INTERACTION OF "VISUAL COMPRESSION" AND FIELD-DEPENDENCE IN RELATION TO SELF-INSTRUCTION AND TRANSFER

Thesis for the Degree of Ph. D.

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DAVID WILLIAM HESSLER

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ABSTRACT

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By

David William Hessler

An experiment was conducted which measured the effects of visual compression within a self-instructional slide sequence and field-dependence as a learner characteristic upon performance in self-instruction and in a subsequent transfer task. Subjects were sixty college students selected on the basis of their performance on the Thurstone and Jeffrey Closure Flexibility Test. Thirty subjects with high scores were labeled field-independent while the thirty subjects with the low scores were labeled less field-independent. The sixty subjects were selected from 218 subjects enrolled in basic audiovisual courses who were tested on the field-dependence dimension with the Closure Flexibility Test.

Visual-compression as described in the study refers to a technique of masking slides to highlight the message function of certain cues in a visual. The masking is not completely opaque, thus permitting background cues to be visible but appear as a gray mass. The technique

is believed to alter the figure-ground relationship within a visual. The experimental slide sequence used the visually-compressed technique. The control slide sequence used the regular color slides without any masking. Each version of the self-instructional slide sequence used the same pictorial and verbal content. The self-instructional units were student paced.

The self-instructional program was concerned with learning to use an exposure meter on a photographic copy-stand. The program was designed with the principles of transfer as a framework. Test subjects were observed and interviewed as a method of developing the program prior to use in the study.

The transfer task consisted of application of the principles of exposure to a camera with a built-in meter rather than the separate camera and meter used during self-instruction.

Six dependent measures were obtained. The four measures related to self-instruction included (1) the amount of time spent with the self-instructional slides, (2) score on a written review task, (3) score on a replication task, and (4) the amount of time spent on the replication task. The other two measures were related to (5) performance score on the transfer task and (6) the amount of time required to perform the transfer task.

Sixty subjects were randomly assigned to four experimental condition groups determined on the basis of slide treatment and field-dependence. There were fifteen subjects in each condition.

The statistical analysis involved a 2 X 2 factorial design. The results of the study are summarized as follows:

1. Field-independent subjects performed better in the self-instruction program in terms of time required and scores obtained than any group of less field-independent subjects.
2. Use of carefully planned masking in the self-paced instructional slide series reduced learning time and resulted in actual and written performance improvement for both field-independent and less field-independent subjects.
3. Masking self-instructional visuals to highlight important cues assisted most subjects, but the field-independent subjects benefited the most during training and transfer.
4. Masking visuals in a verbal-pictorial, self-paced instructional slide sequence resulted in improved performance on the transfer task for field-independent subjects.

The results suggest that field-dependence is a critical variable of individual learning style which should be considered when evaluating self-instructional programs. Results also provide evidence suggesting that carefully planned masking of slides in a self-instructional program can reduce the amount of time in instruction, improve learning and result in greater transfer of that learning. The principles of transfer appear to be useful during the design stage of a self-instructional program. Individual observation and interview can be an effective method of evaluating programs during the formative stage. The training and transfer tasks used in the study are typical of content which combines a cognitive task with some perceptual motor skills. It is suggested that a profitable avenue for further research is to develop a program which works and then manipulate the variables for further study. The complete set of sitmulus materials used in the study are shown as black and white photos in the Appendix.

INTERACTION OF "VISUAL COMPRESSION" AND FIELD-DEPENDENCE IN RELATION TO SELF-INSTRUCTION AND TRANSFER

By

David William Hessler

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CHAPTER I

BACKGROUND

Instructional systems employing a wide range of media are becoming increasingly important in the process of instruction and for the accomplishment of learning at all levels in educational institutions. The term media as used here represents any of the printed and audiovisual resources, including equipment, which are used to present stimuli to learners in instructional settings. One of the most successful advocates of independent study with a self-instructional system using a variety of teaching tools and techniques is S. N. Postlethwait (1971) who comments on the need for new and systematic approaches toward learning:

> Education is a science so that one must define the problem first and then go about logically developing a procedure which permits a student to engage in those activities which result in learning. It may require a total restructuring of courses and reorganization of approaches. Teaching is an art but the artistry comes not through the use of the teacher as a communication device but rather in his skill in determining objectives and developing the materials and sequences which will enable the student to achieve those objectives in the most efficient and effective manner.
>
> Many of us find this approach to education a little difficult. Teachers and educators are the most tradition-bound group of individuals I know. This happened in a logical evolutionary sequence, the explanation of which is relatively simple. In the days of Aristotle, the source of

> information was the scholar and he was the communication vehicle. It was logical that contact between the student and the educator was through lecturing. It is amazing that many of us still teach in this fashion feeling that our contribution is to expose the student to our knowledge of the subject matter, and many people who want to become teachers do so merely because the lecture is an ego-inflating device. We find it an exhilarating experience to stand before a group of people and to mystify them with our great knowledge of a given subject. In this age there are many communication devices more effective than the human being and ego-inflation of scholars is not a worthy objective for an educational system (p. 319).

Most educational institutions are making greater use of individualized instruction by applying a great variety of stimuli in the self-instruction setting. One of the major problems is the relationship between the particular stimuli used, the type of learning task, and the cognitive style of the learner. Typically, all students electing a given course receive the same stimuli in self-instruction. There is often no scientific basis for selecting or designing the particular stimulus material used in the self-instructional program. Some students take considerably longer to accomplish the tasks when self-instruction is the mode employed.

An important relationship exists between the type of stimuli used in the self-instructional program, the task being taught, and the learner's cognitive style. Gagne (1965) supports the view that all learning tasks are not identical. Witkin (1962) developed the measurement

devices and was able to identify differences in cognitive style. Public school subjects tested by Witkin did not demonstrate the same reliance on all cues in a visual display.

A fourth factor of concern is the learner's ability to use the information learned in self-instruction in a new way through transfer of learning to a new but related problem setting. Information learned which cannot be transferred to new problem situations is too limited to justify the amount of time and effort usually require both to develop and participate in self-instructional programs. The high cost of audiovisual media in some programs makes the importance of transfer even more critical.

Research in the area of transfer of learning revealed numerous studies in which five aspects of a program were manipulated to study transfer while basic generalizations as listed by such writers as Ellis (1965) or Travers (1970) were ignored. A program was developed for this study which was based on the major generalizations of transfer as described by Ellis (1965) before minor variations in the design of stimulus material, e.g., masking, color, viewpoint were built into the program.

A task was selected which was needed in the self-instructional laboratory. The task selected for programming was the use of an exposure meter on a photographic copystand. The transfer task required the subject to apply

light measurement principles to the task of determining exposure on a camera with a built-in meter. Subjects were only given minimal instructions before attempting to transfer their learning to a new set of conditions. The need for this type of program was prompted by the following situations.

The College of Education at Western Michigan University uses self-instructional programs to train students in the operation of common audiovisual devices and prepare simple instructional materials, e.g., slides, overhead transparencies, and mounted and laminated pictures. Within the Educational Resources Center which serves the college is a learning laboratory which houses sixteen carrels used for self-instruction. The basic materials used in these carrels are photographic slides presented in sequences on a rear screen, some 8mm motion picture loops and the equipment, supplies, and other items needed for each particular program.

There was need for the development of new programs which would provide instruction and subsequently learning which could transfer to new settings. These new settings might include problems not present in the carrel program. The programs already in the carrels were intended to have transfer which might best be termed, according to Nord (1969), as replicative. The student learns to operate a given piece of equipment with the expectation that he will

be able to operate that same device in a school setting. The majority of the programs in the lab, however, are effective in giving most students a successful experience in performing the task under the presence of the visual stimuli presented in the slide programs, but appear to be ineffective in replication of the task without the presence of the slide program. Further, a random sampling of twenty students who had just completed one of the programs on motion picture projector operation revealed that these students could not solve even the most minor problems requiring a transfer of their training. They could not answer questions about the correction of problems and they could not indicate, by pointing or manipulation of the equipment, how to rectify the problem. This information was discovered by personal interviews carried out informally to keep student anxiety at a minimum. Students at Western Michigan University are accustomed to having professors present in the learning laboratory asking their opinions and assisting in the assessment of their learning.

Purpose of the Study

The purpose of this study is to examine the effects of one method of emphasizing the cue function in a sensory (perceptual) field and one dimension of learner variability (field-dependence) in a self-instructional slide program designed to teach a specific task (determining

exposure on a photographic copystand). The specific task is primarily cognitive, but minor motor learning is also included within the context of the self-instructional task. Field-dependence has been described as one of the identifiable cognitive styles of human learners as described by Witkin (1964). Results should assist designers of self-instructional programs which include the transmission of stimuli through the use of photographic transparencies. The study is particularly concerned with students in the basic audiovisual courses at the university level.

Assumptions

It was assumed that students in the beginning audiovisual courses at Western Michigan University were typical of students in similar audiovisual courses throughout the nation. Typically, these students are a mixture of graduates and undergraduates. The state of Michigan does not require audiovisual instruction for teacher certification, but courses in this area are electives in the field of education. This being the case, the results of this study should be applicable to the graduates and undergraduates at other institutions offering audiovisual courses. Since only about ten percent of the students at Western Michigan University elect a basic course in the audiovisual area, it was assumed that these courses attracted individuals that might be slightly different in perceptual ability (field-dependence in this

case) than students in teacher education courses which were part of the required core for certification and completion of the major. Audiovisual skills often require greater attention to visual detail.

The self-instructional program designed for the study is considered typical of programs being designed for courses or independent experiences related to the production and utilization of audiovisual media. The problems of terminology such as media, instructional material, audiovisual media, instructional technology, non-print media, curriculum materials, hardware and software are discussed effectively by Erickson (1968). The programs used to teach skills related to audiovisual media include a combination of cognitive and motor skills. The majority of programs available in the audiovisual area seem to focus too heavily upon operational motor skills without inclusion of the principles behind such manipulations learned. The program on the determination of exposure when using a photographic copystand as designed for this study was an attempt to place more emphasis on the cognitive skills while including motor activity development.

Each program designed for courses or for experiences in audiovisual media may reflect different proportions of cognitive and motor involvement, but if program designers are interested in transfer of learning from these self-instructional programs to new and different

situations, then more emphasis is needed upon programs which explain the principles or reasons for particular manipulations taught. The program in this study is believed to accomplish this aim.

It is further assumed that learners differ in their cognitive style. These differences are discussed by Hill (1972) describing the measures taken on some Oakland Community College students at Farmington, Michigan. Field-dependency as described by Witkin and his associates (1962) is one relatively stable measure of individual difference in perceptual style. The term is not limited to visual perception alone, but to the cognitive and personality differences in individuals as well.

The measurement of the degree of field-dependency was made by the use of the Thurstone and Jeffrey Closure Flexibility Test (CFT) described by Tyler in The Sixth Mental Measurement Yearbook, edited by Buros (1965). This test was selected over the Embedded Figures Test by Witkin for two major reasons. The Thrustone and Jeffrey test is much more adaptable to group use than Witkins EFT measures. Gough describes the frustrations of hour-long testing sessions, lack of group testing forms, and the logical shift from time to error scores which would correct the unweildiness without loss of any intrinsic validity (Buros, 1965, p. 211). Secondly, the Closure Flexibility Test in Witkin's opinion may be just a different name for

field-dependence (Witkin, 1962, p. 52). The CFT is very similar to Witkin's Embedded Figures Test, but the measure is shifted from time scores to error scores.

It was assumed that the original norms for Thurstone and Jeffrey's CFT measures would not be useful in this study with experimental subjects being entirely composed of college students. The original CFT norms were based on a composite (blue collar, white collar) group from industry. Norms for college students in one of the required courses for education majors at Western Michigan University were determined by testing 900 students on closure flexibility, then separating the means of this group by sex (Dickie, 1969). The human growth and development courses measured by Kenneth Dickie included greater numbers of students with perhaps more diversity than the numbers and types of learners electing basic audiovisual courses. These norms will not serve as the basis for selecting the more or less field-independent subjects for this study. The norms for the 900 tested by Dickie would provide a reliable basis of comparison of the students in the two types of courses, i.e., the required human growth and development courses and the audiovisual course which is elective.

The smaller numbers of students in the audiovisual courses would most certainly reduce the spread in the closure flexibility scores used to differentiate the more

and less field-independent. This smaller gap in scores is taken into consideration when discussing results. It was assumed that common interest in audiovisual media and other characteristics that students in audiovisual courses might possess were more important than obtaining a larger gap between the high and low scores on the perceptual dimension of field-dependency. This assumption would not be made for programs designed and tested in other content areas.

It was assumed that students in the audiovisual production courses might have already learned too much about the determination of photographic exposure on a copystand. The study was limited to students enrolled in the first audiovisual course which does not cover the skills and information taught in the self-instructional program.

Color appeared to be necessary in the self-instructional slide sequence because small details and clues were described in the verbal information provided in the self-paced program. It was felt that students with color blindness or those who were determined to be color defectives should not be used in the collection of data because they might spend excessive time looking for the detail in the self-instructional visuals which required color discrimination. The extra time spent looking for details and relationships would not be attributed to

either the experimental design of the program or the learner's field-dependency. It was decided that the potential subjects for the study should be tested for color blindness or color defectiveness using the Ishihara Test for Colour-Blindness (Buros, 1965, p. 1214). A qualified research assistant doing research in color defectiveness could best administer the Ishihara Test and determine which subjects should be eliminated from further testing.

Previous knowledge of the content presented in the self-instructional programs could be assumed to be a condition present with some students. It was necessary to eliminate subjects with prior knowledge to prevent contamination of results. It was decided that the following procedures would identify subjects with prior knowledge: (1) students would be given a short questionnaire asking them to describe any abilities or experiences they have had with adjustable cameras, exposure meters, or copystands; (2) subjects with high and low scores on the Closure Flexibility Test would be interviewed and asked specific questions about exposure readings, cameras, and copystands; (3) a quick check in the self-instructional setting would be made by asking about the camera and exposure meter immediately observable in the booth; and (4) pre-test scores of those not used in program data collection could be compared with scores in the program.

The original questionnaire and applied criteria proved sufficient to eliminate prior knowledge as a factor.

The final assumptions are concerned with the design and development of the self-instructional slide sequence on the determination of exposure.

It was assumed that extensive experience with the program content and many years of experience in teaching aspects of this content to students, would justify use of the tutorial approach described by Markle (1967). The principles of intervention and checklist for tryout by Horn (1966) served to guide this developmental process, although some modification was used.

Individuals used in the tutorial evaluation process were selected on the basis of interest and lack of experience. It was assumed that students working in the Educational Resources Center of Western Michigan University would be likely candidates for the formative evaluation process at each stage of the design/production process of the program. These stages were: (1) orientation to the real objects including rough verbal sequence (live instructor) and sequence of events (pointing and manipulation); (2) rough photographic sequence with live narration; (3) polished but non-masked photo sequence with synchronized audio tape with control of pacing by the subject; (4) completed slides of non-verbal information alternated with slides containing only the verbal

information completely learner-paced; (5) final revision of the completed slide sequence. Individuals selected for this formative evaluation process were all known reasonably well. It was assumed that self-report data concerning color defectiveness or prior knowledge of content was sufficient. The individuals were asked several key questions, but they were not tested in any other manner. Ten persons participated in this formative evaluation. The excellent rapport which is assumed between this program designer and subjects supported the choice of the tutorial approach to the self-instructional program design used in this study.

The assumption was made that programs which ignore some of the basic generalizations of transfer of learning in their design could not be used to isolate significant differences in less important design variables. The self-instructional program used in this study was designed to include the more important variables identified as being necessary for transfer to occur while the program variable manipulated in this study is a less critical variable in designing programs to foster transfer.

Limitations of the Study

The self-instructional program in the two versions used in this study is for one type of mediated presentation. The program was designed for visual stimuli to be

presented sequentially through 35mm transparencies alternately presenting verbal instructions and pictorial information rather than combining verbal and pictorial, non-verbal information on the same slide. The discussion is restricted to this type of program which is self-paced with university students as subjects.

The design variable used to differentiate the stimulus important to the message function of the particular slide is photographic masking. There is not an exact parallel with ordinary photographic half-tone screens, but the 85 line, 80 percent (No. 850.80 by Para-Tone, Inc.) would be close. The screening process used in the experimental version of the program was developed by using Kodak High Contrast Copy Film. This type masking and the undefined shape of the highlighted technique may prove unique and limit generalizability if there are serious deviations from the approach. This is not meant as a restrictive comment to discourage other techniques to accomplish stimulus differentiation in the separation of figure and ground in a pictorial display.

The independent variable in the study related to the individual's learning or perceptual style in field-dependency. There is a limitation, however, when discussing the less field-independent individual because few of the group tested could be labeled field-dependent on the basis of their scores. In the study by Dickie

(1969) the criterion for being labeled field-dependent was a score which fell -1 standard deviation below the mean for the individual's sex group. Only one subject available for participation would have been in this category. Even this score would not truly be labeled field-independent if we remove the cultural bias and compare scores world-wide. Therefore, those who scored lower and who participate in the study are actually labeled less field-independent. All those tested are field-independent to a greater or lesser degree. Caution needs to be exercised in generalizations based on field-dependency as viewed across cultures.

