of class sessions available. The preceding analysis has shown that concepts embodied in perception
were the ones receiving the least classroom time—a result of absences, fatigue, and because only part of an hour was used for transparencies to present the subject to the class. With these facts in mind it should be noted that on the test questions on visual perception the spring group performed decidedly less well than the winter group. Questions 31 through 50 pertained to visual perception. On 13 of these 19 questions the performance of the spring group was poorer than the winter group by a total of 91.4 percentage points. The spring students gained over the winter students on only 5 of the perception questions by a total of 25.9. They scored the same on the remaining questions. On the other 41 questions the spring group lost 90.8 percentage points on 14 questions while gaining 156 points on 27 questions. Thus the questions on perception accounted for more than one half of the spring group's percentage of loss in performance to the winter group. In fact, the spring group's comparative achievement on perception was a minus 66 and on the rest of the questions, it was a plus 66. (See figure 11).

Analysis of Other Factors

While the above variables in method are probably
ON THE 19 VISUAL PERCEPTION TEST ITEMS

THE SPRING CLASS

LOST A TOTAL OF 91.4 PERCENTAGE POINTS ON 13 QUESTIONS
GAINED 25.99 ON 5 QUESTIONS FOR A NET LOSS

OF 65.5 PERCENTAGE POINTS

ON THE 41 OTHER TEST ITEMS

THE SPRING CLASS

LOST 90.8 PERCENTAGE POINTS ON 13 QUESTIONS
GAINED A TOTAL 156 PERCENTAGE POINTS ON 27 QUESTIONS FOR A NET GAIN

OF 6.52 PERCENTAGE POINTS

FIGURE 11

PERCENTAGE OF ERROR ON VISUAL PERCEPTION ITEMS COMPARED WITH PERCENTAGE OF ERROR ON OTHER QUESTIONS IN UNIT II
sufficient to account for lack of agreement of the two tests, three other minor factors may have been influential. Even if they add little to the present study, they should be mentioned as factors to be considered when planning a similar experiment.

In the spring quarter, several students were on final probation. By the time unit IV was studied, their previous low grades in the class made it impossible for even superhuman effort on the remaining units to raise their psychology grades sufficiently to enable the necessary increase in grade point. They admitted to Miss Anderson that they were spending most of their time on subjects where they felt they had some chance of "pulling an 'A!'" It would be possible to check the number of such students and their grades on unit IV, to determine more exactly the extent of influence on test results, but such a survey was not deemed essential to this study.

A second factor might be that the students were overconfident on unit IV, like a university football team with a string of victories. Having shown such a remarkable improvement after seeing the unit II visuals, did they feel
that mere exposure to the transparencies insured automatic learning, with the result that they actually spent less effort studying the text? One student expressed this opinion to Miss Anderson, and others agreed with it.

As a third factor, Miss Anderson suggested that because of the technicality of the subject, perhaps this level of achievement—a mean of 43.69 out of a possible 60—is as high as can be expected on this objective test by college freshmen. It may well be that this score represents as much as they can assimilate at this state of their development. It would be interesting in this connection to discover the national mean in classes using Ruch as a text and the related tests to measure achievement. One professor teaching Psychology 100 on Central’s campus omits these two chapters entirely as "too difficult for freshmen."

III. SUBJECTIVE EVALUATION OF USE OF OVERHEAD PROJECTOR

In addition to the objective evidence on the effectiveness of the transparencies, it seemed important to determine how the students felt about the use of visuals to
illustrate the psychology lectures. Student acceptance or rejection of the materials, their pleasure or displeasure in viewing the illustrations, seemed worthy of examination. In any study of attempts to improve comprehension and retention of subject matter, the learner cannot be ignored. His attitude toward the materials being tested is of considerable interest. Leland P. Bradford states, "Because the learner is one part of the human transaction of teaching-learning, his motivational, perceptual, emotional and attitudinal systems are very important factors in how he approaches learning and change and how open he is to them" (3:137).

Of equal importance in determining the usefulness of the materials is the attitude of the teacher toward the use of transparencies. Was she comfortable in projecting visuals with her lectures? Were they accurate? Did they accomplish the job she had desired? How did she rate student acceptance? Miss Anderson's answers to these questions and student comments in their reaction to the use of the transparencies will be discussed in this section.
Student Evaluation on Unit II

When the students had finished writing the test for unit II they were asked to write a brief comment in response to the question, "What was your reaction to the use of transparencies?" No attempt was made to coerce compliance with this request. The class was told simply that their cooperation by making comments would be appreciated. Of the fifty-eight students in the class, forty-four reported highly favorable reactions to materials; seven were favorable with qualifications; two were unfavorable; two made no comment; while three students had missed the transparencies because of absences due to the choir tour.

The lack of precision in the wording of the question left each individual free to express his reactions in terms of the characteristics he deemed most important. In the highly favorable group of responses, several characteristics were attributed to the transparencies.

First, they were considered an aid to comprehension as evidenced by the following quote:

My opinion is that the transparencies are extremely valuable in leading the student to a better understanding of the material included in the chapters. I am very much in favor of using these because often times students
(including myself) memorize facts and material without fully comprehending the meaning; therefore the information is soon forgotten. By associating this material with the transparencies plant this material firmly in the student's mind.¹

Second, some students said that the recall of pictures helped them in answering questions on the test.

I certainly believe that adding the transparencies to your lecture helps. After reading the chapters, and then seeing the pictures, clarified many points. [sic] Several questions on this test were easy to answer, because the cartoons and characters came to my mind.