The investigation was limited in time to students in the basic audiovisual courses during the fall term of 1971 and the winter term of 1972. The limitation on the number of subjects fully participating was sixty. Slightly larger numbers of subjects might bring about slightly different relationships among the variables. Subjects in the study were highly motivated toward the task taught in self-instruction. Subjects with little interest in the self-instructional task could confound results on task replication.

Organization of Thesis

The remainder of this first chapter will include the organization of the thesis, the definition of terms used in the study and hypotheses to be tested.

In Chapter II, the review of related literature will be presented. It is organized around major areas of the study.

In Chapter III, the method including the experimental methodology used to test the hypotheses and materials are discussed.

In Chapter IV, the results of the controlled experiment are described and the experimental data reported and analyzed.

In Chapter V, the final chapter, the major findings of the research are summarized, conclusions are drawn and recommendations for further research related to the study are presented.

Definition of Terms

Audiovisual Media

This term as used in this study refers to materials of instruction with the exception of print media. The term audiovisual media is synonomous with nonprint-media. Audiovisual refers semantically to sound and visual stimuli as used in educational process, but in common practice it includes all materials generally used in the classroom instruction except those which use verbal symbols (printed) only (Erickson, 1968, p. 30).

Closure Flexibility Test
(Concealed Figures Form A)

A test developed by L. L. Thurstone and T. E. Jeffrey at the Psychometric Laboratory of the University of North Carolina. Form A was developed in 1965 in an eight page format in which subjects marked in the booklet. The instructions for this test were revised by Dickie (1969) to permit use of a standard testing form for optical scanning. The original test norms were based on 1.105 industrial employees, but more appropriate norms were developed by Dickie with 900 students at Western Michigan University. The trait measured is defined by Thurstone as "the ability to hold a configuration (a simple geometrical figure) in mind despite distractions represented by four geometrical figures of greater complexity which follow" (Thurstone, p. 58). The revised version of the test has the subject place marks on the test form for every complex figure containing the simple figure (Dickie, 1969).

Cognitive

Cognitive is an adjective representing a type of learning process. The noun is cognition which is "a generic term for any process whereby an organism becomes aware or obtains knowledge of an object. It includes perceiving, recognizing, conceiving, judging, and

reasoning." In modern usage sensing is usually included under cognition (English and English, 1958).

Copystand

A typical photographic copystand using a vertical shaft and camera support with 45 degree angle lighting (3200K lamps) on either side.

Criterion Stimuli

The term is used to identify the stimuli which are directly related to learning the task or which the learner will be judged with the criterion measure or score as the dependent or predicted variable (English and English).

Cue

"A signal for an action; that specific portion of a perceptual field or pattern of stimuli to which one has learned to respond. It is common to restrict cue to that which produces an operant response, but it is also for that which arouses expectancy" (English and English).

Cue Function

This refers to the message function of a sensory event; the function of the sensory event in guiding behavior (English and English).

Cue Reduction

This might be related to the term visual compression since the intensity of some of the potential cues in

the background of the slides used in the program is reduced through photographic masking. Masking does not actually reduce the number of cues, but it does deemphasize some of the potential cues. English and English describe cue reduction as the process whereby a part of the stimulus elicits the response formerly elicited by the whole or larger part of the stimulus.

Embedded Figures Test (EFT)

A test for those of age ten and older developed by Herman A. Witkin and consists of twenty four (24) complex colored figures, each of which contains one of eight simple figures. The test is administered individually, it is scored on a time basis, and can take nearly an hour to complete. Its diagnostic implications are related to (a) field-dependence, (b) cognitive clarity, (c) analytic versus global perceptual mode, and (d) general disposition to articulate and structure experience. These are basic theoretical principles from extensive and careful experimentation by Witkin and his associates according to Gough (Buros, 1965, p. 210).

Field-Dependency

Field-dependency is one of several relatively stable individual differences which Witkin describes as perceptual style. The characteristic differs in individuals with regard to both visual perception, cognition,

and personality. Field-independent individuals can either be analytical or global in their approach to a problem, while those more field-dependent are influenced by the problem context and have difficulty in locating figures embedded in a more complex field. The characteristics can be measured by a number of tests (Witkin, 1962).

Figure-Ground

English and English describe figure-ground as a general property of a perceived field of being divided into at least two parts or aspects, the figure and the ground, which mutually influence each other. The figure is perceived as having unity and as being segregated from the ground; the ground is relatively, though not entirely, homogeneous, i.e., the constituent impressions are not sharply marked off from each other. Generally, the figure is the part attended to, but the relationship is not necessarily static. It is possible to attend to the ground without its becoming figure. More than one figure may be segregated on one ground, and what is figure for one ground may itself be ground for another figure. This latter shift is evident throughout the program on exposure.

Formative Evaluation

This is the type of evaluation process which was used to develop the original (control) version of the

slide program on exposure. It is the process by which information is obtained and used by the designer to identify problems and revise instruction until it is ready to be used with a substantial number of students (Abedor, 1971, p. 8).

Gray Card

This is a cardboard card measuring 8 x 10 inches in size for use with an exposure meter in artificial light. The gray card, often called a neutral test card, was used specifically in this experiment to determine reflected measures. It is designed to provide a reference area of known reflectance when precision is required. The card is particularly recommended for copying and close-up work. The gray side used in the program has 18% reflectance and the reflected readings are then the same as measurements of incident illumination (Kodak Publication, R-27).

High Contrast Masking

High contrast masking is a technique developed for this study to highlight the cue function of a slide by reducing the brightness or image intensity of the background. Background is often described as irrelevant cues. Masking was accomplished by superimposing the original slide series with a photographic mask consisting of a negative on high contrast copy film.

Incident Reading

Individuals participating in the self-instructional program learn to measure incident light with an exposure meter and they replicate the process, without the aid of slides, immediately after completing the slide series used to teach exposure on a copystand. An incident light reading is made with the cell of the meter screened to permit light falling upon the cell to be measured, rather than light reflected from the subject. The incident measure is made by placing the meter at the subject and aiming it at the camera. This method establishes only the relative intensities of illumination; and not the relative brightness of the light and dark tones as would reflected measures, according to Mannheim (1963, p. 52).

Irrelevant Cue

Cue or cues not deemed necessary or essential to the instructional content (Travers, 1967).

Isihara Test for Color Blindness

This test was used in the study to detect color blindness and serious color defectives. The test is available in several versions. The 24 plate version of the 1964 edition was administered by a trained research assistant to all potential subjects under controlled lighting conditions.

Learning/Discriminative

This refers to learning which is manifested in ability to make certain required perceptual discriminations, or to react differentially to various objects or stimuli (English and English).

Learning Perceptual

The term represents learning in which the principle change is that the learner perceives something differently. This contrasts with perceptual-motor learning.

Medium

The media in this study are the slides and apparatus used for instruction. The medium or media refer to that through which something is accomplished (English and English).

Motor Learning

This type of learning involves a task which is described in motor terms and is contrasted with ideational learning in which the task is to understand certain ideas or relations. The distinction is not basic since motor learning generally involves ideational elements, and vice versa (English and English).

Perceptual Style

The manner in which one perceives related to the fact that not all learners possess the same visual perceptual style (Gagne, 1965).

Picture/Realistic

According to Knowlton (1967) this represents a picture which is a realistic visual-iconic representation of some object in the visual world based upon the communicator's intent to represent some state of affairs or object that is visually perceivable either directly or with a technological aid.

Prototype

The prototype refers to the final revised version of self-instructional slides which comprised the instructional program after ten individuals participated in the formative evaluation process. The term as used includes the complete but untried program in both experimental (masked slides) and the unmasked control version.

Rod and Frame Test (RFT)

This test which is often used to measure field dependency is described by Witkin (1962, p. 36). The RFT consists of a luminous square frame and rod which pivot about the same axis independently of each other. The subject sees only the rod and frame as he is seated

upright in a dark room and is asked to place the rod in a position he perceives as upright. The task is repeated with the subject's chair tilted. During a number of such trials a large tilt of the rod, when it is reported to be straight, indicates adherence to the visual field. A small tilt indicates independence of the field and reliance on the body. Positive standard scores reflect field-dependence and negative scores indicate performance termed field-independent. The RFT is only suitable for individual testing.

Sensory Field

English and English define sensory field as all the stimuli affecting a receptor at a given time; or all those affecting the whole organism at a given time. The definition can be interpreted to be the perceptual field; all the things a person experiences through the senses at a given time.

Slate

The term often used by faculty at Michigan State is actually an acronym for Structured Learning and Teaching Environment. The environment is usually a carrel with a variety of stimuli used to achieve specified objectives through structured responses (Davis, 1968).

Stimulus, Stimuli

English and English provide a long discourse on the multiple uses of the term which have destroyed the pure physicalistic definition. Their seventh definition although inclusive and nondiscriminatory refers to a stimulus as any phenomenon, object, aspect of an object, or event however conceived or described, which modifies behavior by eliciting activity in a sense organ. This definition combines the three basic ideas or concepts appearing in most of the definitions. These ideas are: (a) incitement, (b) external agent, (c) relation to sensory process.

Tutorial Evaluation

Tutorial evaluation as used in this study refers to the process of using students one at a time to interact with the self-instructional program during the tryout and revision stage. The process includes the identification of each student's response to the frames in the program and apparent trouble areas. Revision stages of the program development is described by Horn (1966). The tutorial approach was tested by Silberman and Coulson (1965).

Transfer of Learning

Ellis (1965, p. 3) describes transfer of learning as "that experience of performance on one task influences performance on some subsequent task. Transfer of learning

may take three different forms: (1) performance on one task may aid or facilitate performance on a second task, which represents positive transfer; (2) performance on one task may inhibit or disrupt performance on a second task, which represents negative transfer; and (3) finally, there may be no effect of one task on another, in which case we have an instance of zero transfer. Zero transfer can occur either as a result of no effect of one task on another, or as a result of equal effects of positive and negative transfer that cancel."

Nord (1969, p. 124) describes three relationships among levels of decision making which could be described as three levels or types of transfer: (1) replicative in which the lower level was a mirror image of the upper level; (2) homomorphic in which the lower level was an abstracted model of the upper level; (3) generative in which the lower level is the embryo or seedling of the upper level.

Visual-Compression

The term visual-compression has been used by Robert M. W. Travers in several studies (1966, p. 180) where the "visually-compressed" treatment was described as an effort made to eliminate many irrelevant bits of information by reducing the visual aspect of a presentation to a series of line drawings. The term was used

again by Travers (1967, p. 62) and described the "visually-compressed" treatment as one which had many of its irrelevant cues eliminated or obscured. The definition used in this study deviates from above and Travers (1964) where the treatment leaves out cues which provide the least information and instead adapts the definition as altered by Dickie (1969, p. 6) who described his approach of compressing visual information with realistic black and white photographic slides. The intensity of background cues were reduced to make the background appear as a homogeneous and amorphous mass. This is the "visually-compressed" treatment used in this study, but the production techniques, and stimulus materials are more involved and include full color photographic slides. The technique as used in this study could be labeled visual highlighting since cues are not removed in the experimental slide series.

The Experimental Hypotheses

The following experimental hypotheses are derived on the basis of the preceding discussion and a search of the literature reported in Chapter II. Hypotheses tested in a study of visual-compression effects in acquisition of a procedural skill (Dickie, 1969) lend support to some of the hypotheses of this study.

Six hypotheses were proposed for testing based on two independent variables and two dependent variables with two measures each. The independent variables were field-dependence as determined by scores on the Thurstone and Jeffrey Closure Flexibility Test and the use of masking to aid cue differentiation in the experimental version of the self-instructional slides. The dependent variables included a replication task and a transfer task. Both the replication task and the transfer task had score and time measures recorded.

Hypothesis I pertains to the effect of using masked visuals in the self-instructional slide sequence. The effect measured was the amount of time subjects spent with the self-instructional slides when background information was masked (labeled visually-compressed slide sequence) compared to the amount of time subjects spent with the unmasked slide sequence. Time was measured as the total number of seconds elapsed during self-instruction with either the masked or unmasked slides.

Hypothesis I: If the background cues of the visuals used in the self-instructional programs are masked, then subjects will require less time in self-instruction.

Masking slides to alter the figure-ground relationship of each visual saves the learner viewing time when the figure is emphasized by reducing the screen image intensity of the ground when the figure contains

the message function cues and the ground contains cues which are (irrelevant) not identified as vital to the instructional message. When the subject does not have to search extensively for the important visual cues, the amount of time spent attending to a particular slide or slide sequence is less.

Hypothesis II examines the effect upon slide viewing time when masked or unmasked slides sequences are used with either field-independent or less field-independent subjects and predicts that field-independent subjects will spend less time with either self-instructional slide program than less field-independent subjects.

Hypothesis II: Field-independent subjects will spend less time in self-instruction than less field-independent subjects regardless of the program version they are given.

Field-independent subjects approach visual information in a manner which is more analytical. These subjects are capable of isolating visual details necessary for the message function more rapidly than less field-independent subjects.

Hypothesis III looks at the relationship between field-dependency, masking of background information in the self-instructional slides, and time spent viewing the slides and predicts that less field-independent subjects will save more time in self-instruction than

field-independent subjects when taught with the masked (visually-compressed) slides.

Hypothesis III: Less field-independent subjects will have greater reduction of time spent in self-instruction than field-independent subjects when visuals are masked.

Less field-independent subjects are more global in their approach to visual information and they often have difficulty in isolating visual details which are important to the message function of the visual. Masking which helps isolate the important visual cues by altering the figure-ground relationship benefits the less field-independent subject even more than the field-independent subject. This is not to say that less field-independent subjects spend less time with the masked self-instructional slides than field-independent subjects.

Hypothesis IV is based on the relationship between scores obtained on the duplication task and the use of masked slides during self-instruction. Points were awarded on the basis of performance in replicating the task learned during self-instruction with apparatus and the instructional slides.

Hypothesis IV: Subjects taught with masked visuals in self-instruction will receive higher scores on the duplication of the task taught in the self-instructional program.

All subjects taught with self-instructional slides which masked the irrelevant or less critical cues are

given the chance for better performance scores on the task taught. Learning is more efficient because less searching is needed for cues which contain the message function. The subject has the opportunity to improve concentration on what is being taught.

Hypothesis V is concerned with the effect of masking upon the amount of time required to perform a transfer task which necessitates application of the rules and principles learned during self-instruction.

Hypothesis V: Subjects given the self-instructional program with masked visuals will perform the transfer task in less time than subjects given the self-instructional program without masked visuals.

Subjects taught with masked slides, which have the effect of highlighting important message function cues during self-instruction, are able to transfer their learning better. The same relationship which existed between field-independent and less field-independent subjects concerning instructional time should exist for the amount of time required to perform the transfer task. Field-independent subjects should have the best performance when time is the measure regardless of the program they take, but the reduction in time should be greater for less field-independent subjects taught with masked slides. Less field-independent subjects will not perform the transfer task in less time than field-independent subjects

receiving the masked slides. However, less field-independent subjects will have the most amount of time saved in performing the transfer task when taught with masked slides.

Hypothesis VI is concerned with performance scores on the transfer task as related to self-instruction with the masked slide sequence. The hypothesis does not specifically predict the effect on field-independent and less field-independent subjects, but the same relationship that is predicted between field-dependence, masked instructional slides, and self-instructional time should exist.

Hypothesis VI: Subjects given the self-instructional program with masked visuals will achieve higher scores related to performance on the transfer task than subjects given the self-instructional program without masked visuals.

Success on a transfer task which requires the application of rules and principles to a problem solving situation will be greater when instruction has been more efficient in terms of self-instructional time. Subjects will be able to recall important visual detail better when the detail has been highlighted with masked (visually-compressed) slides used during self-instruction. The masked slide treatment should remove some anxiety and permit better concentration on the procedures, rules, and principles taught in the self-instructional task. Masking

becomes a significant variable only after the self-instructional program has been designed to maximize transfer.

The self-instructional program used in this study is designed to maximize transfer with or without masked visuals. The design of the program attempts to include the five major guidelines to teach for transfer as outlined by Ellis (1965, pp. 70-72). These guidelines include: (1) maximizing the similarity between teaching and the ultimate testing situation; (2) provision for adequate experience with the original task; (3) provision for a variety of examples when teaching concepts and principles; (4) identification or labeling of important features of a task; (5) making sure that general principles are understood before expecting much transfer. The last point emphasizes the measures taken in the form of scores assigned to subjects by the experimenter as they take the written review task and then replicate the task taught in self-instruction. The role played by the masking variable in the improvement of transfer is the greater efficiency expected in the self-instructional program and replication of the task learned.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

The review of the literature is centered on the variables of this study which include: the transfer of learning; studies suggesting program design techniques or mode of transmission; relevant and irrelevant cues in training including discussion of the technique labeled visual-compression; the differentiation of stimuli and the relation to pyschological differentiation as measured by the degree of field-dependence or independence. Recent research on the field-dependent-independent dimension which is pertinent to this study is also reviewed.

Transfer of Learning

The first problem in discussing the transfer of learning is the need to define the term transfer.