As a third point, others mentioned that the projected materials helped focus their attention on the lesson. "I think the transparencies are an excellent help in understanding the content and subject of the course. It keeps me alert because I like the cartoon style and even become anxious to see the next transparency; thus, I stay alert."

Fourth, the artistic style appealed to many. "Cartoons make material much more interesting. Contemporary art entertains and is a subtle way of presenting information." Another similar comment was, "The transparencies added much interest to the class and were especially good as review. The style

¹Here and in other responses cited, the mistakes are accurately quoted.
of drawing particularly makes the situations meaningful."

(It is not surprising that the above students were favorably impressed with the transparencies. Their grades on this test ranged from fifty-five to fifty-nine out of the possible sixty points). A fifth characteristic mentioned was that the visuals may have stimulated discussion. "I think the transparencies were beneficial. They were interesting, and they covered the main points in the chapter. There seemed to be more people asking questions and discussing the material."

Finally, typical comments among the statements which were highly favorable were, "I feel that the transparencies were very helpful in understanding the chapter. They picked out the main points of the chapter. I think we should have them in all solid classes." And "I think the overhead projector helped very much and I hope it will be possible to use it more."

The following three quotations sampled the comments which indicated that the students liked the transparencies, but were not completely satisfied. "I think the transparencies should be more detailed!" "I think we ought to cover more topics with them." "They aren't complete enough in
the major facts. They just give you an idea, but an idea is no good if there isn't material to back it up." The writers of these comments made grades of forty-three, thirty, and thirty-nine, respectively. And one boy made this ambiguous statement, "Transparencies\textit{sic} are all right but seem boring." His grade was thirty-seven.

Two boys did not like the visuals shown by the overhead projector. One who scored fifty-five said, "Makes no difference--I believe the workbook helps the most." The other was frank: "As for myself, I don't think it makes any difference I do most of my studying directly from the book. I don't pay that good attention in class for it to make any difference which I know is wrong\textit{sic}." His score was fifty-one, the median score for the class.

Thus, it is evident that on unit II, the students' appraisal of the transparencies' value corroborates the highly significant difference evidenced by the t-value from the comparison of winter and spring achievement on objective tests.

\textbf{Student Evaluation on Unit IV}

At the close of unit IV, the students were asked to
comment on the question: "Which do you prefer: a discussion of material from the book first or the transparencies used as the introduction?" Twenty-four in the class stated a preference for using the transparencies as an introduction to the unit. Twenty-two thought they preferred discussion first. There was no comment from six. Two were enthusiastic about the visuals, but didn't answer the question, and two considered the transparencies of no value, while one reasoned that they should be used to illustrate what was being discussed. One answer was unintelligible.

Several reasons were given for preferring the transparencies first, the most frequently being that they planted a "picture in the mind" which "makes absorbing the complicated text material much easier." "Pictures are more understood than Discussion." One boy appears to have applied one of the points the Unit presented about learning. He says, "It familiarizes you with the material with more than one sense and makes it easier to react."

The other comments not specifically mentioning the value of a "picture in the mind" indicated that use of the transparencies as an introduction made "reading easier,"
resulted in "better class notes," was helpful as an "outline" or "summary" with the discussion and text filling in the details, and that the transparencies made the subject "more interesting." Eleven of the statements merely indicated preference for the transparencies first, although some were emphatic in this preference, for example, "Introduce [sic] through transparencies is a lot better."

The students preferring discussion of the subject first felt that they "got more out of the transparencies" when discussion had given them a "background" of "details." One student stated that "... if shown later they clear up things that seem mixed up." Only seven explained their preference for discussion first, the most articulate response being,

The use of transparencies are [sic] very helpful in making clearer the material. I think that they are more helpful though where use [sic] after the material has been discussed in class. This way the material has been presented in detail and the use of the transparencies can help clarify specific points not fully understood through reading and discussion.

One girl seems to agree with the explanation of the reason for the contradictory results from the two units by saying, "I felt that more time should be spent on the transparencies
and not rush through them so quickly." Another girl comes close to asking for integration of the transparencies and the lecture by stating, "I believe the lecture should have been presented first and then the transparencies relating to the particular items of the lecture. I believe more could have been gained this way."

The two negative statements were: "Introduce, discuss, do not care for transparencies," and "Unfortunately, neither one of the methods were [sic] particularly helpful to me." In contrast was found this statement: "The use of transparencies were [sic] more helpful to me than lecturing. I hope that you will continue the use of the transparencies."

There seemed to be no relationship between scores on this test and the comments on the use of visual material. For example, the first of the two negative statements above was made by a boy who scored thirty-six on the test and the second by a boy who scored fifty-two. A girl scoring forty-five asked for continued use of the transparencies.

Nearly all of the comments reflected the need for fuller explanation of the projected pictures, indicating that they are not self-explanatory. Nor were they intended to be
so. They were planned to be integrated with the lecture as illustrated exposition. They lose some of their effectiveness when not used in this manner. The no significant difference indicated by the t-value on unit IV testifies to this point as do the comments of the students, divided almost equally as to whether discussion or the transparencies should be used first.

Teacher Evaluation of the Use of the Transparencies

The key to the learning in any classroom is the teacher. Materials for learning can contribute little without an enthusiastic presentation by the teacher. To be effective, any method of teaching must seem natural and comfortable to her. Therefore, in considering the value of these transparencies to the achievement of students in Psychology 100, the following statement by Miss Anderson carries great weight:

An important factor in the use of the transparencies was the ease with which they were projected. Even though I had no previous experience with the overhead projector, nor had I seen it demonstrated, I felt secure in its use after only a few suggestions. I feel that any instructor could use the transparencies in the overhead projector with ease and security.

Student interest was so high on units where transparencies were used, that teaching was much more enjoyable.
The transparencies captivated the interest of this instructor as well as that of the students.

The excellency of the transparencies was a great factor in developing interest in those units in which they were used. They depicted an accurate understanding of content, a clever selection and talented portrayal of concepts, and a sensitivity to the interests and the needs of the students.

Value of this Subjective Evaluation

The importance of student and teacher acceptance of overhead projection for the use of the transparencies seems obvious. Harold L. Kingsley in "The Nature and Conditions of Learning," says, "as important as capacity in the learning process is motivation . . ." (8:191). He continues: "Essential to the learning process is motivation, which energizes the organism, gives direction to activity, and selects goals deemed valuable" (8:206).

In order to learn, the student must make responses; he must do something. He makes responses to visual stimuli in the same manner he responds to words. In a classroom these responses are usually images and thoughts. These perceptual and ideational responses are extremely important because if his responses are irrelevant, such as day dreaming, we cannot expect him to learn anything relevant.
For most of the students in the spring section of Psychology 100, the transparencies had some value as motivation: they increased interest in subjects studied. Miss Anderson commented on her renewed interest in teaching the class. Her constant enthusiasm for the transparencies was a source of inspiration for their production.
CHAPTER V

SUMMARY

I. SUMMARY OF THE EXPERIMENT

The experiment described in this report was set up to investigate the possibility that visual materials designed to a professor's specified requirements and integrated with his lectures might improve student learning of psychology concepts as measured by standardized objective tests and evaluated by subjective statements. This study was conducted in an introductory psychology class at Central Washington College of Education in Ellensburg, Washington. Miss Mabel Anderson was the cooperating professor.

Miss Anderson divided the subject matter of this course into six units. During the winter quarter, 1960, she taught all six units by the lecture method, using no visuals except the film, "Gateways to the Mind." There were 100 students in her winter quarter classes. These students served as the control group for the experiment.

During the spring quarter Miss Anderson taught four of the six units in the same manner as she had taught them during the winter quarter. The experiment was conducted on units II and IV. For these units, transparencies were
designed and produced to illustrate the concepts she wished to emphasize. These transparencies were the only variable in method of teaching the experimental units II and IV. The same number of days was spent on each unit, winter and spring. "Gateways to the Mind" was shown in unit IV in the spring as it had been shown in the winter.

The same objective tests prepared by the author of the text, Floyd L. Ruch, were used to measure achievement of the students in both the winter and spring quarter classes. The performance of the spring group on the test for the units using the transparencies was compared with the record of the winter group on the same units. Miss Anderson and the students in the experimental group were asked to give opinions concerning the effectiveness of the transparencies.

II. CONCLUSIONS

Examination of the evidence supplied by the objective evaluation of effect of the transparencies in unit II revealed a highly significant difference at the 1 per cent level of confidence. Subjective evaluation also indicated that they had contributed to the learning in Psychology 100. Thus the evidence collected by this experiment in unit II clearly refutes the null hypothesis of this thesis by
indicating that the use of the overhead projector did result in significant difference in achievement as measured by the objective tests.

On the other hand the evidence on unit IV supports the hypothesis predicting no significant difference in achievement.

Comparison of the sum of the scores for both experimental units in the spring with the sum of scores for the same units in the winter results in a t-value of difference significant to the 1 per cent level of confidence. On the basis of these figures, it would be possible to conclude that this study refutes the null hypothesis but such a conclusion would be of little value. It seemed of greater importance to explore the reasons for the contradiction in results on the two experimental units. This contradiction has made this study more interesting and actually of more value than had both units shown the same results.

After the contradiction was examined and analyzed, the conclusion was reached that the no significant difference in unit IV resulted from insufficient classroom time spent on each transparency to allow students to benefit fully from the visualization of highly technical concepts. Therefore the procedure in unit IV was not a fair test of the possible effectiveness of overhead projection.
III. IMPLICATIONS

The most important implication, certainly, is that "visualized exposition" is a field worthy of further exploration. This conclusion is supported by the enthusiasm of students and teacher for the materials in both units and by the improved performance on an objective test in unit II.

A second implication is that visual materials alone are no guarantee of learning. The method of using them determines their effectiveness. This conclusion is supported by findings of M. D. Vernon in a study "Presenting Information in Diagrams" (20:147-158).

A third implication is that perhaps the objective test does not measure achievement of some of the most important goals in education. Quoting Mr. Kingsley again, "The end of learning is not only a skill or knowledge but also the acquisition of motives, attitudes, and interests which serve individual, educational, and social needs" (8:206). The objective test does not evaluate the student's problem-solving behavior, his creative thinking, his formation of desirable attitudes, nor the generic use of knowledge. Perhaps scholarly observation is needed in research as well as controlled experiment.
IV. SUGGESTIONS FOR FUTURE RESEARCH

Repeat this experiment with more effective control. The evidence from this experiment indicates that consideration should be given to repeating the experiment, controlling the variables which were obtained in unit IV. Specific recommendations for repeating the study include: (1) Teach the experimental and control classes the same quarter by the same teacher. This would insure the same number of days for each unit with each group and the closest possible similarity in lecture presentation. (2) Establish the length of each unit to meet the requirements of effective use of the visual materials. Thus the full benefit from the transparencies will accrue to the students and be a fair test of their value. Rushing through visuals can result in more annoyance than learning. (3) Schedule the experiment to avoid campus holidays, which interfere with normal study habits, and other activities such as choir tours which take students out of class for several days. (4) Prepare a questionnaire to structure the subjective evaluation to measure attitudes and learnings other than mere feedback of facts on the objective tests.