Definition and Use of the Term Transfer

Stolurow (1964) defined two types of transfer: (1) specific transfer and (2) non-specific transfer. Specific transfer is defined as the psychological process which is evidenced by the learner's performance on a

subsequent task that has common elements with the task previously learned. He states:

> The apparent "carry over" of the effects of prior learning is called transfer of training. Those situations in which it can be related to common features or elements of the stimulus materials (specific transfer) have been studied most extensively (p. 3).

Non-specific transfer is either positive or negative and it appears to be cued by structural, relational and formal (abstract) features of stimulus materials not often found in a single element. Stolurow comments on the nature of the stimulus materials as follows:

> They can, however, be described as analogies, metaphors, algorithms, congruities, and incongruties. Non-specific transfer is assumed to be mediated by a process (a response or set of responses) which serve to relate perceptually distinctive and often perceptually different materials to behavioral outcomes.

The definition of specific transfer described by Stolurow are elaborated to suggest that the mechanisms which account for transfer are content-specific or process-specific such as studied in relation to a skill. The distinction between specific and non-specific transfer lies in the nature of the relationship that exists between or among a set of tasks. According to the preceding discussion, the present study fits the description of non-specific transfer.

Bruner (1960, pp. 17, 18) describes two types of transfer in relationship to the importance of structure

in learning; (1) specific transfer and (2) non-specific transfer. He describes these two types as follows:

> There are two ways in which learning serves the future. One is through its specific applicability to tasks that are highly similar to those we originally learned to perform. Psychologists refer to this phenomenon as specific transfer of training; perhaps it should be called the extension of habits or associations. Its utility appears to be limited in the main to what we usually speak of as skills. . . . A second way in which earlier learning renders later performance more efficien is through what is conveniently called non-specific transfer, or more accurately, the transfer of principles and attitudes. . . . The more fundamental or basic is the idea he has learned, almost by definition, the greater will be its breadth of applicability to new problems. Indeed this is a tautology, for what is meant by "fundamental" in this sense is precisely that an idea has wide as well as powerful applicability.

A study by Kelly (1962) questioned the use of the expression "transfer of training" or "transfer of learning." The various ways "transfer of training" has been defined in the literature was analyzed by Kelly. He concluded that the expression should be eliminated from educational literature because the literature in the field of education is filled with so many different notions of the expression. Further, Kelly noted that the technical use of the term was legitimate when defined as the effect of some specific learning upon the acquisition of some particular subsequent learning. The expression, prerequisite knowledge, was recommended as being more useful than transfer if the distinction was

made between necessary and beneficial knowledge. The expression, prerequisite knowledge, might prevent the vague and non-technical uses associated with the term transfer.

Beauchamp (1950) proposed that the term transfer was not precise enough for continued use in psychological research except as a general word to refer to the fact that previous experiences influence the mode of response of an individual in a given situation. Analysis by Beauchamp of nearly fifty years of transfer studies since 1900 implied that the major mental process variables in transfer studies were perception, set, retention, and conceptual structuring. Beauchamp concluded that investigators concerned with transfer should be devoted to analysis of problem-solving behavior in terms of specific mental processes involved.

The Importance of Transfer

The importance of transfer is discussed by S. Erickson (1969) by relating it to learning theory and the gap which exists between theory and practice. He states:

> From the point of view of learning theory, the ideal purpose of instruction is to teach a student to know more than he has learned, to develop concepts, skills, and attitudes in the classroom that can be generalized to other times and places. This is what is meant by transfer of learning.

> The transfer paradigm is basic to college teaching. Researchers have sought to explain in theory how information is generalized beyond the site of original learning and to distinguish in practice the specific conditions that increase the amount of transfer within a particular content area. Nevertheless there remains a conspicuous gap between theory and practice and this is where the teacher stands (p. 1).

Ellis (1965) discusses the important relationship between training programs and transfer and the necessity to discover conditions under which transfer can occur. He comments:

> There is perhaps no more important topic in psychology than transfer of learning. . . . Many educational and training programs are based on the assumption that what is taught in the classroom or in the training program will transfer to new situations. . . . For example, pilots are taught complex discriminations using simulated cockpits on the assumption that these discriminations, such as learning to read the altimeter correctly, will carry over to the actual flying task. In view of the fact that many educational and training programs are designed to teach for transfer, it is important that psychologists discover the conditions that govern transfer of learning.

The need to match specific learner characteristics with specific characteristics of the learning situations were discussed within an historical context by Grose and Birney (1963) in the introduction of their book on transfer of learning. They state:

> Ever since William James discovered in 1890 that practice in memorizing Milton's "Paradise Lost" did not produce any improvement in his memorization of French poetry, transfer of training has been one of the most popular topics for educational-psychological research. At first, there was a rush of concern as to whether, in fact, transfer was present in the school

> curriculum, whether it was positive or negative, and to what degree. As is often found in other fields of scientific inquiry, however, increasing attention began to be shown to the exact conditions under which transfer occurred. Both the characteristics of the learning situations and the characteristics of the learners came under study. The concept of transfer itself became broader as it was realized that all learning involves transfer through time, even from learning trial to learning trial of the same task.

Davis and Klausmier (1969) have agreed that the relationship among variables which facilitate or inhibit transfer are important and not merely the finding that transfer does or does not occur. The perceptual style of the individual learner is one such variable. Field-dependency is a major variable in perceptual style which can be related to transfer. The relationship could be important.

The Principles of Transfer

Two sources which describe the major principles or generalizations of transfer are Stolurow (1964) and Ellis (1965). Both authors have reviewed an extensive amount of literature on the transfer of learning. The concise statements of Ellis were useful in designing the self-instructional program used in this study.

The independent variable of masking should be important to transfer in its ability to isolate the proper cues, but the variable is not as critical to transfer as the following principles described by Ellis

(1965, pp. 3-85) which were used in the design of the visual program in this study.

1. Task, stimulus, and response similarity between the training and transfer tasks.

2. Learning to learn. Practice with some related tasks assists transfer.

3. Early task learning. Transfer is greater if more effort is spent on mastery of the early task in a series of related tasks.

4. Insight. Problems are solved better when there is practice on similar or related classes of problems.

5. Warm-up. Practice in some activity prior to learning has only a temporary facilitating effect on transfer.

6. Time interval between tasks. Transfer of training remains rather constant with varying intervals of time elapsing between the original and transfer tasks (Bunch, 1936, 1938); (Gladis, 1960); (Ellis and Hunter, 1960, 1961a, and 1961b).

7. Mediated transfer. Transfer can result from mediation with a network of associative links between tasks.

8. Task or stimulus variety. Variety of tasks and stimuli during learning promotes positive transfer.

9. Practice on the original task. More practice on the original task increases the amount of positive transfer.

10. Principles and transfer. Transfer is greater when the rules or principles which are appropriate to the transfer task are understood.

Generalizations and Transfer

Wills (1967) worked with mathematics students to determine if they could learn a particular set of

discovery stratagems as a bonus to the content learned by discovery. It was supported that the discovery strategems helped them learn both the content and the techniques of discovery. The "covert" group learned the stratagems through instructional materials alone. The "overt" group received the instructional materials and teacher assistance. Both groups did equally well.

This study confirmed some of the transfer generalizations from other studies. Generalizations or principles are valuable tools for problem solving and transfer. Simple tasks provided a basis for learning the more complex tasks which followed. Generalizations were suggested in the initial task. Principles were also stressed by Katona.

Katona (1940) stressed the importance of principles in learning when transfer is the criterion. Principles learned can assist in providing a framework for the individual to transfer his learning to a new setting.

The value of the learner having to derive the principles rather than being directly told was demonstrated in a study with college students by Haslerud and Meyers (1958). They suggested that principles which were derived were more effective in facilitating transfer. Fast and accurate learning performance with immediate guidance was no guarantee of one's ability to transfer.

It was proposed that transfer possibly was not a preservative function, but an anticipative function.

Derivation of a concept or principle is not always the most effective. Solved examples are more satisfactory when the content is difficult. Barcaski (1969) studied three different methods of teaching presequenced concepts with a lesson on numeration systems. Concepts in this area are developed in a hierarchial fashion. Initial learning and transfer questions were handled most effectively by the group instructed with solved examples toward concepts. The most ineffective teaching of numeration systems was the concepts and unsolved example method. Those who did better in initial learning tended to do better on transfer measures. The relationship between better initial learning and transfer of that learning would appear to be an obvious relationship.

Interaction, Continuity, the Individual and Transfer

John Dewey (1938) discussed the learning environment as whatever conditions interact with personal needs, desires, purposes, and capacities to create the experiences he has had. In any learning situation the principles of continuity are involved. He stated:

> The two principles of continuity and interaction are not separate from each other. They intercept and unite. They are so to speak, the

> longitudinal and lateral aspects of exposure. Different situations succeed one another. But because of the principles of continuity something is carried over from the earlier to the later ones (p. 44).

Dewey's comments provide a view toward the transfer of learning and in addition, some strategies for the design of the instructional situation.

> What he has learned in the way of knowledge and skill in one situation becomes an instrument of understanding and dealing effectively with the situations which follow. . . . Responsibility for selecting objective conditions carries with it, then, the responsibility for understanding the needs and capacities of the individuals who are learning at a given time. It is not enough that certain materials and methods have proved effective with other individuals at other times. There must be a reason for thinking that they will function in generating an experience that has educative quality with particular individuals at a particular time (p. 46).

Stimulus and Response Similarities in Transfer

Transfer (1969) attempted to test three basic transfer paradigms with young college students and retired professors. The three paradigms tested in the verbal paired-associate learning were: (1) different stimuli, different responses (AB-CD), (2) different stimuli, same responses (AB-CB), (3) same stimuli, different responses (AB-AC). The generalizations for positive transfer would have isolated the major findings of this study. Young and old alike experience problems with the AB-CB and the AB-AC paradigms. Older subjects

had greater difficulty in shifting from one cognitive set to another. This group also exhibited greater stress, more rigidity and less cognitive flexibility. If these older subjects had been tested for field-dependency, these results might provide clues for transfer problems.

This study lends support to the transfer generalizations which pertain to stimulus similarity and response similarity described by Ellis (1965).

Concept Levels and Transfer

Transfer from lower to higher level concepts was explored by Lee (1967) using twelfth graders as subjects. Two experiments were conducted. In the first experiment the variables manipulated were three rules for lower level concepts to be learned. Subjects received one, two, three or no rules with a different number of problems associated with each. The second experiment either gave or did not give pretraining on attribute coding in concept learning. Transfer was a more difficult conceptual rule to be learned. Results favored pretraining on all three of the lower level concepts prior to rule learning. Thus pretraining and the learning of rules from easy to difficult appears to assist positive transfer.

The present study was designed to assist students in learning easier concepts prior to learning more

difficult concepts. Training in the application in the rules is provided by a written test following the instructional visuals and an opportunity for the subject to practice the task learned is provided prior to being tested for transfer.

Transfer Effects in Hierarchial Learning

Some considerations for the design of self-instructional programs in hierarchial learning are provided in a doctoral study by Marriner (1964). The study concludes that constant correction on lesson frames brings about student responses which are hesitant and slow without any gain in accuracy of response. Over-correction, lack of stimulus variety and excitement, and lack of interest on the part of the learner can all lead to reduced performance according to Marriner.

Transfer and Task Similarity

Overall task similarity and response similarity both are generalizations of positive transfer which were verified in the study by Mahler (1951). Mahler studied the transfer effectiveness of a flight simulator in naval air training. Results parallel the generalizations of transfer outlined by Ellis (1965). Transfer was greater when the patterns in the training device were similar to the real aircraft. Negative transfer resulted

when a different response was required to the same stimulus or when the stimulus and response had their relationships reversed.

Further evidence relating better performance on transfer to learning task and transfer task similarity can be derived from a study by Bjorkquist (1965). The study determined that the group taught with pictorial drawings performed better in the transfer task than groups instructed without any aids or with models. Those who performed best on the initial learning task also performed best on the transfer task.

Verbalizations and Transfer

Turner (1968) offered additional evidence that verbalization plays a key role in the ability to transfer. The learning was related to three principles of symmetry. Practice which included verbalization of the principles assisted transfer performance.

Task Components and Transfer

A study by William (1966) outlined the utility of analyzing instructional tasks into their perceptual and motor components. Practice was permitted on similar perceptual elements with a positive result in the accuracy of transfer. The technique was particularly stressed for teaching perceptual-motor skills. Most

tasks involved in the audiovisual field could be separated by perceptual components and motor components.

Verbal Direction and Transfer

The amount and type of verbal direction during the learning task is an important variable relating to the transfer of learning. Kittell (1956) reported that verbal statements of relationships, which did not include the specific answers, fostered learning, retention, and transfer. He stated:

> Providing direction to learners in the form of underlying relationships encourages searching, discovery and applying which are more effective processes in solving new problems of similar types in the future than rote memory (p. 93).

The development of programs which place an emphasis upon verbal directions which provide direction through the proper questions stress the learner's use of a covert response when the answers are not given immediately in verbal form. The subject is encouraged to seek the answers from the conditions present in the form of the non-verbal aspects of a visual and the manipulation of the objects used in the task being taught.

Labeling and Transfer

Labeling is one of the key generalizations to promote positive transfer. Di Vesta and Rickards (1971) investigated the effects of labeling pictorial stimuli at three different levels: (1) general concept level,

(2) specific concept level, and (3) specific object level. Their findings suggest that labeling at the particular concept level was a more successful approach for objects to be learned as concepts. Labeling was identified as an encoding mechanism for the particular task.

Transfer and the Mediation Hypothesis

Mediational processes in transfer are among the most difficult to isolate, but they appear to be directly related to individual learner characteristics. The mediational processes emphasize the covert behavior of an individual during a transfer task. They are the intervening processes which mediate between the question provided and the ultimate answer given. Mediated transfer is one of the major principles of transfer outlined by Ellis (1965, p. 73) and he defines mediating responses as follows:

> From our point of view, mediating responses are to be regarded as mechanisms for producing transfer. In other words, the ease or difficulty with which a person learns a new task depends in part upon the kind of mediating responses which are available, these in turn being a function of earlier learning experiences. Much of the ability of humans to learn new tasks with ease stems from their use of language, a major source of mediating responses. In fact, a chief difference between humans and lower animals is in their ability to use language to help mediate new behavior (p. 36).

Verbal Stimuli and Transfer by Mediation

The theory behind the mediation hypothesis helps explain the effects of verbal cues upon conceptually mediated behavior. The hypothesis of mediation emphasizes covert responding instead of direct conditioning of external stimuli to external responses. Verbal stimuli in the form of labels within an instructional program assist the learner in stimulus generalization and differentiation. A more technical description of the mediation hypothesis and the use of verbal stimuli conditioned to mediating responses is provided by Wittrock (1965).

Structural Coherence and Transfer

The design of visuals for teaching a specific task is a process which involves structural coherence. Elements of a display can either be segregated or integrated into a single unit or whole. The degree of structural coherence present in visual-verbal and visual-pictoral dispalsy plays an important role in transfer.

Spangenberg (1970) studied the effects of different levels of structural coherence in verbal and pictorial informational displays upon initial learning and a transfer task. Levels of structural coherence varied from minimal to maximum where the display formed a single unit. Initial learning was best accomplished by pictorial displays over verbal displays. Structural

coherence evident in the learning displays, whether verbal or pictorial, provided the best improvement in learning the transfer task.

Programmed Instruction and Transfer

The literature on programmed instruction reveals few studies which are concerned with transfer of learning as the criterion. Klausmier and Davis (1969) explain this issue by stating:

> Programmed instruction has received much attention in the past decade. Programs are being developed in many subject fields that are intended to facilitate student achievement, defined in terms of an acquisition test upon completion of the program or in terms of gains between pretest and posttest scores. Despite this rational approach, the issue of transfer has been almost completely ignored in the research with programmed instruction (Ellis, 1965). Stolurow (1966) projected a transfer research program with the focus on studying transfer phenomena in the medium of programmed instruction. If programmed instruction is to contribute to the scientific foundation of educational psychology as enthusiasts have hoped, others will join Stolurow (p. 1491).

Field-Dependency, Anxiety and Transfer

Transfer can be directly linked to field-dependency in many ways, but manifest anxiety is one link to consider in difficult training and transfer tasks. Witkin (1962, pp. 157n, 167-169, 210-211) discussed the relationship between field-dependency and manifest anxiety by a series of studies using galvanized skin response

(GSR) activity to measure anxiety. Field-dependent subjects tended to be GSR-labile (responsive).

Cohen, Silverman, and Shmavonian (1959) experimented with sensory isolation and found that field-dependent subjects reacted with anger alone or anger and some anxiety.

Murphy (1968) working with fifth graders as subjects found that anxiety did not have an effect upon the performance of fast learners, regardless of whether the transfer condition was positive, neutral or negative. The results with slow learners indicated that anxiety did have an effect upon these learners as the difficulty of the transfer task was increased. This may in part account for anticipated differential performance times between field-dependent and field-independent subjects.

Studies Related to Program Design

Advanced Organizers and Transfer

Retention is critical to transfer. A study by Burse (1969) evaluated the retention and performance on selected problems in descriptive geometry. Meaningful verbal material was retained better when an advance organizer or preorganizer was used. Results suggest a heuristic (rule-of-thumb) for the design of instruction: The use of advance organizers in the instructional process improves differentiation of information and ideas

and permits the learner to incorporate new material into his cognitive structure and retain it better.