A study of the performance in advanced psychology of the students in this experiment. The purpose of such a
study would be to determine the possibility that the use of visuals in introductory psychology might improve student achievement in advanced psychology classes.

A study to measure generic learning from visuals. Studies from Karl Smith indicate that "well designed artistic illustration promotes esthetic, moral, pragmatic, and emotional values in any learning situation . . ." (18:99). It would be helpful to quantify these values to determine the extent to which pictures and diagrams attract attention and compel concentrated mental participation so that the student can internalize concepts, making the ideas functional in his behavior.

A study of the qualities in transparencies which make for greatest effectiveness. Many questions concerning style—both of lettering and cartooning—color, methods of abstracting, size and arrangement need answers. These are difficult problems. Fitting the new graphic technique into education is a complicated process. Research must tell us more. There is a great need for basic research on how communication occurs.

Communication means shared meanings. It is important for audiovisual production people to know how meanings are shared. In 1956 William H. Allen reported:
Stimulated in part by Wiener's concept of cybernetics,1 Shannon and Weaver's mathematical theory of communication,2 and Korzybski's semantic principles,3 progress has been made in the construction of a general theory of communication. This theory has important implications for AV production and utilization; and an improved understanding of the process of communication should result from better theory construction (8:147).

This whole problem of communication is basic to any method of teaching whether by lecture alone or with the aid of electronic equipment. This study gives evidence that the overhead projector, properly used, can be effective in improving learning in a classroom. Nevertheless, the quality of the teaching materials, brought to life by the teacher's ingenuity and sensitivity to the needs of the students, determines the learning. Guidelines are needed in the designing of these materials. Here is an exciting area for the imaginative educator to explore.


THE APPENDIX
APPENDIX

Test for Unit IV

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<th>Diff. in % of Errors</th>
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A 1. The term "cutaneous senses" refers to the: (A) senses of touch; (B) labyrinthine senses; (C) senses of active movement; (D) senses of passive movement.

B 2. The labyrinthine senses are concerned with: (A) active movement; (B) passive movement; (C) heat and cold; (D) hearing.

B 3. The gustatory sense is the sense of: (A) smell; (B) taste; (C) active movement; (D) touch.

D 4. Weber's law deals with (A) color vision; (B) dark adaptation; (C) hearing; (D) difference threshold.

D 5. The structure in the eye which focuses light rays onto the sensitive surface of the retina is the: (A) pupil; (B) cornea; (C) iris; (D) lens.

* Number of Students
C 6. An area of the eye which consists entirely of tightly packed cones is the (A) sclera; (B) cornea; (C) fovea; (D) occipital area.

A 7. During dark adaptation, sensitivity to which color of light is lost first: (A) red; (B) green; (C) blue; (D) violet.

C 8. The process by which the lens thickens or flattens according to the distance of the object from the eye is called: (A) convergence; (B) cyclofusional movement; (C) accommodation; (D) adaptation.

C 9. Cyclofusional movement refers to the: (A) process by which the eyes turn toward each other to fixate upon a near object; (B) movement of the iris in adjusting the size of the pupil; (C) independent rotation of each eye to make light from an object strike corresponding parts of both retinas; (D) gliding motion of the eyes in following a moving object.

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B 10. The keenest daytime vision is obtained when the image falls on the: (A) rods; (B) fovea; (C) point where the optic nerve enters the eye; (D) periphery of the retina.

B 11. In hiring a forest ranger, you would be least likely to select a man whose vision was: (A) 20/20; (B) 20/10; (C) 20/40; (D) 20/100.

B 12. Myopia is caused by: (A) hardening of the lens; (B) the lens bulging out too far; (C) old age; (D) irregular curvature of the cornea.

B 13. Hyperopia is another name for: (A) near-sightedness; (B) far-sightedness; (C) old-sightedness; (D) color blindness.

C 14. Presbyopia is caused by: (A) injury or excessive use of alcohol; (B) the lens bulging out too far; (C) old age; (D) irregular curvature of the cornea.

C 15. Clear vision in one
dimension but fuzzy vision in the other dimension is characteristic of the defect known as:
(A) presbyopia; (B) myopia; (C) astigmatism; (D) dichromatic vision.

D 16. An important theory of color vision was advanced by: (A) Weber; (B) Wever and Bray; (C) Hardy, Rand, and Rittler; (D) Young and Helmholtz.

A 17. The physical stimulus responsible for the sensation of brightness of color is the: (A) amplitude of the light waves; (B) frequency of the light waves; (C) complexity of the light waves; (D) length of the light waves.

C 18. The complexity of the light waves is responsible for which quality of color: (A) hue; (B) glow; (C) saturation; (D) brightness.

B 19. When blue light is mixed with yellow light, what color

* See Text, pp.
light is obtained:
(A) white; (B) gray; (C) green; (D) purple.

B 20. Which of the following is not a primary color of light: (A) red; (B) yellow; (C) green; (D) blue.

A 21. Colors which combine to produce gray are known as: (A) complementary colors; (B) primary colors; (C) psychological primaries; (D) unsaturated colors.

D 22. Which of the following is not characteristic of the color green: (A) a primary color of light mixture; (B) soothing and peaceful in mood; (C) psychological primary; (D) advancing color.

D 23. The Hardy-Rand-Ritter test requires the individual to: (A) distinguish numerals on color plates composed of dots; (B) match spots on a transparent disk with spots on a master diagram beneath; (C) match painted metal chips; (D) distinguish

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triangles, circles, and squares in charts composed of dots.

B 24. The dimension of sound produced by the amplitude of the waves is: (A) pitch; (B) loudness; (C) timbre; (D) overtones.

C 25. On the basis of wave characteristics, sound timbre corresponds to which quality of color: (A) hue; (B) shade; (C) saturation; (D) brightness.

C 26. The intensity of sound is measured in: (A) partials; (B) cycles per second; (C) decibels; (D) intervals.

D 27. Persons who are unable to discriminate between auditory frequencies are said to suffer from: (A) partial deafness; (B) tinnitus; (C) intensity deafness; (D) tone deafness.

A 28. Infrared absorption apparently plays an important role in the: (A) olfactory

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sense; (B) sense of sight; (C) cutaneous senses; (D) labyrinthine senses.

B 29. The receptors which inform you of straight-line motions are located in the: (A) ampullae; (B) utricle; (C) organ of Corti; (D) Eustachian tube.

D 30. The base of the tongue is primarily sensitive to which kind of taste: (A) sweet; (B) sour; (C) salt; (D) bitter.

D 31. Perception, the complex process of gaining information about our environment, involves both: (A) thoughts and past experience; (B) sensory data and thinking; (C) observation and thinking; (D) sensory data and past experience.

C 32. The process by which the individual selects, from the vast number of stimuli acting upon him at a given time, only certain stimuli to which he responds is known as: (A) perception; (B) physiological selec-
tivity; (C) attention; (D) sensory adaptation.

C 33. In which of the following psychological processes is the actual presence of physical stimulus objects not required: (A) sensation; (B) observation; (C) thinking; (D) perception.

B 34. Habitual attention differs from involuntary attention primarily in that habitual attention: (A) requires more effort; (B) is the result of practice; (C) is more dependent upon set; (D) precedes voluntary attention.

C 35. Distraction by noise would be most likely to: (A) decrease the amount of work output; (B) decrease the quality of work output; (C) decrease the efficiency of work as measured by energy expended; (D) cause a steady decrease in worker's contentment on the job.

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A 36. The processes which operate to make your perception of a juicy beefsteak a delightful experience are the:
   (A) affective processes; (B) receptor processes; (C) symbolic processes; (D) motivational processes.

B 37. We are able to classify situations of related kinds and also the kinds of behavior appropriate in those situations because we possess:
   (A) psychological selectivity; (B) schemata; (C) affective processes; (D) a variety of "sets".

B 38. Which of the following factors in perception is not an external characteristic of the stimulus object:
   (A) likeness; (B) inclusiveness; (C) context; (D) set.

B 39. What characteristic of the stimulus object important in perception is illustrated

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by the sequence
XXOOXXOO: (A)
proximity; (B)
likeness; (C) in-
clusiveness; (D)
context.

C 40. Our perception
of color depends
most upon the
factor of: (A)
proximity; (B)
inclusiveness; (C)
part-whole relation-
ships; (D) likeness.

C 41. The experiment in
which subjects
matched the color
of stimulus patches
to the colors on a
color-mixer illus-
trated the prin-
ciple that perception:
(A) maintains the
stability of the en-
vironment; (B) de-
pends upon organic
needs; (C) clarifies
and defines ambi-
guous stimuli; (D)
is selective in
character.

C 42. College students
can perceive food
objects in ambi-
guous drawings
most readily: (A)
immediately after
eating; (B) one hour
after eating; (C) six
hours after eating; (D)
nine hours after eating.

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A 43. When a "success" group and a "failure" group of subjects were shown an ambiguous slide representing a paycheck, the failure group tended to:
(A) see the amount of the paycheck as larger than did the success or control groups; (B) see the amount of the check as smaller; (C) show less difference in their perception of the paycheck than in their perception of other ambiguous items in the test; (D) fail to see any amount at all on the check.

D 44. Persons who experience relatively little difficulty in perceiving an item accurately, regardless of changes in the surrounding field, tend to have personalities characterized by: (A) willingness to submit to authority; (B) poor control of their aggressive impulses; (C) relatively high anxiety; (D) high self-confidence.
A 45. The field-dependent perceiver would be least likely to display: (A) ability to initiate and organize activities; (B) poor control of sexual impulses; (C) high anxiety; (D) low evaluation of the physical body.

C 46. Studies of field-dependence in relation to age have revealed that dependence upon the perceptual field: (A) steadily increases from about age 8 to 17 and then declines; (B) steadily decreases until age 13 and increases up to age 17; (C) shows its most dramatic decrease between the ages of 10 and 13 and does not begin to increase again until age 17; (D) remains relatively low until age 13 and then increases during adolescence until about the age of 17.

B 47. Women have been found to be: (A) more analytic in their perception than men; (B) more dependent
on visual cues than men; (C) more subject to the illusion of autokinetic movement than men; (D) more able to restructure the perceptual field than men.

D 48. Perceptual defense is most closely related to: (A) visual illusion; (B) autokinetic movement; (C) field dependency; (D) social taboos.

C 49. A cue to depth and distance which can be utilized by the person with monocular vision is: (A) convergence; (B) cyclofusional movement; (C) relative position; (D) retinal disparity.

A 50. In judging distance we are most likely to make errors in using the cue of: (A) atmospheric perspective; (B) linear perspective; (C) texture; (D) relative position.