Time Effects Upon Learning

The effects of time upon learning were studied by Mangum (1967). Inter-item presentation time and learning rate were varied to observe the effects upon learning and retention of verbal material. The importance of total processing time per unit is suggested in the process of acquiring and retaining verbal material. College subjects were identified by their performance on learning prior to the actual experiment and ranked into quartiles. No single presentation time was isolated for either slow or fast learners. Slow learners tended to retain more when given more time. A certain, fixed amount of time is required to learn a fixed amount of material regardless of how inter-item presentation time is varied in a serial presentation.

The importance of self-pacing is supported to meet the varied times required for each learner to retain information. Longer times available to master a task should close the gap between the amount learned by slow and fast learners.

The Relationship of Color to Cue Function

Color can be used to assist the learner in the process of differentiating the cue function from the

array of cues in the program visuals. Color also serves an attention-getting function as described in a study by Dooley and Harkins (1970). Findings indicated that color in the graphic charts resulted in increased attention. This motivational aspect of color is important.

Advantages of a Pictorial-Verbal Approach

Equated verbal and pictorial-verbal programs presented in a linear approach on a teaching machine were used to assess acquisition, retention and transfer in a study conducted by Yeamans (1965). The program can be closely associated with the present study since the content dealt with selected facts and principles in the audiovisual field. The groups receiving the verbal and pictorial-verbal programs were both tested on verbal and pictorial-verbal test items. Significant results favored the pictorial-verbal program group on: (1) the immediate verbal test, (2) the pictorial-verbal test, (3) the verbal retention test, and (4) the amount of time to complete the program. The pictorial-verbal approach seems well suited for tasks which are too complex perceptually to be taught by either verbal or pictorial stimuli alone.

Pictorial Materials in Concept Formation

Heidbreder (1934) studied concept formation among college students and found that concepts were more easily evolved from pictorial material. Concepts could often be applied correctly even when verbal definition was beyond the subject's grasp. Pictorial material was especially effective with concepts of concrete objects. The emphasis upon the pictorial aspect in concept formation in the present study places an even greater burden on the learner's ability to differentiate among relevant and irrelevant cues.

Definition of a Picture

Knowlton (1966) described twenty-six types of pictures. Nine types in the classification scheme were considered to be labeled as realistic. These nine types varied as to whether their elements, pattern of arrangement in space, or their order of connection would be designated iconic, analogic, or arbitrary. A visual would be considered iconic if at least one part, i.e., elements, spatial arrangements of the elements or connection of the elements, is nonarbitrary. The realistic category includes pictures in the vernacular sense but does not include all pictures because Knowlton's classification system is based on the communicator's intent to make reference to the type of object portrayed.

The visuals used in the present study are realistic by intent and they are iconic with regard to elements, pattern, and connection of the elements. The method of masking used in the visual sequence in the experimental version of this study does not completely change any of the above parts of a representation, but it does appear to alter the emphasis of certain elements, modify the pattern at first glance, and minimize the order of connection of those elements which are masked.

Visual-Compression and Irrelevant Cues

Visuals vary in their ability to communicate. An instructional message is often lost in the visual which is too abundant with details. "Visual-compression" is one technique for removing unwanted cues.

Visual-Compression: A Discussion

Travers (1964) referred to theory on the compression of visual information as the process of discarding those aspects of transmission which provide the least information and retaining and strengthening those aspects which furnish most of the information. Travers (1964a) concludes that special embellishments with arrows and symbols have the effect of making the process of transmitting information too complex for the learner to handle.

Spaulding (1956) working with adults in Latin America, found that realistic pictures with small numbers of objects were the most effective in communicating specific ideas.

The interpretation of "visual-compression" used in this study is based on the same idea of figure-ground altering in the visual as used by Dickie (1969) who defines "visual-compression" as follows:

> This study examines the effects of compressing the visual information in realistic visual representations, black and white photographic slies, by reducing the intensity of background cues so as to make the background appear as a homogeneous and amorphous mass.

This does not leave out the cues as does the definition of visual-compression by Travers, but the cues which are identified as important and relevant to the task are visually separated from the background cues by a photographic screening or masking process. In this experimental treatment the figure-ground relationship is altered by differentiation through contrast masking to highlight the cue function of the visual. The irrelevant cues become part of the background which appears gray and less noticeable when viewed as a projected image on a rear screen. Irrelevant or background cues were determined by associating the cue function (message function) of the visual with the preceding verbal context which provides the set for viewing the pictorial visual.

Questions Used to Identify Relevant Cues

A study by Dwyer (1970) appears to negate the use of questions when realistic visuals are involved in the program. The study was based upon previous research by Dwyer (1967, 1968a, 1968b) which found that all types of visual illustrations were not equally effective in complementing oral instruction. Additional stimuli contained in the more realistic visuals is one reason for variance in visual effectiveness. Dwyer (1970, p. 51) states:

> One of the explanations usually given is that the additional stimuli contained in more realistic visual illustrations tend to distract the S's attention from relevant cues in the oral and visual instruction, thereby reducing their effectiveness as efficient learning media. Presumably, if questions preceding exposure to the visual display could, by channeling the S's attention to the relevant visual cues, improve the instructional effectiveness of the more realistic visuals, a significant contribution will have been achieved. The purpose of this study was to determine which types of visual illustrations preceded by questions were most effective in promoting S's achievement on five critical measures.

Dwyer's (1970) results revealed that all types of visuals were not equally effective in facilitating achievement of different learning objectives. Dwyer suggested that the use of questions to focus the subject's attention on relevant visual cues in more realistic visual displays is not an effective technique for increasing a subject's achievement.

Realistic still pictures of a human heart may actually mask the specific heart functions. Dwyer also used the same verbal message for each visual which is contrary to verbal highlighting techniques of visual media. Thirdly, the study by Dwyer was externally paced by a slide synchronizer rather than internal pacing by the subject himself. The study did not provide a sound basis for not using questions with the realistic visuals.

Irrelevant Cues in Training

Variation in the presence of irrelevant cues in training has been explored by Travers (1964, 1966, 1967), Overing (1966), Dwyer (1967, 1968a, 1968b, 1970), Dickie (1969) and others. Severin (1967) discussed the number of cues present in a training program by suggesting that the cue summation principle of learning theory predicts that learning is increased as the number of available cues or stimuli are increased. He links this with stimulus generalization which would predict information gains as testing becomes more similar to the training situation. Linking cue summation and stimulus generalization together, Severin stated:

> Together, stimulus generalization and cue summation predict that an increase in the number of cues available in the communication of information increases the information gain from that communication, provided the cues are also available in the situation where the gain is tested (p. 238).

According to this statement, subjects would benefit from training situations with many cues either relevant or irrelevant to the task, but present during both the training and the transfer task. Realistic visuals, i.e., actual full color slides, would contain many cues.

Dale (1968), Carpenter (1953) and Gibson (1954) hold the views of "realism theorists" concerning the process of learning from visual displays. These theorists hold the view that learning will be more complete as the number and iconicity of these cues with their referents increases in the learning situation.

Travers (1964) held the opposite view about realistic displays. He suggested that stimuli which are identical to those emitted by the actual referent provide no assurance that useful information will be retained.

Dwyer (1967, 1967a) found that the need for realistic detail varied with the particular learning task. He also suggested that highly realistic visuals seem to be more effective when the learner controlled the pace of the visual presentation. The present study uses realistic visuals which are learner-paced.

Overing (1966) carried out a study using "visually compressed" materials in the form of line drawings used in instruction. Evidence was cited from studies in concept formation which suggested that irrelevant cues or dimensions interfere with learning when they are present

in the instructional task. The study was an attempt to find the possible effects of the presence or absence of irrelevant cues upon transfer. Two experiments were carried out with the principle of refraction applied to the phenomenon of the visual shift of underwater objects. In the first experiment treatments in four conditions varied in the extent the subjects used their auditory and visual modalities during instruction; the amount of irrelevant information was varied, and a problem was introduced for some subjects in order to establish set. The four experimental conditions were: (1) verbal information only, (2) an actual (realistic) demonstration, (3) visually compressed information, and (4) visually compressed information plus a problem to establish set. Results of experiment I indicated that subjects who experienced set performed significantly better on the more difficult transfer task. Verbalizing the principle prior to the transfer task assisted transfer. The second experiment worked with only two treatment groups including: (1) use of realistic materials with all its irrelevant cues, (2) new materials which included actual apparatus, but with irrelevant cues reduced by hiding irrelevant aspects of the demonstration. Results suggested further investigation, but the data indicated that decreased transfer could be due to the presence of irrelevant cues in the transfer situation which were not present in the

training condition. Subjects trained and tested for transfer in the presence of irrelevant cues outperformed those not confronted with irrelevant cues during instruction. The superiority of the group trained with irrelevant cues present may not be supportative of the need for irrelevant cues in training, but may just support the transfer generalization by Ellis (1965) which states: "Transfer of training is greatest when the training conditions are highly similar to those of the ultimate testing conditions" (p. 72).

Travers (1966) investigated the effects of varying training conditions upon transfer. The principle of refraction was taught (1) by varying irrelevant information while holding relevant information and time constant, (2) by establishing a set, and (3) by verbalizing knowledge gained during training. The transfer task performance was measured by the scores established while shooting at an underwater target. The dimension varied was essentially irrelevancy. The realistic training condition had many irrelevant bits of information. The "visually-compressed" training condition eliminated many irrelevant bits of information through the use of a series of line drawings.

Results indicated that the establishment of set prior to training in the presence of irrelevant information facilitated the application of a principle to a new

situation. Set was provided by contact with a relevant problem immediately preceding instruction with the visually compressed materials. Written verbalization prior to a difficult transfer task was said to possibly contribute to transfer. A tentative conclusion suggested that transfer is facilitated when irrelevant cues present in the training condition are also present in the transfer condition.

Travers and Overing (1967) varied the amount of irrelevant cues in training and test conditions and studied the effect upon transfer. Conclusions suggested that subjects trained under conditions possessing irrelevant information were able to transfer their learning to test situations where irrelevant cues were present or to test situations where the irrelevant information was reduced. Subjects trained in the absence of irrelevant information were less able to transfer to test conditions where irrelevant information was present. This is consistent with the task similarity generalization of transfer.

Field-Dependency and Differentiation

Less field-independent subjects are less able to differentiate cues in a visual than field-independent subjects according to Witkin (1962). Field-dependence

is related to the ability to differentiate stimuli in a visual display.

The Differentiation of Stimuli

If a learner can differentiate the important cues or elements in a visual the time he spends in learning should be reduced. Gagne (1965) discussed the importance for the learner to be able to differentiate the criterional stimulus from the background stimuli. Gagne stated:

> Should the external stimuli be faint, or indistinguishable from background stimulation, the acquiring of an $S_S \leftrightarrow R$ connection will be accordingly difficult and require many repetitions. If the stimuli are vivid and distinct, learning will be rapid (p. 77).

Stimuli can be differentiated in several ways. Berelson (1964) includes: (1) type of stimuli, (2) the absolute intensity of the stimuli being represented, and (3) the sensitivity of an individual's receptor. The type of stimuli used can affect differentiation.

Berelson (1964) noted that only a small portion of all potential stimuli present in any given situation actually become part of the individual's experience. The attending to specific stimuli is related to the nature of the stimuli. The differential intensity or quality of the stimuli is a major determinant. The reduction in the projected intensity of background cues in the

experimental slide sequence alters the figure-ground distinction in each masked visual.

The receptor nas already been discussed as a major factor in differentiation with respect to the subject's ability to receive color. The perceptual style of an individual also affects his ability to differentiate stimuli within a visual field. Witkin and his associates (1962) were able to categorize subjects into two individual modes of perception, labeled "field-dependent" or "field-independent." There are individual differences which can be measured in a number of ways. The present study identified individuals as being "field-independent" and "less field-independent."

The "more field-independent" individual experiences his surroundings analytically with objects experienced as discrete from their background. He is less influenced by the context in which the objects or figures are embedded.

The "less field-independent" person tends to experience his surroundings in a global manner. This individual is influenced by the context or prevailing field and has difficulty in isolating figures or objects from the field perceived.

The figure-ground relationships can be altered in visuals to examine the effects upon perceptual style.

Psychological Differentiation-- A Brief Overview

Field-dependency as it related to psychological differentiation is an important individual difference to consider in designing instructional programs.

Problems in cognition continue to be of interest to researchers. One of the areas of major concern is the presence of different styles of cognitive functioning, as it relates to individual pattersn of adaptation. Witkin and his associates (1962) have carried out longitudinal studies in psychological differentiation which have revealed particular clusters of complexly interrelated characteristics in people. They have offered a theoretical framework which links some of the diverse aspects of individuals functioning together. Research with the dimension is related to earlier studies by Witkin which found that people differed in the way they oriented themselves in space. This they found (Witkin, 1962, p. 1) was linked to a variety of personal characteristics involved with many types of psychological functioning.

Witkin et al. (1954) found that young children perceived in a relatively field-dependent manner, but as they grew older, their perceptual style became more field-independent. Young children are more influenced

by the over-all structure which structures the way in which the various parts are perceived.

The findings just cited associate field-dependent perception with early development and might be considered a lower way of functioning than field-independent perception.

The Differentiation Hypothesis

Early research with the differentiation concept can be found in the writings of Lewin (1935) and Werner (1948).

Witkin and his associates (1962) developed the differentiation hypothesis to illustrate the association of clusters of individual differences. The hypothesis is described as follows:

> Specifically, the differentiation hypothesis proposes an association among the characteristics of greater or more limited differentiation, identified in the comparison of early and later functioning in each of several psychological areas; degree of articulation of experience of the world; degree of articulation of experience of the self, reflected particularly in nature of the body concept and extent of development of a sense of separate identity; and extent of development of specialized structural controls and defenses. Implicit in this hypothesis is the view that greater inner differentiation is associated with greater articulation of experience of the world.

Determiners of Differentiation

There appears to be a definite relationship between initial endowment at birth and the complex circumstances of particular life experiences. Life experiences can assist, hamper or even forcibly push a child toward greater differentiation, but the results are affected by the child's initial make-up (Witkin, 1962, p. 18). An individual can operate at several different levels of differentiation at different times or even during the same time. Lack of motivation could prevent a more differentiated person from functioning at the high level within his capability (p. 17).

To eliminate motivation as a contaminating factor in this study only those individuals which showed high interest in the content to be taught were selected.

Analytical Functioning in Perception

There are differences in analytical functioning in perception which can be identified from the measurements of a variety of tests. Witkin (1962) defines the field-dependent-independent dimension and the nature of the tests which measure it as follows:

> Each of the tests of the perceptual battery devised in the course of this work requires the person to separate an item from the field or context of which it is a part and which therefore exerts a strong influence upon it; to "break up" a field on configuration. The

> person with a more field-independent way of perceiving tends to experience his surroundings in a relatively global fashion, passively conforming to the influence of the prevailing field or context.

Several tests have been used to identify the field-dependent-independent dimension of perceptual style, but most require individual testing and specialized environment. This is especially true of the tilting, room-tilting chair test and the rod and frame test.

Flexibility of Closure and Field-Dependence

The similarity of closure flexibility was suggested by Witkin (1962, p. 49) because the definition of closure flexibility as a perceptual dimension paralleled the definition of field-dependence. Thurstone (1944) used a battery of tests to measure flexibility of closure. One of these tests was the Thurstone-Gottshaldt Test which used modifications of Gottshaldt's (1926) original figures used for his work related to the role of post experience in perception.

Witkin (1950) modified the Gottshaldt figures by increasing their complexity with the addition of color. The simple figure is hidden in a larger figure and subjects are scored on a timed basis.

Both Witkin and Thurstone used modifications of Gottshaldt's original figures to measure field-dependency and closure flexibility respectively. Witkin's Embedded

Figures Test (EFT) which uses the modified Gottshaldt figures has shown high reliability on test-retest correlations. Test-retest correlations as high as .92 have been found by Dana (1959) and .89 in a study by Bauman (1951).

Witkin's EFT measures were positively correlated with other measures of the field-dependent-independent dimension in his cross-sectional studies (Witkin, Goodenough, and Karp, 1959).

Significant correlations between Thurstone's test for closure flexibility using concealed figures have been reported by Rudin and Stanger (1958), by Witkin (1962) and by others in Witkin (1962, p. 49), including Goodman (1960), Phillips et al. (1957) and Crutchfield, et al. (1958). Witkin summarizes these studies as follows:

> The results of several studies suggest that the field-dependence-independence dimension is very similar to dimensions of perceptual functioning (flexibility of closure and spatial decontextualization) identified by other investigators. It may be that these refer to the same dimension, called by different names.

The test for closure flexibility was selected because of its ease of use and reliable correlations with Witkin's EFT. This test was used to measure the field-dependent-independent dimension.

Field-Dependence and Comprehension

Schimek and Wachtel (1969) speculated that field-dependent subjects possessed less capacity for quick comprehension and organization of verbal material. They attributed the difference to a lack of clarity and structure when complexity goes beyond a certain level.

Their study suggests the importance of field-dependence-independence as a design consideration.

Field-Dependence and Memory

Fitzbiggons, et al. (1965) found that field-dependence played a role in memory for incidental material. They found that field-dependent persons with global perceptual orientation showed superior ability to remember incidental material if it was socially relevant. Field-independent persons are more task oriented. The content being learned could be related to the field-dependent-independent dimension. These findings were supported by Goldberger and Fitzgibbons (1971).

Cognitive Style, Attention and Learning

Wachtel (1971) showed that field-dependency is associated with stress responses whenever the situation is unusual, unfamiliar, or novel in any fashion. Field-dependent persons are the most likely to feel and express

stress in these situations. This would seem to suggest that care be taken to prevent this condition within the context of any research.

Field-Dependence and Concept Formation

Elkind and Koegler's (1963) study supported the hypothesis that field-independence is an asset on tests that require perceptual concept formation (the abstraction of elements and relations from things rather than from words). They noted that other studies found field-independence was not helpful when the tests required verbal concept formation, i.e., the abstraction of elements and relations from words rather than from things.

The present study tests both verbal and perceptual concept formation, but with greater emphasis on the perceptual dimension. This should favor good performance from field-independent subjects in the process of determining exposure on a photographic copystand.

Field-Dependence and Task Performance

Dargle and Kirk (1971) found that there was an interaction between field-dependency and task difficulty. Field-independent subjects performed better on moderately difficult tasks. Their final comments supported the need to evaluate the field-dependency dimension in perceptual learning experiments.

Eye Movement and Field-Dependency

Boersma et al. (1969) found that field-independent subjects tended to make more shifts between target and alternatives than did field-dependent subjects. This was explained as being an indicator of analytical visual search and the amount of time looking at the complex figure (target). Females spent more time in target fixation.

The use of photographic screening in this study should result in fewer shifts and improve visual search behavior.

Summary

Bruner (1960) and Stolurow both defined two types of transfer: (1) specific and (2) non-specific. Bruner describes the two types of transfer in relationship to the importance of structure in learning. Stolurow distinguishes between the two types of transfer through the relationship that exists between or among a set of tasks.

Kelly (1962) and Beauchamp (1950) focus on what they consider to be the lack of precision of the term transfer.

Erickson (1969) relates the importance of transfer to learning theory and expresses concern about the gap between theory and practice. Ellis (1965) discusses the

important relationship between transfer and the conditions under which it can occur. Grose and Birney (1963) stress the need to match learner characteristics to these conditions. Davis and Klausmier (1969) argree that these relationships are important and must be researched.

Ellis (1965) provides a listing of generalizations which facilitate the process of transfer and gives the program designer a valuable framework. The effects of learning or deriving generalizations and applying them to transfer tasks are reported by Wills (1967), Katona (1940), Haslerud and Meyers (1958) and Barceski (1969). Derivation of principles and rules is generally more useful in the transfer process than rote learning of the rules.

Johy Dewey (1938) relates the individual, continuity and environment to successful transfer. Traxler (1969) supported the need for similarity of both stimulus and response for the subject. Lee (1967) provided support for the easy to hard rule path in rule learning. Marriner (1964) cautions using a program designed with constant correction to the learner.

Studies by Mahler (1951) and Bjorkquist (1965) support the need for similarity between the instructional task and the transfer task. Turner (1968) suggests that verbalization of the principle will assist transfer performance.

Task components, verbal directions, labeling and mediation are linked to successful transfer. Wittrock (1965) and Ellis (1965) explain the role of the mediation hypothesis towards transfer.

The need for structural coherence in message design is emphasized by Spangenberg (1970). Davis and Klausmier describe the missing link between programmed message design and transfer.

Witkin (1962) presents the relationship between anxiety and field-dependence. This relationship is tied to transfer with studies by Cohen et al. (1959) and Murphy (1968).

Program design factors are examined in connection with the need for advance organizers described by Burse (1969); color and cue relationships by Dooley and Harkins (1970); pictorial-verbal approach advantages examined by Yeamans (1965); and Knowlton's suggestions for a picture classification scheme to increase the precision of design.

Travers (1964) refers to theory or the compression of visual information. Spaulding (1956) lends support to the idea of simple visuals. Dickie (1969) defines "visual-compression" in terms of reducing background cues into an amorphous mass through masking of black and white photographs.

Dwyers' studies (1967, 1968a, 1968b, 1970) focused on the need to match the type of visual with the particular task. Travers' (1964, 1966, and 1967) studies dealt with the problem of irrelevant cues in training along with a study by Overing (1966). Travers suggested that the presence of irrelevant cues could assist transfer if the training conditions and transfer conditions contained similar cues.

Gagne (1965) discussed the need to help learners differentiate stimuli. Some of the ways in which this differentiation can be accomplished were outlined by Berelson (1964). The type of stimuli, the intensity of the stimuli and the sensitivity of the individual's receptor are key factors of differentiation mentioned by Berelson.

The field-dependence construct is identified as a major variable in an individual's perceptual style by Wilkin (1954 and 1962) and his associates. The Thurstone and Jeffrey Test for Closure Flexibility is linked to field-dependency measures and the test serves as the main instrument for determining the degree of field-dependence in this study.

Field-dependence is linked with anxiety, memory, attention, concept formation, and task performance with brief reporting of several studies.

The report of the literature was an attempt to establish the theoretical framework for the study by specifically linking the key independent and dependent variables. The independent variables are "visual-compression" (masking technique on slides) and field-dependence as a learner characteristic. The dependent variables include time and score measures of a specific replication task and a related transfer task. The research cited was used in the developmental stages of the self-instructional programs used in the study.

CHAPTER III

METHODS AND MATERIALS

The research methods and materials used to investigate the effects of field-dependency and visual-compression upon non-specific transfer are described in this chapter.

Clarification of Terms, Techniques, and Measures

Field-dependency refers to the individual perceptual style of the learner described in this study as being either field-independent or less field-independent as determined by scores achieved on the Thurstone and Jeffrey Closure Flexibility Test.

Visual-Compression

Visual-compression is the label given to the design technique used in the visual sequence for the experimental, self-instructional program. The technique employs a photographic screening process which subdues the brightness of background cues when viewed as an image projected on a rear screen.

Irrelevant Cues

Irrelevant cues is the label given to the background cues which are screened to provide emphasis of the cue

function or message function of each visual by highlighting the cues most relevant to the task being taught.

Relevant Cues

The relevant cues are those cues which are most important for the message function of each pictorial visual. The relevant cues were selected from the total visual field of each visual with pictorial content on the basis of their role in the message function. This was determined by the verbal information contained on the visual preceding each pictorial visual.

The term visual here refers to a standard 35mm photographic transparency in full color and mounted in the 2 x 2 mount. Visuals are actually slides which contain either verbal instruction or pictorial information, but not both at the same time.

Visuals containing verbal instruction includes statements in the form of directions, discussion, or questions. These visuals are alternated with the pictorial visuals (Appendix A).

The Training Task

The training task is offered in an experimental version which used the visual-compression technique employing a photographic screen and in a control version which is alike in all respects except a photographic screen or mask is not used.

The training task in both experimental and control versions consists of: (1) the self-instructional slide sequence which is paced by the learner, (2) a written review task performed without the aid of the self-instructional visuals, and (3) a performance task which is a replication of the two techniques for measuring light taught in the slide program. This latter task had to be performed without returning to the visual sequence for help.

Training Task Measures

Measures taken during the completion of either the experimental or control versions of the training task are related to the three aspects of the task just described and include: (1) total time (recorded in seconds) required to complete the self-instructional slide sequence, (2) score on the written review immediately following completion of the self-instructional slide series, (3) performance score achieved for replication of the two techniques for measuring light which were taught in the self-instructional visuals, and (4) time (recorded in seconds) required to perform the combined replication of the two tasks.

The Transfer Task

The transfer task immediately follows the completion of all three aspects of the training task. The transfer task required the subject to apply principles and

techniques learned in the training task to the interpretation of the limited instructions provided during the transfer task. The transfer task used different stimuli which required different, but related responses than were required in the training task. This form of transfer fits the AB-CD transfer paradigm where A and C represent related, but different stimuli and where B and D represent related, but different responses. This procedure fits design 5 of the transfer designs outlined by Ellis (1965, p. 11).

Table 1. Transfer Design Used in the Study

Group	Original Task	Transfer Task
Experimental and Control	Learn A	Learn B

Measures on the Transfer Task

Measures taken during the performance of the transfer task include: (1) total time (recorded in seconds) required to complete the transfer task, and (2) task performance scores based upon both the performance process and the resultant product. The performance scores of individual subjects represent the combined process and performance scores.

Transfer Formulas

The amount and direction (positive or negative) of transfer can be determined by using one of several transfer formulas available. These formulas can be applied with measures of time, number of correct responses, or the number of errors. Three common formulas and their derivations are used to measure the results of transfer according to Ellis (1965). The three formulas used in interpreting the results to facilitate the comparison between the results of this study with those studies which used any one of the three transfer formulas.

In each of these three formulas, two or more of the following letters are used: "E" refers to the experimental group mean, "C" refers to the mean of the control group, and "T" represents the total score possible. In addition to common statistical analysis, i.e., analysis of variance, each of the following transfer formulas was applied to the results in this study. When time is the measure the formulas which were used were:

(1a) Percentage of Transfer = $\frac{C-E}{C}$ X 100

(2a) Percentage of Transfer = $\frac{C-E}{E+C}$ X 100

The formulas used to interpret the results of transfer when the measure is the number of correct responses (including knowledge of the total possible score for 3a) were:

(1b) Percentage of Transfer = $\frac{E-C}{C}$ X 100

(2b) Percentage of Transfer = $\frac{E-C}{E+C}$ X 100

(3a) Percentage of Transfer = $\frac{E-C}{T-C}$ X 100

Formulas (2a) and (2b) are preferred by Murdock (1957) because the amount of positive or negative transfer cannot exceed 100 percent and both are symmetrical with regard to the upper and lower limits possible. The different formulas permitted comparison of the results with other studies.

The Subjects

The subjects were selected from the entire group of students enrolled in the basic audiovisual courses (TEED 548 and TEED 646) offered in the College of Education at Western Michigan University during the fall term of 1971 and the winter term of 1972. The TEED 646 course differed from TEED 548 in that it provided more emphasis on the possibility for independent study and practice in some basic production processes, exclusive of photography.

Students from these courses were selected because their motivation to learn the experimental content was judged to be high. The audiovisual courses are electives. These students could be expected to participate in self-instruction as a normal part of their routine during the course. Further, the content used in self-instruction for

this study is related to the content taught in these courses, but it is not specifically taught. Several years of teaching this course has indicated to this writer that interest in photography and the activity of producing slides on a copystand are high interest activities for students electing an audiovisual course.

Testing for Prior Knowledge

All subjects enrolled in the basic audiovisual courses were tested for prior knowledge and experience with the content to be taught in the training task or applied in the transfer task. This test was administered early in each of the two terms by the instructors teaching each of the sections. The information was gathered as an ordinary routine in the courses. Data usually collected included a variety of information about the students. The form used to collect this information will be referred to hereafter as the student information form.

The Student Information Form

The purpose of the student information form was to collect data about: (1) the level of interest in producing photographic slides on a copystand; (2) the amount of skill or experience with: (a) an exposure meter (hand held or built in the camera), (b) a camera with adjustable settings, and (c) a photographic copystand; (3) prior experience and present attitude toward the programs in the

self-instructional laboratory of the Educational Resources Center; (4) class information, and (5) the student's whereabouts during the current and subsequent term. The short form (Appendix B) did not mention the student's willingness to participate in the study.

Interpreting the Student Information Form Data

It was determined that self-report data would reveal fine points of experience which might be overlooked on a questionnaire (Appendix C). Each student information form was evaluated by a fixed set of criteria (Appendix D) to determine his acceptability as a potential subject for further participation in the study.

Students who were familiar with the use of an exposure meter, or the use of a single-lens reflex camera on a copystand, were eliminated as potential participants in the study. This instrument was not the final check for the elimination of a subject due to prior knowledge or experience, but it served this purpose very well.

Final Check for Prior Knowledge

A final check of a subject's prior knowledge was made at the time he entered the self-instructional setting in the learning laboratory. The final check consisted of asking the subject to identify reflected or incident light readings following a brief demonstration. Subjects were

also asked to point to key features of an exposure meter and a single-lens reflex camera. The self-report instrument proved to be very reliable. This is not surprising since relatively few individuals work with both types of exposure readings and a gray card under the artificial light conditions used with the photographic copystand.

Testing Color Blindness and Color-Defectiveness

All the students in the basic audiovisual courses considered to be potential subjects were tested for color blindness and color defectiveness early during each term. This was accomplished with the aid of an experienced research associate. Each subject was given the Ishihara Test for Colour Blindness under controlled lighting of a Macbeth lamp which simulated north light. Only one subject was tested at a time. Results were recorded on a special form (Appendix E). Subjects with serious color defects or color blindness were eliminated from the list of potential subjects for the study.

Determining the Degree of Field-Dependency

All subjects in the basic audiovisual courses (217 persons) were tested with the Closure Flexibility Test (Concealed Figures-Form A) developed by Thurstone and Jeffrey. This test has a high and reliable relationship with the other tests (Appendix F) commonly used by Witkin

and his associates (1962) to determine whether an individual's perceptual style is field-independent or less field-independent.

Revision of the Closure Flexibility Test

The original version of the Closure Flexibility Test was meant to be administered as a group test which would then be hand scored. This would have been a rather slow process since the subject's responses would be spread throughout the booklet. Dickie (1969) revised the test directions (Appendix G) to facilitate machine scoring on the IBM 1230 Optical Mark Scoring Reader. This writer was able to score the standard answer form (Appendix I) quickly with the aid of a technical research assistant, a light box and an overhead transparency with answers marked in transparent color. Students marked the answer sheet with ink or soft lead.

Distribution of Closure Flexibility Scores

There is a major consideration concerning the spread of the scores between those who scored high and those who scored low on the closure Flexibility Test. The gap between the mean of the thirty subjects labeled field-independent and the mean of the thirty subjects labeled less field-independent is smaller than in some studies.

Dickie (1969) tested a rather heterogeneous group of 900 students enrolled in the beginning course of the professional education sequence. He was able to separate the high and low scoring groups by selecting only from those who scored +1.0 standard deviation above the mean for the field-independent groups (male and female groupings) and selecting only from those scoring -1.0 standard deviation below the mean for the group he labeled field-dependent. His study involved forty subjects balanced and separated by sex.

The sixty subjects in the present study are more homogeneous. They tended to score higher (Appendix J) than the subjects used in Dickie's study, but the gap between the means of the high and low scoring participants is considerably less. These rather striking differences will be discussed again when the results are interpreted. The population from which the stratified random sample was drawn for this study consisted of 217 individuals which is a considerably smaller number than Dickie's 1969 study.

Selecting the Student Sample

The total population of subjects tested (Appendix J) as potential subjects for this study was the 217 students enrolled in the beginning audiovisual courses. This population was reduced to 189 subjects after eliminating those who possessed prior knowledge or were identified as being either color blind or color defective.

Subjects who possessed prior knowledge of the content in either the training task or the transfer task were eliminated on the basis of responses to the student information form and brief pre-test performed in the instructional booth (SLATE). There were 19 subjects eliminated on the basis of prior knowledge of content in either the training task or transfer task.

Those subjects identified as being either color blind or color defective were eliminated from further study on the basis of the interpretation of results on the Ishihara Color Test. Color blindness or color defectiveness eliminated nine individuals as potential participants in the experiment.

The remainder of the population comprising 189 subjects was arranged in rank order on the basis of scores obtained on the Thurstone and Jeffrey Closure Flexibility Test (Appendix K). Subjects participating further in the study would be selected from the upper and lower groups of scores. Forty individuals with the top forty scores and forty persons making the lowest scores were called on the telephone to verify the subject's availability and willingness to come to the Learning Laboratory of the Educational Resources Center for the SLATE experience. They were told that the experience would take about an hour or slightly longer.

This phone call was critical for the following reasons: (1) seven individuals who had been in the fall 1971 courses were student teaching in cities too distant from the campus to be used as subjects, (2) those who would be participating in the study could plan a time which would be convenient for participation within the month long testing period, and (3) one person was leaving the country and did not wish to participate.

A procedure of stratified random sampling was used to assign sixty subjects randomly to the four cells which would be required for the experimental design. A table of random numbers was consulted (Arkin and Colton, 1950, p. 144). Subjects scoring high on the field-dependent-independent dimension were randomly assigned to either the experimental or control version of the manipulated or active (Kerlinger, 1966, p. 42) variable. The active variable in this study is the screened (visually-compressed) version or the masking effect used on the pictorial visuals in the training task. The same procedure of assignment was used for subjects scoring low on the measured (field-dependency) or assigned variable.

The subjects who had been previously telephoned were phoned again and asked to select a specific time block (Appendix L) during any day of the week of the month long testing period. Subjects had considerable freedom of

choice for participation because the scheduled hour and a half time blocks included hours from 8:30 A.M. to 10 P.M. on weekdays and in the mornings or afternoons on Saturdays and Sundays. All the testing was observed except for a limited number of conflicts. Observation was possible by being situated in a position where physical presence was not obvious to the subject.

All the subjects who agreed to participate did do so, but some individuals were rescheduled as often as three times in order for them to participate.