C 51. Radial motion means: (A) relative motion; (B) motion in a circle; (C) motion directly toward or away

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from the observer; (D) the apparent motion of movies composed of a series of still pictures.

A 52. Our discrimination of short intervals of time varies as different senses are involved. In general, the finest discrimination has been found to be: (A) auditory; (B) visual; (C) mixed auditory and visual; (D) kinesthetic.

A 53. With regard to localizing the source of a sound, a person who was totally deaf in one ear would probably be able to determine: (A) distance but not direction; (B) direction but not distance; (C) neither direction or distance; (D) both direction and distance.

C 54. The passage of awareness from one mind to another without intervention of the sense organs is known as: (A) hallucination; (B) clairvoyance; (C) mental telepathy; (D) autokinesis.

B 55. Clairvoyance is a form of: (A)
perceptual defense; (B) extrasensory perception; (C) social suggestion; (D) binocular cue in depth perception.

D 56. The chronoscope is used in experiments on: (A) ambiguous stimuli; (B) extrasensory perception; (C) depth perception; (D) reaction time.

A 57. With regard to speed of reaction time, it has been established that: (A) reaction time is faster when two sense organs are stimulated simultaneously than when only one is stimulated; (B) in general, women have faster reaction time than men; (C) reaction time becomes more rapid under conditions of vigilance; (D) strengthening the stimulus has little if any effect on speed of reaction time.

C 58. Speed of reaction increases with age until the individual is about: (A) 15; (B) 20; (C) 30; (D) 45.

C 59. Which of the following kinds of stimuli would

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probably produce the most rapid reaction in the untrained individual: (A) visual; (B) tactual; (C) auditory; (D) pain.

D 60. The "g" factor would be most likely to affect the reaction time of: (A) mathematicians; (B) psychotics; (C) elderly persons; (D) airplane pilots.

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Unit II

Test

B 1. The term "ability" as used by psychologists, refers to: (A) capacity; (B) quality or quantity of actual performance; (C) trainability; (D) potential plus present performance.

B 2. The relation of M.A. to C.A. maintains a steady ratio for a time, but mental age increases more slowly than chronological age after a person reaches: (A) 10; (B) 13; (C) 16; (D) 20.

C 3. Nancy has an I.Q. of 75. When she is 12 years old, we would expect her mental age to be (A) 9; (B) 10; (C) 12; (D) 16.

C 4. Tommy is 3 years old and has a mental age of 2 years. When he is 9 years old, his mental age will probably be: (A) 3; (B) 4½, (C) 6; (D) 12.

C 5. With regard to the constancy of the I.Q., it has been found that: (A) the I.Q. is most constant in very young children, gradually decreasing in constancy; (B) the I.Q. tends to vary with environmental conditions, making yearly testing desirable;

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(C) the I.Q. remains essentially the same unless health or environment changes markedly; (D) different degrees of constancy exist in different individuals, making a general conclusion impossible at the present time.

A 6. The relative constancy of the I.Q. is: (A) borne out in experimental studies; (B) an experimental artifact; (C) theoretical only; (D) found in the superior levels only.

B 7. The "normal" category of I.Q., including about half of the population extends from: (A) 85-95; (B) 90-109; (C) 95-115; (D) 100-112.

C 8. Jimmy, with an I.Q. of 56, would be classed as: (A) an idiot; (B) an imbecile; (C) a moron; (D) a borderline normal case.

D 9. A mental defective capable of going as far as the fifth grade in school would be classed as: (A) an idiot; (B) an imbecile; (C) a high-grade imbecile; (D) a moron.

D 10. An imbecile: (A) usually runs afoul of the law; (B) can seldom learn to talk; (C) can usually learn to read and write; (D) can do simple work under supervision.

B 11. If Sammy has an I.Q. of 65 when he enters the first grade, we can predict that he: (A) will complete first grade only;
(B) can probably get as high as the fifth grade; (C) may get through junior high school; (D) may finish college if he gets special help or tutoring.

A 12. In a study of adults who had obtained low scores on the Binet test in childhood, it was found that: (A) a lower percentage of them were married than would be normal for their age group; (B) most of their children had subnormal intelligence; (C) very few of them were regularly employed; (D) very few of them had been in trouble with the law.

C 13. The group of mentally gifted persons studied by Terman was characterized by: (A) high insanity rate; (B) early decline of abilities; (C) low death rate; (D) high divorce rate.

A 14. The occupational group which would probably show the narrowest range of I.Q. is: (A) accountants; (B) stenographers; (C) mail carriers; (D) auto mechanics.

D 15. An intelligence factor which apparently does not depend upon heredity to any great extent, as indicated by British studies of identical twins, is: (A) verbal comprehension; (B) word fluency; (C) numerical ability; (D) intellectual speed.

B 16. Children from the slums tend to excel children from higher socioeconomic levels on
intelligence-test items involving: (A) repeating digits; (B) sensory discrimination; (C) making rhymes; (D) stating the essential similarities between concrete objects.

B 17. College students in Ceylon show striking superiority to American students in which of the following intelligence factors: (A) numerical ability; (B) verbal ability; (C) space visualization; (D) reasoning ability.

A 18. The intelligence of people in our population is most closely related to which of the following: (A) economic standing; (B) musical ability; (C) mechanical ability; (D) artistic ability.

C 19. A marked improvement in environment: (A) usually causes a marked improvement in I.Q.; (B) may cause marked improvement in I.Q. if it does not occur too early in life; (C) may improve the I.Q. by about 10 points; (D) does not affect the I.Q.