Stimulus Material

The stimulus materials consisted of: (1) experimental or control sequences of ninety-one 35mm color transparencies mounted in standard, cardboard 2 x 2 inch mounts contained in the 140 slide capacity tray for the Kodak carousel type slide projector, (2) a Gossen Pilot exposure meter capable of measuring both incident and reflected light, (3) a 35mm Pentax model Hla single-lens reflex camera equipped with a 55mm f/2.0 lens, (4) Kodak neutral test card or gray card, (5) a dry mounted magazine picture with high detail, sharply contrasting colors, and of sufficient size to be brought into focus with the standard 55mm lens, and (6) a photographic copystand with four 3200K lamps operating at half power through the use of a special device to minimize heat and glare during the SLATE experiment.

Developing the Training Slide Sequences

The training slide sequences were eventually produced in two versions known as the "control" and "experimental" version. Initial effort was concentrated on the development and production of the "control" slide sequence.

A set of 4 X 6 inch cards were used to record main functions and principles necessary to learn how to determine photographic exposure on a copystand using a gray card and a hand-held meter capable of measuring incident and reflected light. The training process would have to include the process of transferring the readings to a single-lens reflex camera and actual operation of the camera. The visual training sequence would also have to include principles and techniques which would facilitate transfer to a single-lens reflex camera with an integrated exposure meter.

Simulation Prior to Photography

A tutorial approach was used in the formative evaluation process of producing the slide sequence. The first step in the process required two subjects. The subjects were on the staff of the Educational Resources Center, they were interested in photography, but they knew little about the subject. The two subjects were trained and tested for transfer individually. This step was a

simulation with the real objects rather than the use of slides. The purpose was to determine the proper lighting adn sequence plus a rough estimation of what verbal information would ultimately be needed to clarify the visuals. During this process, the planning cards were used to assist in the proper sequence of presentation. Each specific slide-to-be was simulated by holding the actual camera, meter, or other items used in the actual positions in which they would be photographed. The subject was given information, asked questions about the process. They were also asked if they could see the particular object or details well. Immediately following the simulated training task, the subject was handed the camera which would be used in the transfer task, given limited information about the camera, and told to shoot a picture of the dry mounted picture which would be used in the training task. Immediately following the subject's attempts in the whole training and transfer process, the process was discussed with the subject including its sequence, visual stimuli, and verbal information.

The success of this approach can be noted by the fact that this three to four hour evaluation process resulted in a pool of slides so complete that additional slides of pictorial content were not needed later. This is especially significant considering that the verbal

information was changed in content and sequence eight times during further evaluation using the tutorial approach.

Producing the Control Slides

The simulated process in the formative evaluation process just described made it possible to develop a series of typical planning cards for the pictorial slides which could be used in the "control" version of the training program. The slide series required the use of a subject whose hands would be photographed throughout the sequence. A subject with slender fingers and well groomed nails was selected to prevent critical details on the apparatus from being obstructed or causing distractions for the learner.

Professional Kodachrome II, type A film was used in conjunction with four mobile lights equipped with diffusion lens for even lighting and a spot for critical areas needing more light. Seventy-two slides made up the basic pool from which the final set of pictoral slides were selected.

Developing the Verbal Message

The development of the verbal message required the use of eight more subjects individually tested on both the training and transfer tasks. A production technique was developed which maintains flexibility during the formative evaluation process required to link the verbal and pictorial messages together.

The completed training program has no audio component. All verbal information eventually appeared on slides which would be interspersed among the pictorial slides of the training sequence. The verbal message presented in slide form permits complete independence of pace with ease of review through reverse on the projector.

The tutorial process was continued as the verbal message was being designed. A tape recorder was used to present the recorded verbal message. The audio message could be changed quickly without cost. Each of the eight subjects went through the training task with the writer present and available to assist when needed. Detailed observations were made as the subject first viewed and listened to the training task and then performed the transfer task using a Ricoh Singlex single-lens reflex camera with an integrated behind-the-lens exposure meter. The subject was provided with limited instructions concerning the Ricoh camera and another sheet which described his task along with data to be recorded.

After the subject completed the transfer task, he was informally, but thoroughly interviewed concerning the task, the training program, forms used, and written instructions. The eight subjects used for this process were all students working in the Educational Resources Center. They were eager to assist, interested in the

tasks, yet totally unfamiliar (they said) with the content of the tasks. This process resulted in eight changes in the verbal message, elimination of several pictorial slides, four shifts in sequence, and two modifications of the instructions and data collection forms. The tutorial approach brought the program designer closer to the conceptual naivete of the subject with regard to the particular training and transfer tasks used in this study.

The subject used last in the formative evaluation process performed both the training task and the transfer task exceptionally well. The decision was made to proceed with the development of the "experimental" slide sequence and the production of the slides which would present the verbal information for both the "control" and "experimental" versions of the training program.

Producing the Verbal Slides

The slides with the verbal information were produced from slide flats which were made by using the large primary type on yellow construction paper with a smooth texture. Yellow construction paper was used to minimize the contrast and image brightness viewed on the rear screen. This would balance the receptor (eye) reaction throughout the entire slide sequence. The flats were photographed with Type A Professional Kodachrome II film on the photographic copystand with balanced, artifical lighting. Frame

numbering was not used so last minute insertion of additional pictorial or verbal information would have been possible.

The Experimental Version

The "experimental" slides with pictorial content were produced by a process developed during this study. The intent of the design for the pictorial slides used in this version was to alter the figure-ground relationship between the cues readily associated with the message function and those which were considered more irrelevant to the message function of the visual. The variety of shapes of elements serving as the important or relevant cues gave rise to the suggestion of using a free form shape to highlight these cues. This version labeled "visually-compressed," was designed to diffuse the background into a less distinct gray mass while serving to highlight the important cues. The differences in image brightness of the two areas on the screen thus served to alter the figure-ground relationship by making the figure (important cues) appear brighter and more distinct.

A Costly Approach

A costly approach to provide masked areas on full color slides would be to use a photographic screen similar to the Para Tone 85-line, 80 percent screen with adhesive

backing. The screen would have to be applied to color prints approximately 8 X 10 inches in size. These prints in turn would have to be rephotographed to produce a series of screened slides.

An Alternative Approach

An alternative approach to develop a series of screened slides was developed by using high contrast negatives superimposed with the original color slides on a Honeywell Repronar and duplicating them. The original slides were placed in the negative carrier of a photographic enlarger and enlarged to nearly 8 x 10 inches on single-weight polycontrast enlarging paper. Tracing paper was used on top of the enlargement (which now appeared as a paper negative) and a free form line was drawn to outline the important cues. This line was transferred to white zinc coated copy paper and the free form shape was cut out.

The resulting paper rectangle with a free form cutout was photographed with black felt appearing behind the free form hole. High Contrast Copy film was used because of its great density, reasonable sensitivity to light (ASA 64) and extremely low cost. It took over 250 shots to perfect the process, but any density of photographic screen could be simulated with this technique (Appendix N). The High Contrast Copy film negatives became the masks which were superimposed with the original pictorial

slides and duplicated as a new slide. The original pictorial slides were also duplicated without the negative screen so the "control" set of slides would match the brightness and contrast of the "experimental" set except for the screening.

The Training Environment

The training environment is illustrated in Figure 2 and shows the location of the various apparatus within the entire SLATE area. The area included the following equipment ant materials: (1) a projection carrel (Figure 1) which included a Kodak Carousel A-V 900 projector equipped with a 3-inch f/3.5 lens and a 140 slide capacity tray containing either the "experimental" or "control" slide sequence, (2) a Graylab photographic timer connected to the remote slide projector switch behind the projection carrel, (3) a stool with a foot rest and swivel seat, (4) a library-type step stool, (5) a table containing the Gossen Pilot exposure meter, Kodak gray card, Pentax Hla single-lens reflex camera, cable release, dry-mounted magazine picture, and remote advance cord for the slide projector, (6) package "A" which contained the written test and instructions and data sheet for replicating the training task, (7) package "B" which defined the transfer task and included the Ricoh Singlex Camera loaded with high contrast copy film, an empty film box marked with ASA 32 rating, package "B" instructions and data sheet, abbreviated

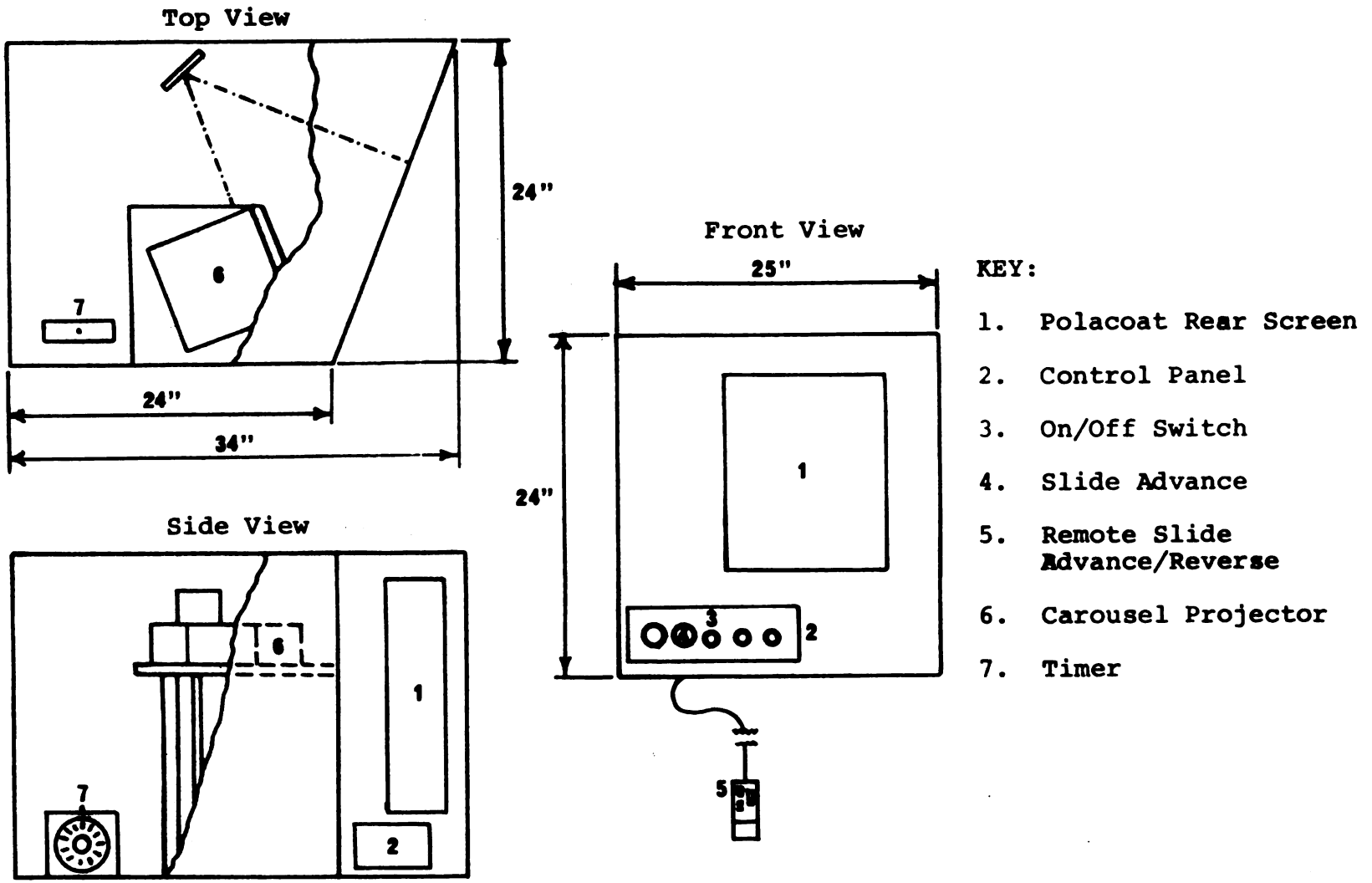
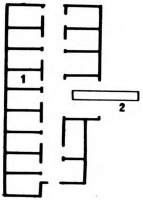


Figure 1. Projection Carrel

Figure 3. Self-Instructional SLATES



1. Exposure SLATE
2. Check-in Counter (Students can be observed from this point)
3. Projection Carrel
4. Timer
5. Remote Slide Advance/Reverse
6. Exposure Meter
7. Package "A"
8. Cable Release
9. Pentax Hla Camera
10. Photographic Copystand
11. Mounted Picture
12. Kodak Gray Card
13. Control for Copystand Light
14. Package "B"
15. Stool
16. Foot Stool

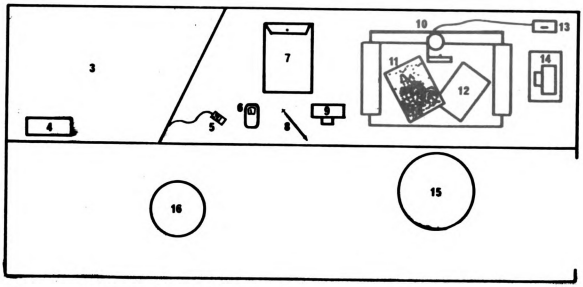


Figure 2. Details of Exposure SLATE

instructions for the Ricoh camera, and a display card which pictured the location of some of the key operational features of the camera, and (8) a digital clock mounted on the projection carrel.

Observation of Subjects

The behavior and modes of attack used by the subjects were observed directly by this writer. The particular location of the SLATE (Figure 3) permitted visual observation of the subject performing in the SLATE environment. Figure 3 gives an idea of how the subject could be observed. The relationship between the field-dependent-independent dimension and personality makes this type of observation particularly interesting.

Procedures

Sixty subjects participated in the SLATE programs. Thirty of these subjects received the experimental treatment, i.e., the screened slides, and thirty received the control version of the slide program. Subjects were randomly assigned to control and experimental versions after grouping by score. Each group of thirty subjects was equally divided among those who received high scores on the field-dependent-independent dimension and those who received low scores on this dimension. The group which

received high scores is labeled "field-independent" and the low scoring group is labeled "less field-independent."

Table 2. Assignment of Subjects to the Four Experimental Conditions

	Visuals Screened	Visuals Not Screened
Field Independent	15	15
Less Field Independent	15	15

Eligible Subjects--A Review

The sixty participating subjects had no color defect, they did not have prior knowledge of the training task or the transfer task, they had scored high or low on the Closure Flexibility Test, they were willing and available to participate, and they had been randomly assigned to either the experimental or control set of slides used in the training task.

SLATE Assignment Record

Subjects reported to the learning laboratory on an appointment basis. In the learning laboratory, this writer or an assistant assigned the individual to booth #6 which was reserved for the experimental SLATE. A weekly

record (Appendix O) of the subjects scheduled provided arrival time, phone number, name and information as to whether they would receive the "E" program, i.e., the experimental slide version or the control slide program labeled "C".

Timing the Slide Sequence

The assistant in charge of the learning laboratory was also provided with a procedures sheet (Appendix Z) which explained how to record the time from the hidden timer and how to prepare the lab for the next subject. Subjects did not know the time they spent with the self-instructional slide sequence was recorded. The photographic timer was directly connected to the slide projector, remote switch and recorded the exact amount of time the slides were used. Attending times for individual slides were not recorded.

Training Task Procedures

The subject moved at his own pace through the self-instructional sequence of 91 slides, containing either verbal or non-verbal (pictorial) information. The subject could reverse the slides or rapidly advance them, but the last slide of the sequence instructed him to turn off the slide projector. Turning off the projector stopped the hidden timer. The last slide had also instructed the subject to grab package "A" and proceed with the instructions

in the package. The first instruction in package "A" provided an additional reminder to turn off the slide projector. The slides never jammed in the projector during this phase of the study.

Training Review and Practice

Package "A" was a manila envelope containing a two page, stapled handout (Appendix P) designed to provide both a mental review of the content covered in the self-instructional slide sequence and practice in the techniques learned. The review was a fifteen question quiz requiring the subject to recall when to use reflected light readings, incident light measures, or identify the situation which applied to using either type of measure. The second part of package "A" engaged the subject in the actual process of making both an incident and a reflected light reading. Three measures were made on package "A" including: (1) a score obtained on the written review, (2) a score obtained on the performance of the task learned, and (3) time required to perform the incident and reflected light measurement tasks. A digital clock mounted above the projection carrel was used by the subjects to record the time at the beginning and at the completion of the performance task. The final information in package "A" instructed the subject to reach for package "B" and proceed.

The Transfer Task

Package "B" was a small box containing all the materials necessary to perform the transfer task. The instruction and data sheets (Appendix Q) were a two page, stapled handout. The handout instructed the subject to record the time from the digital clock in the booth and begin the transfer task. The subject worked with abridged operating instructions of the Ricoh camera, a display card which pictured the camera and located its main features. The subject also worked with the Ricoh Singlex camera and empty box of film representing the film loaded in the camera. Actually, the camera was loaded with Kodak High Contrast Copy film which has very limited latitude for exposure which helps identify minor errors in exposure.

The transfer task required the subject to: (1) be able to operate the major controls of the camera with only limited instructions, (2) be able to determine whether an integrated meter in the camera measures incident or reflected light, (3) determine the proper ASA number and set the built-in meter, (4) decide on the use of a gray card during light measurement, (5) select the aperture recommended in the training program and match the correct shutter speed, (6) decide on the use of a cable release, (7) be able to properly align and focus the image according to training procedures, and (8) to actually take the picture.

Measurements on the Transfer Task

The measurements made during the transfer task included the time to perform the task and the score achieved on the task. The score was a combined total of points for both procedure and product. Procedure was scored from the written responses on the data sheet. The product was evaluated against a limited set of fixed criteria (Appendix R). The product was a negative on high contrast film which was evaluated with the aid of an enlarger. The subjects' negatives were all processed in the same solution at the same time. The rolls of film were from the same emulsion batch. Test shots were made daily on each roll of film (Appendix R).

Exposure Problem Avoided

A major problem was avoided in the interpretation of the negatives produced by the subjects when it was noticed that the overhead lighting affected the built-in exposure meter reading. The overhead lights caused light to enter the eye-piece and affect the meter reading. The reading would vary by the manner in which one placed his eye over the eyepiece. The first test shots revealed this problem which was then rectified by removing the fluorescent light tubes from the light fixture directly overhead.

Experimental Design

The experimental design selected for this study is based upon the Posttest-Only Control Group Design described by Campbell and Stanley (1966, p. 25). In describing this design, Campbell and Stanley have said that researchers in education and psychology have avoided the design because there is no pretest. Others are said to distrust the process of randomization as an equalizing process. The design is attractive because it does not require a scored pretest, yet it is a true experimental design. A pretest was not desired in this study because it would have given too many clues about the unique content of the self-instructional program. There was information collected to detect prior knowledge, but it was not scored or used to detect change between the pretest and the posttest in the common gain score approach.

The posttest-Only Control Group Design controls for testing as a main effect and interaction. The design controls a large number of the factors which affect internal and external validity. These controls are summarized in Table 3 which has been excerpted from Campbell and Stanley (1966).

The factors which are not controlled by the design: Any interaction of selection and treatment can be overcome by the process of random selection. Reactive arrangements

Table 3. Sources of Invalidity for Posttest-Only Control Group Design

	Sources of Invalidity											
	Internal								External			
	History	Maturation	Testing	Instrumentation	Regression	Selection	Mortality	Interaction of Selection and Maturation, etc.	Interaction of Testing and X	Interaction of Selection and X	Reactive Arrangements	Multiple X Interference
Posttest-Only Control Group Design R X O R O	+	+	+	+	+	+	+	+	+	+	?	?

Note: In the table, a minus indicates a definite weakness, a plus indicates that the factor is controlled, a question mark indicates a possible source of concern, and a blank indicates that the factor is not relevant.(Campbell and Stanley, 1966, p. 8). In the representation of the experimental design, R represents randomization, X represents the treatment, and O represents the process of observation or measurement of the dependent variable.

should not become a factor because both experimental and control groups are in the same environment and proceed in the same manner in going through the experiment. Significant differences found in the experiment should be accounted for by the experimental treatment.

The 2 X 2 factorial design was selected as the method for analysis of the data since the treatment dimension occurs at only two levels (Dayton, 1970, p. 81). This method of analysis permits the main efforts of the two independent variables to be examined in addition to the interactive effects of these variables. A schematic diagram in Table 4 represents the 2 X 2 factorial design which was applied to each of the dependent variables in this study.

Table 4. Factorial Design Which was Applied to the Dependent Measures

	Field Dependency	
Background Intensity	A_1 Field Independent	A_2 Less Field Independent
B_1 Screened	A_1B_1	A_2B_1
B_2 Not Screened	A_1B_2	A_2B_2

Processing the Data

The data were placed on standard IBM 80 column cards with the IBM 029 printing keypunch. The cards were read into the card reader at the Western Michigan University Computer Center and stored on tape. All of the work on the PDP-10 time-sharing computer was accomplished through a remote access terminal. The terminal is connected to a data set or modem (modulator demodular) which converts the terminal output into a signal suitable for the telephone network. Another data set in the computer center reconverts the signal and sends it to a data line scanner which feeds information from a number of terminals to the computer. The user terminal is a full duplex teletype.

The programs used in processing the data included one-way analysis of variance, two-way analysis of variance, probability for F ratios, correlation, and basic (mean, standard deviation, variance). All of the programs used are part of Stat Pack. Stat Pack is an integrated statistical package written for teletype use. The user can use a conversational mode to issue simple commands. Input can come either from disk or teletype.

Chapter Summary

The method and materials used to investigate the effects of field-dependence and visual compression upon self-instruction and transfer were described in this chapter.

The terms, techniques and measures were described and clarified. The separate measures within the training program and the transfer task were outlined. Resulting scores and t time means will be analyzed with one and two-way analysis of variance. Five common transfer formulas were described which were used to determine the percentage of positive or negative transfer.

The design selected to analyze the data was the 2 X 2 factorial posttest-only control group design. Sixty subjects were selected on the basis of their lack of prior knowledge, no color defects in sight, and their high or low performance on the Thurstone and Jeffrey Closure Flexibility Test. The high average of scores on this test was discussed.

The learning environment, its equipment, tests, and materials was described. The process for producing the masked (visually-compressed) slide sequence was presented with some detail. The total development process for producing the training program emphasized the tutorial approach with one subject at a time.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this chapter is to provide an objective analysis of the results of testing the experimental hypotheses. The results have been analyzed within the framework of the Pretest-Posttest Control Group Design described in Chapter III. Judgments and questions which have been considered during analysis of the data will be discussed in Chapter V.

Research and Statistical Hypotheses

The following research and statistical hypotheses were tested to study the effects of field-dependency and the compression of visual information (by screening the irrelevant cues) upon transfer and the effectiveness of self-instruction. The effects upon transfer and self-instruction were measured through the use of performance scores and time measured in seconds.

H_1: If the background (irrelevant) cues of the visuals used in the self-instructional program are masked, then subjects will require less time in self-instruction.

H_1: $\bar{X}_e < \bar{X}_c$ $\qquad$ H_o: $\bar{X}_e = \bar{X}_c$

H_2: Field-independent subjects will spend less time in self-instruction than less field-independent subjects, regardless of the program (masked or unmasked) they are given.

H_2: $\bar{X}_{e(FI)} < \bar{X}_{v(LFI)}$ $\quad H_o$: $\bar{X}_{e(FI)} = \bar{X}_{c(LFI)}$

H_{2a}: $\bar{X}_{e(FI)} < \bar{X}_{e(LFI)}$ $\quad H_o$: $\bar{X}_{e(FI)} = \bar{X}_{e(LFI)}$

H_{2b}: $\bar{X}_{c(FI} < \bar{X}_{e(LFI)}$ $\quad H_o$: $\bar{X}_{c(FI)} = \bar{X}_{e(LFI)}$

H_{2c}: $\bar{X}_{c(FI)} < \bar{X}_{c(LFI)}$ $\quad H_o$: $\bar{X}_{c(FI)} = \bar{X}_{c(LFI)}$

H_3: Less field-independent subjects will have greater reduction of time spent in self-instruction than field-independent subjects when taught with masked visuals.

H_3: $\bar{X}_{LFI(\bar{x}_e - \bar{x}_c)} > \bar{X}_{FI(\bar{x}_e - \bar{x}_c)}$

H_o: $\bar{X}_{LFI(\bar{x}_e - \bar{x}_c)} = \bar{X}_{FI(\bar{x}_e - \bar{x}_c)}$

H_4: Subjects taught with masked visuals during self-instruction will receive higher scores on replication of the task taught in the self-instruction program.

H_4: $\bar{X}_e > \bar{X}_c$ $\quad H_o$: $\bar{X}_e = \bar{X}_c$

H_5: Subjects given the self-instructional program with masked visuals will perform the transfer task in less time than subjects given the self-instructional program without masked visuals.

H_5: $\bar{X}_e > \bar{X}_c$ $\quad H_o$: $\bar{X}_e = \bar{X}_c$

H_6: Subjects given the self-instructional program with masked visuals will achieve higher scores related to performance on the transfer task than subjects given the self-instructional program without masked visuals.

$H_6: \bar{X}_e > \bar{X}_v$ $H_o: \bar{X}_e = \bar{X}_c$

Testing the Research Hypotheses

Each of the six major hypotheses listed above were broken into a total of ten statistical hypotheses to test for significant differences between the means of either time or score measures. After each of the six hypotheses were tested for statistical significance further analysis was made using the common transfer formulas described in Chapter III. Analysis of variance, and correlations among the variables, were used to uncover any interactions among the variables, or to identify unique characteristics for either of the four treatment groups used in the research design. Data relevant to each of the six major hypotheses immediately follows the particular hypothesis being investigated.

Hypothesis 1: If the background (irrelevant) cues of the visuals used in the self-instructional program are masked then subjects will require less time in self-instruction.

Data relevant to this hypothesis are presented in Tables 5-7. This hypothesis was tested by using a one-way analysis of variance to determine if the experimental treatment (masked visuals) had any differential effect

upon the time measure. The treatment variable is a manipulated-type fixed-effects variable since the levels were arbitrarily fixed. The treatment variable affects the particular way in which the instructional content appears on the rear screen in the projection carrel.

The variable upon which the one-way analysis of variance was run for this hypothesis was the amount of time (in seconds) spent viewing the self-instructional slide series. Table 5 presents the data to compare the means of the experimental and control groups for the level associated with the field-independent subjects. Table 6 shows the one-way analysis of variance results for the level representing those subjects labeled as less field-independent.

Table 5. Analysis of Variance on Time Spent Viewing the Instructional Slides for Experimental and Control Groups of Field-Independent Individuals

Source	df	ss	ms	F
Between	1	1,510,661.00	1,510,661.00	16.87***
Within	28	2,507,460.01	89,552.14	
Total	29	4,018,120.99		

Required F (1,28) = 4.20, P = < .05
***Significant at P <.001, (.0003)

Table 6. Analysis of Variance on Amount of Time Viewing the Instructional Slides for Experimental and Control Groups of Less Field-Independent Individuals

Source	df	ss	ms	F
Between	1	325,105.99	325,105.99	1.18
Within	28	7,695,119.98	274,825.71	
Total	29	8,020,225.99		

Required F (1,28) = 4.20, P=<.05

Table 7. Analysis of Variance on Time Spent with the Masked and Unmasked Self-Instructional Slide Sequence for Combined Field-Independent and Less Field-Independent Groups

Source	df	ss	ms	F
Between	1	1,618,682.00	1,618,682.00	8.00**
Within	58	11,742,514.00	202,457.14	
Total	59	13,361,196.00		

Required F (1,58) = 4.02 P < .05
**Significant at P< .01, (.0064)

The field-independent group means for time spent with the self-instructional visuals varied significantly in favor of the experimental treatment. The control group spent 31,931 seconds in self-instruction as opposed to only 25,199 seconds for the field-independent group receiving the experimental treatment. This difference yielded an F ratio of 16.87 which produced a probability of .0003, or less than .001 which provides a highly reliable difference in the two means. The statistical hypothesis in null form was rejected.

In using analysis of variance (Hays, 1963) in the fixed effects model it was assumed that errors are independent. This assumption can be made because care was taken in collecting the data to insure that observations were independent within and across groups. The assumption that the error variance must have the same value for all treatment populations can be violated when the number of cases in each group is the same. The assumption of normality can safely be ignored since the number of cases in each group is the same. The assumption of normality can safely be ignored since the number of cases is moderately large in each group and there is reason to suspect that a nonnormal distribution would be the same for each treatment condition. These assumptions justify the use of the F test in the analysis of variance for the first half of the

hypothesis just tested and the remainder of the hypotheses to be tested.

The first portion of the results necessary for H_1 compared the control and experimental groups of field-independent individuals on the dependent measure of attending time required with the self-instructional slide sequence. The second part of H_1 required a test for significance between the experimental and control groups for less field-independent persons on the variable of time spent viewing the self-instructional slides.

Individuals considered to be less field-independent were observed on the measure of time spent viewing the instructional slides. Those who received the experimental (masked) version of the self-instructional slides spent 31,458 seconds viewing the slides compared with 34,581 seconds for those who received the control version of the slides. These results were tested for significance, but the resulting F of 1.18 did not indicate a significant difference between the two means.

The hypothesis was tested by comparing the two sets of means for the experimental and control groups of the field-independent and less field-independent groups. In addition, the hypothesis was tested by grouping the means of experimental and control groups together. All those taught with the masked slides (both field-independent and less field-independent groups) were grouped and compared

with the combination of the two groups which were taught with the control (unmasked) slide set. The means compared with analysis of variance were those measures of time spent with the visuals during self-instruction. The total time spent with the slides for the experimental group was 56,657 seconds compared to 66,512 seconds for the group of thirty which received the unmasked slides. Comparison of the means resulted in an F of 8.00. The difference between the means was significant at less than the .01 level. The experimental (masked) slides resulted in significantly less time required in viewing. Table 7 presents the statistical results of analysis of variance and probability level.

Hypothesis 2: Field-independent subjects will spend less time in self-instruction than less field-independent subjects regardless of the program (masked or unmasked) they are given.

It was necessary to make four different tests for significance to analyze each of the four parts which make up the total hypothesis. The experimental and control means for field-independent subjects were compared against both the experimental and control groups of those individuals who were less field-independent. The least amount of time spent viewing the self-instructional slide sequence was among the field-independent persons receiving the experimental treatment. The mean of this group was 1,679 seconds compared with 2,090 seconds for the less

field-independent group. When these means were compared with a one-way analysis of variance an F of 12.16 resulted. A significant probability of less than the .01 level indicated a significant difference between the means. The field-independent group receiving the experimental treatment spent significantly less time viewing the self-instructional sequence than the less field-independent group which also received the experimental treatment. Table 8 shows the results of the comparison.

Table 8. Analysis of Variance on Slide Sequence Attending Time Between Experimental Treatments of Field-Independent and Less Field-Independent Groups

Source	df	ss	ms	F
Between	1	1,305,835.99	1,305,835.99	12.16**
Within	28	3,007,608.99	107,414.60	
Total	29	4,313,445.02		

Required F (1,28) = 4.20, P < .05
**Significant at P < .01, (.0016)

The second part of analysis for H_2 required a comparison of the field-independent group receiving the experimental treatment with the less field-independent group receiving the slide treatment without masking. The measure compared was again the amount of time subjects

attended to the self-instructional slide series. The mean time for the field-independent group receiving the experimental treatment (masked slides) was 1,679 seconds compared to 2,305 seconds for the less field-independent group receiving the control set of slides. The result after performing a one-way analysis of variance, fixed effects, was an F of 10.46. Probability was less than .01. The amount of time spent viewing the masked (experimental) slides for field-independent persons was significantly less than the viewing time required by less field-independent individuals who received the unmasked (control) slides. The results are reported in Table 9.

Table 9. Analysis of Variance on Slide Sequence Attending Time Between the Field-Independent Group Receiving the Masked Slides and Less Field-Independent Group Receiving the Unmasked Set of Slides

Source	df	ss	ms	F
Between	1	2,934,064.01	2,934,064.01	10.46**
Within	28	8,856,872.01	280,602.57	
Total	29	10,790,936.00		

Required F (1,28) = 4.20, P=.05
**Significant at P < .01, (.0031)

The third part of the analysis for H_2 involved the comparison of means for slide sequence viewing time for the field-independent group which received the unmasked (control) slides with the less field-independent group receiving the experimental (masked) set of slides. The mean viewing time for the field-independent control group was 2,128 seconds compared with a mean of 2,090 seconds for the less field-independent group receiving the masked (experimental) slides. The less field-independent group receiving the experimental slides actually spent less time viewing the slides than the field-independent group which received the unmasked (control) slide sequence. Although not reported here, the analysis of variance did not yield a significant difference between the means. The third part of the main hypothesis was not supported.

The fourth part of the analysis for H_2 involved a comparison of the means of time spent viewing the self-instructional slide sequence for the field-independent and less field-independent groups when each group was given the control (unmasked) set of slides. The field-independent group spent 31,931 seconds in total viewing time for a mean of 2,128 seconds. The less field-independent group viewing the control (unmasked) slides spent 34,581 seconds total viewing time for a mean of 2,305 seconds. When the means of these two groups were compared using a one-way analysis of variance, the resulting F was .91. An F of 4.20 was

required for a probability at the .05 level. This portion of the hypothesis was not supported. Table 10 shows the results.

Table 10. An Analysis of Variance on Attending Time for the Unmasked (Control) Slide Sequence for the Field-Independent and Less Field-Independent Groups

Source	df	ss	ms	F
Between	1	234,084.00	234,084.00	< 1
Within	28	7,194,970.03	256,963.21	
Total	29	7,429,054.01		

Required $F(1,28) = 4.20$, $P < .05$

Hypothesis H_2 was partially supported in that the field-independent individuals receiving the experimental (masked) self-instructional slide program spent significantly less time than the less field-independent subjects receiving the control (unmasked) slides or the experimental (masked) slides. The field-independent group which received the control set of slides did not spend significantly less time viewing the self-instructional slides than either the experimental or control groups of less field-independent individuals. The less field-independent group which viewed the experimental (masked) slides

actually spent less time in viewing the program than the field-independent group which was taught with the unmasked slides. The difference was not significant, but the results suggest a marked effect for the masked treatment of the visuals presented to the experimental groups of both field-independent and less field-independent subjects.