D 20. The advantage of improved environment in raising the I.Q. will be greatest for: (A) feeble-minded individuals; (B) identical twins; (C) superior children; (D) young children.

C 21. Indian children score lower than white children on the Stanford-Binet. The best interpretation is that: (A) Indians are mentally inferior; (B) the test measures achievement rather than intelligence;
(C) our concept of intelligence may not apply to Indian culture;
(D) Indians reach mental maturity more slowly than white persons.

C 22. Klineberg's hypothesis, verified by later studies in Philadelphia, stated that: (A) Negroes are inherently inferior to whites in verbal, though not in nonverbal, aspects of intelligence; (B) the most intelligent Negroes are those who move north, causing the intelligence level of southern Negroes to be somewhat lower than that of those who live in the north; (C) better environmental conditions can cause an improvement in Negro I.Q.'s in the north; (D) the I.Q.'s of southern negroes are really as high as those of northern negroes but appear lower because the tests are not culture-fair.

D 23. Studies of various special factors which affect intelligence have shown that: (A) first-born children are slightly superior in I.Q. to those coming later; (B) improved nutrition can cause significant improvement in I.Q.; (C) highly intelligent children tend to be somewhat delicate and weak; (D) month of birth has no significant effect on intelligence.

D 24. A child is most likely to be abnormally low in intelligence if: (A) he is born in extremely cold weather; (B) he is born prematurely; (C) he suffers from malnutrition in infancy; (D) he suffers thyroid deficiency in infancy.
C 25. Children who are born prematurely tend to be: (A) inferior to normally born children both in intelligence and emotional adjustment; (B) equal in intelligence but superior in emotional adjustment because of the special care received during infancy; (C) equal in intelligence but inferior in emotional adjustment to other children; (D) about equal in emotional adjustment and slightly superior in intelligence because of the unusual stimulation in early infancy.

A 26. Boys tend to excel girls in: (A) spatial intelligence; (B) word fluency; (C) reasoning; (D) memory.

B 27. It has been found that scores on the Bennett Test of Mechanical Comprehension are valuable in predicting: (A) degree of interest in scientific subjects; (B) masculinity of interests; (C) stability and sense of responsibility; (D) general intelligence.

C 28. Which of the following is a true statement about human abilities: (A) creative artistic ability shows no correlation with art appreciation; (B) the elements of musical ability, such as pitch discrimination and sense of rhythm, tend to be highly correlated; (C) mechanical ability shows no correlation with general intelligence; (D) musical ability and artistic ability are correlated.

D 29. Studies conducted to determine the effect of age on intelligence have revealed that: (A) general
intelligence declines steadily with age; (B) age has no effect on the constancy of mental abilities; (C) the sharpest decline occurs on comprehension items; (D) although performance items decline, verbal items such as vocabulary or information questions actually increase with age.

C 30. A major problem involved in the use of the longitudinal method of studying the growth and decline of human abilities is that of: (A) obtaining tests that are equally fair to all age groups; (B) obtaining representative samples of the population; (C) obtaining enough different forms of the tests used; (D) controlling the motivation factor.

D 31. With regard to human motivation, it may be accurately said that motives: (A) are particularly important in simple reflex behavior; (B) are inborn and are little affected by learning; (C) often lead to aimless activity; (D) may cause the individual to seek objects not present at the time.

C 32. Motives differ from drives in that motives: (A) come from social needs, whereas drives come from physiological needs; (B) are acquired, whereas drives are inborn; (C) always direct the organism toward a goal, whereas drives may cause aimless activity; (D) are more intense than drives.

A 33. Which of the following drives is more intense than thirst: (A) air hunger; (B) sex; (C) extreme fatigue; (D) none.
A 34. The best term to use to refer to any internal stimulus condition of the organism which impels it to activity is: (A) drive; (B) motive; (C) tissue need; (D) appetite.

B 35. The biological drives help maintain the constant physiological stability or equilibrium of the organism known as: (A) phychophysiology; (B) homeostasis; (C) internal need satisfaction; (D) tissue renewal.

B 36. From the results of research on the hunger drive, it has been concluded that: (A) the hunger pangs are not felt unless stomach contractions are present; (B) the temperature of the stomach drops sharply during hunger; (C) hunger pangs have many causes but stomach contractions are necessary; (D) it is impossible to feel hunger only when the stomach is completely removed.

D 37. Experimental rats will eat most ravenously when: (A) the stomach is removed so that food storage is decreased; (B) the temperature of the stomach is artificially lowered; (C) the contractions of the stomach are experimentally increased in intensity; (D) the hypothalamus is surgically manipulated.

D 38. An investigator who has performed a number of experiments on the effects of the hunger drive is: (A) Harry Harlow; (B) Nathaniel Kleitman; (C) Alfred Kinsey; (D) Ancel Keys.

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When the organism is hungry, it: (A) becomes abnormally sensitive to all environmental stimuli; (B) reacts most strongly to environmental situations connected with food or feeding time; (C) becomes apathetic and reacts less than normally to environmental stimuli; (D) shows little change in reactivity.

During the first twelve weeks of the Minnesota hunger experiment, the subjects ate: (A) bread and water; (B) a diet normal in content but only half as large as normal in size of portions; (C) mainly bread, macaroni, potatoes, turnips, and cabbage; (D) a well-balanced diet.

A person subjected to a prolonged period of semistarvation would be least likely to suffer a loss in: (A) intelligence; (B) sexual desire; (C) basal metabolism; (D) self-confidence.

In the experiment in which newly weaned babies were allowed to choose their own foods for a six-month period, it was found that the infants: (A) chose food that was bad for them about half the time; (B) ate so little that they lost weight; (C) chose foods that met their nutritional needs and gained normally; (D) chose mostly foods that were sweet.

The most accurate statement about man's "wisdom of the body" in selecting the best foods for the body's needs is: (A) science has disproved its existence;
(B) it will prevent a man from eating injurious foods; (C) it is often overruled by learned preferences; (D) there probably is no such thing.

D 44. After a group of dogs have been deprived of water for some time, an amount of water equal to the deficit that had been built up was placed directly into the stomachs of the dogs. When they were offered water after fifteen minutes had passed, it was found that the animals: (A) drank an amount approximately equal to the bodily deficit; (B) drank until they could hold no more; usually consuming more water than the bodily deficit; (C) drank only a small amount of water to relieve the dryness of mouth and throat tissues; (D) drank no water at all.

C 45. As compared with thirsty rats, hungry rats usually: (A) show more frenzied activity because of the greater intensity of their desire; (B) learn to find food more quickly than the thirsty rats learn to find water; (C) show greater variety of behavior during learning; (D) show a high degree of apathy in the maze-learning situation.

B 46. A peculiar sort of drunken behavior, in which the person feels confident of his abilities but fails to control his emotions normally, is characteristic of severe: (A) fatigue; (B) air hunger; (C) thirst; (D) hunger for food.

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A 47. The infant who experiences severe anoxia at the time of birth is most likely to suffer from: (A) feeble-mindedness; (B) dwarfism; (C) weakness of the respiratory system; (D) impaired heart action.

A 48. It has been shown that the maximum period during which an individual can go without sleep and still perform very simple, short tasks with only slight losses in efficiency is about: (A) 100 hours; (B) 75 hours; (C) 50 hours; (D) 30 hours.

B 49. The experience of the British North Greenland Expedition was significant for our knowledge of man's sleep needs because it indicated that: (A) people actually need considerably less sleep than had formerly been thought necessary; (B) the traditional eight hours of sleep is probably based on bodily needs; (C) when it is dark all the time, people tend to sleep excessively; (D) when people are released from conventional sleep habits, tremendous individual variations in sleep needs appear.

B 50. A structure which responds directly to the temperature of the blood flowing through it and plays a vital part in the regulation of the body's adjustment to heat and cold is the: (A) thymus; (B) hypothalamus; (C) cerebellum; (D) pineal body.

B 51. When the external temperature is cold, a number of bodily reactions take place. Among these is which of the following: (A) secretion of thyroid and adrenal glands slows
down; (B) blood is driven from the surface of the body to the deeper tissues; (C) blood pressure decreases; (D) muscular activity decreases.

C 52. The female sex drive differs from that of the male primarily in that: (A) while less rapidly aroused, it is more intense; (B) it develops more rapidly than the male, reaching its peak in the late teens; (C) it shows periodic variations in intensity; (D) it is considerably less intense than the male.

D 53. The male hormones which help regulate sexual desires are the: (A) estrus hormones; (B) estrogens; (C) progestins; (D) androgens.

A 54. In the female, estrus generally coincides with: (A) ovulation period; (B) gestation period; (C) the lactation period; (D) the menstrual period.

G 55. The time of the month during which the female is capable of conceiving is: (A) a few days immediately preceding the menstrual period; (B) a few days immediately following the menstrual period; (C) the period of ovulation; (D) the entire month except the few days of estrus.

G 56. The biological drive which is most closely related to the general emotional setting in which it occurs is: (A) hunger; (B) heat and cold; (C) pain; (D) fatigue.

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B 57. Symbolic rewards are particularly important in the acquiring of: (A) tissue needs; (B) psychological and social drives; (C) homeostatic mechanisms; (D) curiosity.

D 58. The tendency to want the things forbidden by parents and to be averse to things for which the child is praised is known as: (A) negative transfer; (B) symbolic perversion; (C) drive reversal; (D) negativism.

C 59. Interests are most closely related to our: (A) biological drives; (B) intellectual level; (C) need for self-enhancement; (D) age.

D 50. Curiosity as a drive is: (A) virtually nonexistent in the lower animals; (B) present in the lower animals but inadequate as an incentive for learning; (C) acquired through the use of symbolic rewards; (D) apparently a strong inborn motive in man and the lower animals.
SAMPLES OF THE TRANSPARENCIES
NOISE

REDUCTION IN EFFICIENCY
GREATER ENERGY REQUIRED TO DO DAY'S WORK.

WORRY-FEAR.. CAUSES ACCIDENTS

CONTROL OF DISTRACTION

RELATE SUBJECTS TO EVERY-DAY PROBLEMS.
HABITUAL ATTENTION IS A MATTER OF PRACTICE.
NEED FOR SLEEP

100 hrs. WITHOUT SLEEP

ONLY SLIGHT LOSS OF EFFICIENCY IN PERFORMING SIMPLE TASKS.

30 hrs. WITHOUT SLEEP

LOWER PERFORMANCE OF COMPLEX MENTAL TASKS.

BRITISH NORTH GREENLAND EXPEDITION: INDICATED THAT THE TRADITIONAL 8 HRS. OF SLEEP IS PROBABLY BASED ON BODILY NEEDS.

7.9 hrs.
Capacity must mature and be developed by training into ability. Measured as quality or quantity of actual performance or trainability.