Hypothesis 3: Less field-independent subjects will have greater reduction of time spent in self-instruction than field-independent subjects when taught with masked visuals.

Data which are relevant to this hypothesis are presented in Table 11. The hypothesis required the comparison of one set of means for attending time. A one-way analysis of variance was used to compare the mean times spent with the self-instructional slide sequence for less field-independent subjects receiving the experimental (masked) slides with less field-independent subjects taught with the control (unmasked) slide sequence. The total time spent with the visual sequence was 31,458 seconds for the experimental slides with a mean of 2,090 seconds. The total time spent viewing the control slide sequence was 34,581 seconds with a mean viewing time of 2,305 seconds. The means were compared with a one-way analysis of variance resulting in an F of 1.18. The difference between the means was not significant. An F of 4.20 would have been required for significance with a probability at the .05 level. The hypothesis was not supported.

Table 11. Analysis of Variance on Attending Time for Experimental (Masked) and Control (Unmasked) Slide Sequences for Less Field-Independent Groups

Source	df	ss	ms	F
Between	1	325,105.99	325,105.99	1.18
Within	28	7,695,119.98	274,825.71	
Total	29	8,020,225.99		

Required F (1,28) = 4.20, P < .05

Hypothesis 4: Subjects taught with masked visuals during self-instruction will receive higher scores on the duplication of the task taught in the self-instruction program.

The data required to test this hypothesis using a one-way analysis of variance were the combined means (experimental and control group) and the two sets of means from the scores obtained on the replication of the task which had been taught with the slide sequence. The hypothesis was tested in two parts. First, the experimental and control groups of the field-independent subjects were tested for significance on the measure of performance scores obtained on replication of the task (making incident and reflected light readings with a hand-held exposure meter) taught with the slide series. The experimental group was

taught with masked visuals. The control group of field-independent subjects were taught with unmasked visuals in the slide program. The mean for scores earned by those in the experimental condition was 5.4. The mean was 4.4 for field-independent subjects taught with the unmasked (control) slide sequence. Analysis of variance yielded an F of 6.17 which resulted in a probability of less than .02. This part of the hypothesis was supported in that field-independent subjects instructed with the experimental (masked) slides significantly outscored field-independent subjects on the replication task when they were taught with the unmasked slide sequence.

The field-independent subjects receiving the experimental slide sequence also outperformed the less field-independent subjects who received instruction with the control slides when the measure was scores on the replication of the task taught in self-instruction. The mean of the scores obtained by the field-independent subjects was 5.4 as compared with a mean of 3.37 for the less field-independent subjects on replication task scores. The differences in the means resulted in an F of 8.77. The difference between the means was significant. The probability was less than .01. The hypothesis was supported with regard to field-independent subjects taught with the experimental slide series. This group significantly outscored both field-independent and less field-independent

groups taught with the unmasked slides. The experimental treatment was effective for field-independent subjects. The results are seen in Table 12 and Table 13. The effects of the experimental slide series with less field-independent subjects on the measure of replication task scores continues following the tables.

Data required for part of the final phase of testing H_4 consisted of analysis of variance of the means for replication task scores obtained by less field-independent subjects taught with the experimental (masked) slides compared with the means of less field-independent subjects taught with the control (unmasked) slide sequence. The less field-independent group taught with the experimental slides was also compared with the field-independent

Table 12. Analysis of Variance on Replication Task Scores for Field-Independent Subjects Taught with the Masked and Unmasked Slide Sequences

Source	df	ss	ms	F
Between	1	32.03	32.03	6.17*
Within	28	145.33	5.19	
Total	29	177.37		

Required F (1,28) = 4.20, $P < .05$
*Significant at $P < .02$, (.0192)

Table 13. Analysis of Variance on Replication Task Scores For Field-Independent Subjects Taught with the Masked Slides and Less Field-Independent Subjects Taught with the Unmasked Slide Sequence

Source	df	ss	ms	F
Between	1	20.83	20.83	8.77**
Within	28	66.53	2.38	
Total	29	87.37		

Required F (1,28) = 4.20, $P < .05$
**Significant at $P < .01$, (.0062)

group on replication task score means. The results are shown in Tables 14 and 15.

The mean of scores on the replication task for the less field-independent group taught with the experimental (masked) slide sequence was 5.00 out of a possible 6.00 mean. The mean for replication task scores for the less field-independent group receiving the control (unmasked) slide sequence was 3.73. A one-way analysis of variance of the means resulted in an F of 4.62 and a probability of less than .05. Results supported the hypothesis.

The field-independent group had a mean of 4.40 on the replication task score when taught with the control slide sequence as compared with the 5.00 mean achieved by the less field-independent group of subjects on the same

Table 14. Analysis of Variance on the Replication Task Scores for the Less Field-Independent Group Taught with the Experimental Slide Sequence or the Control (Unmasked) Slide Sequence

Source	df	ss	ms	F
Between	1	12.03	12.03	4.62*
Within	28	72.93	2.60	
Total	29	84.97		

Required F (1,28) = 4.20, P < .05
*Significant at P < .05, (.0404)

Table 15. Analysis of Variance on Replication Task Scores or the Less Field-Independent Group Instructed With the Experimental (Masked) Slide Sequence and the Field-Independent Group Instructed with the Unmasked Slide Sequence.

Source	df	ss	ms	F
Between	1	2.70	2.70	1.91
Within	28	39.60	1.41	
Total	29	42.30		

Required F (1,28) = 4.20, P < .05

measure, but taught with the experimental slide sequence. The differences in the two means were not statistically significant with an F of only 1.19 when the required F was 4.20 for significance at the .05 level.

The hypothesis was supported on three of the four sets of means compared with analysis of variance. The experimental slide sequence had a significant effect on replication task scores with the field-independent group over both field-independent group and the less field-independent group receiving the control set of slides.

The experimental slide sequence also had a significant effect on improving replication task scores for the less field-independent group compared with subjects from the less field-independent group taught with the control slides.

The less field-independent group had a higher mean on the scores on the replication task when taught with the experimental visuals than the mean achieved by the field-independent group taught with the control (unmasked) slide sequence. The difference was not significant with an analysis of variance measure on the means.

The final analysis of H_4 required a comparison of the means of combined scores of those receiving the experimental (masked) slide sequence and the combined (field-independent and less field-independent) group which was taught with the control (unmasked) slides. This gross

measure resulted in a mean of 5.20 out of a possible 6 point maximum on the replication task for the thirty individuals receiving the masked slides as opposed to a 4.07 mean for the group of thirty which was taught with the unmasked (control) slides. Analysis of variance revealed an F of 10.10. The differences between the means were significant at the .01 level. The results are shown in Table 16.

Table 16. Analysis of Variance on Replication Task Scores for Groups Receiving either the Masked or Unmasked Self-Instruction Slide Sequence

Source	df	ss	ms	F
Between	1	19.26	19.26	10.10**
Within	58	110.66	1.90	
Total	59	129.93		

Required F (1,58) = 4.20, P < .05
****Significant at P < .01**

Hypothesis 5: Subjects given the self-instructional program with masked visuals will perform the transfer task in less time than subjects given the self-instructional program without masked visuals.

The data necessary for testing H_5 were mean times for each of the four treatment groups in the design and the

means resulting from combining both experimental (field-independent and less field-independent) groups and both control groups. The mean times refer to the time spent in accomplishing the transfer task. Each set of group or means of the combined group were analyzed with three separate measures including: (1) analysis of variance, (2) transfer formula "1a", and (3) transfer formula "2a".

The individual group means were analyzed first. The field-independent group trained with masked visuals took less time in performing the transfer task than did the field-independent group trained with the unmasked slides. The group trained with the masked slides spent a mean time of 522 seconds compared to 640 seconds for the group trained with the unmasked slides. Analysis of variance however only yielded an F of 3.01 which is only at the .10 level of significance for difference between the means. The results are displayed in Table 17.

The experimental and control groups of field-independent individuals were compared on transfer task time by determining the percentage of transfer using two common transfer formulas for measures of time. Formula (1a) is the least conservative formula of the two used.

$$\text{Formula (1a)} \quad \frac{C-E}{C} \times 100 = \text{Percentage of Transfer}$$

Table 17. Analysis of Variance on Time Required to Perform the Transfer Task for the Field-Independent Groups Trained with Masked or Unmasked Slides

Source	df	ss	ms	F
Between	1	104,194.12	104,194.12	3.01*
Within	28	968,705.75	34,596.63	
Total	29	1,072,899.88		

Required F (1,28) = 4.20, P < .05
* Significant at P < .10, (.0937)

Calculations using formula (1a) resulted in a figure of 18% for percentage of transfer in favor of the experimental (masked slide) group of field-independent individuals. Formula (2a) is more conservative.

$$\text{Formula (2a)} \quad \frac{C-E}{E+C} \times 100 = \text{Percentage of Transfer}$$

This formula resulted in a percentage of transfer which amounted to 10% for field-independent subjects trained with the masked slides and measured on time spent in performing the transfer task.

The experimental and control treatments of the less field-independent group were compared first with analysis of variance. Those trained with masked visuals spent a mean time of 674 seconds performing the transfer task compared

with a mean time of 853 seconds for less field-independent subjects trained with unmasked slides. The resulting F was 2.60, which indicated that the differences between the means were not significant.

Transfer formula (1a) resulted in a 21% figure for the percentage of positive transfer for the less field-independent group trained with masked visuals when the measure was time spent on the transfer task.

Formula (2a) calculations reflected a positive percentage of transfer of 12% for the amount of time spent in performing the transfer task when the less field-independent group was trained with masked visuals.

The final analysis of hypothesis H_5 involved the comparison of the experimental group mean with the control group mean regardless of whether the individual was field-independent or less field-independent. This comparison of mean time spent with the transfer task placed the time measure of thirty subjects in both the experimental and control groups. The group trained with the masked slides spent a mean time of 598 seconds performing the transfer task compared with a 746 second mean time required on the transfer task by the group trained with the unmasked slides. Analysis of variance performed upon the means resulted in a significant difference between the means which gave a probability of less than .05. The results are shown in Table 18.

Table 18. Analysis of Variance on the Amount of Time Required to Perform the Transfer Task with Masked and Unmasked Visuals for Combined Groupings of Field-Independent and Less Field-Independent Subjects

Source	df	ss	ms	F
Between	1	329,596.75	329,596.75	4.71*
Within	58	4,058,096.74	69,967.19	
Total	59	4,387,693.52		

Required F (1,58) = 4.02, P < .05
*Significant at P < .05, (.0341)

The experimental treatment which used masked slides resulted in significant time savings on performance of the transfer task. Further comparison of the means of the combined groups required application of the common transfer formulas (1a) and (2a) which are used to determine the percentage of transfer when time is the transfer measure.

Formula (1s) produced a positive transfer percentage of 19% for the group trained with masked visuals when measured on the amount of time required to perform the transfer task.

Formula (2a) resulted in a positive percentage of transfer of 11% on time spent on the transfer task for the combined experimental groups which had been trained with the masked slides. Masking saved time in accomplishing the transfer task.

Hypothesis 6: Subjects given the self-instructional program with masked visuals will achieve higher scores related to performance on the transfer task than subjects given the self-instructional program without masked visuals.

Data required to test this hypothesis included measures in the form of scores achieved on the transfer task. The scores represented a combined total of points achieved for both procedure and performance.

The data were analyzed by comparing the mean of experimental and control group scores for both the field-independent and less field-independent subjects. The data were also compared by examining the means of all subjects taught with masked slides with the means of all the subjects taught with unmasked slides regardless of field-dependency characteristics. All data were tested for significance with analysis of variance. Each of the following formulas used to assess the percentage of transfer on measures of scores in a transfer task were used.

Formula (1b) $\frac{E-C}{C} \times 100 =$ Percentage of Transfer

Formula (2b) $\frac{E-C}{E+C} \times 100 =$ Percentage of Transfer

Formula (3a) $\frac{E-C}{T-C} \times 100 =$ Percentage of Transfer

Measures of the scores for less field-independent subjects trained with masked visuals produced a mean of 7.80 out of a

possible 10.00 compared to a mean of 5.33 for field-independent subejcts trained with masked visuals. A one-way analysis of variance produced a significant difference with an F of 12.56 which resulted in a probability of less than .01. Field-independent subjects taught with the masked visuals scored significantly higher of the combined transfer scores than field-independent subjects trained with the unmasked self-instructional slide sequence. Analysis of variance results are shown in Table 19.

Table 19. Analysis of Variance on Transfer Scores for Field-Independent Subjects Trained with Masked and Unmasked Slides

Source	df	ss	ms	F
Between	1	45.63	45.63	12.56**
Within	28	101.73	3.63	
Total	29	147.36		

Required F (1,28) = 4.20, P= < .05
**Significant at P < .01, (.0014)

The first of the three transfer formulas applied to the means for the two groups on transfer performance scores was (1b). The amount of positive transfer on transfer scores for the field-independent group trained with the masked slide series was 46%.

The second transfer formula applied to the mean group scores was (2b). Results produced a positive percentage of transfer of 19% on scores made by those trained with masked slides. This formula tends to produce very conservative figures.

The final transfer formula used for the mean scores for the two field-independent groups was (3a). When this formula was applied, the group taught with the masked (visually-compressed) slide sequence had a 53% figure for positive transfer when the measure was scored on a transfer task.

The second sets of means on scores analyzed for H_6 were those made by the less field-independent subjects trained with either masked or unmasked visuals. These two groups were also compared with both the one-way analysis of variance and the three transfer formulas used when the measure is a score on a transfer task.

Less field-independent subjects trained with masked visuals achieved a mean score of 6.13 out of the possible 10.00 points. Less field-independent subjects trained with unmasked slides produced a mean score of 5.40. The eleven point difference in the sums of each set of scores was not sufficient to be significant. Analysis of variance of the means of the scores for the two groups yielded an F of .98. An F of 4.20 was required to indicate a significant difference between the means at the .05 level.

The three transfer formulas applied to the scores made on the transfer task by less field-independent individuals did reveal that positive transfer resulted when the group was instructed with masked visuals.

Formula (1b) produced 14% positive transfer achieved on the transfer scores when less field-independent subjects were trained with masked slides.

Formula (2b) produced a positive transfer of 9% on the transfer task scores for less field-independent subjects trained with masked slides.

Formula (3a) produced a percentage of positive transfer amounting to 16% on the transfer task scores when the group was composed of less field-independent subjects trained with masked visuals.

Analysis of the field-independent and less field-independent groups separately generally supported the hypothesis except for lack of statistical significance for the score differences with the less field-independent subjects trained with masked visuals or unmasked visuals. All applications of the three transfer formulas yielded positive transfer percentages favoring the group trained with masked (visually compressed) slides.

Final analysis of H_6 was accomplished by applying one-way analysis of variance and the three transfer formulas to the mean of the scores of the two experimental groups as compared with the mean of the scores of the subjects from the

two control groups. This analysis looks at only the effect of the treatment, but ignores the effect of field-dependency. The mean of the total group of experimental subjects, i.e., all those trained with masked visuals, was 6.97 of 10.00 compared to a mean of 5.37 for those trained with unmasked (control) slides. Analysis of variance results are given in Table 20.

Table 20. Analysis of Variance on Transfer Scores for Subjects Trained with Masked or Unmasked Slides

Source	df	ss	ms	F
Between	1	38.4	38.4	9.36**
Within	58	237.93	4.10	
Total	59	276.33		

Required F (1,58) = 4.02 = P $<$ .05
**Significant at P $<$ .01, (.0034)

The three common transfer formulas used for score measures were applied to the mean transfer task scores of the two groups trained with masked slides and with unmasked slides in self-instruction.

Formula (1b) yielded a positive transfer percentage of 30% on scores obtained by subjects instructed with masked visuals.

Formula (2b) applied to the means produced a percentage of positive transfer equal to 13% for subjects trained with the masked set of slides.

Formula (3a) produced a 6% positive transfer percentage for scores achieved on the transfer task when the subjects had been trained with a slide sequence which masked irrelevant cues.

Each of the three transfer formulas and the one-way analysis of variance supported hypothesis 6. Performance scores on a transfer task were higher when subjects had been trained with visuals which were masked than when subjects were trained with unmasked visuals prior to the transfer task.

Analysis of Variance Summary Tables

The results of applying one-way analysis of variance to each of the sets of means have been reported under the particular hypothesis concerned with a given set of means tested. One-way analysis of variance reported independently of a summary table provides fewer degrees of freedom and less opportunity for a significant difference between the means to be revealed. There were actually six dependent measures made within the context of the experimental treatment. An analysis of variance summary table shown for each of the six measures which include four within the context of the training task: (1) time spent with the

self-instructional slides, (2) scores on a written review, (3) scores on performing a replication of the task learned, and (4) time spent on accomplishing the replication task. The other two measures associated with the transfer task were (5) score on the transfer task, and (6) time spent on the transfer task. The summary tables for the sums of the measures are in Appendix S. The analysis of variance summary tables were produced by applying a two-way analysis of variance on the computer.

Slide Sequence Viewing Time

A two-way analysis of variance was used on the measures of the amount of time subjects spent (in seconds) viewing the self-instructional slide sequences in either experimental (masked) or control (unmasked) treatments. The summary in Table 21 yielded significant results for field-independent subjects and the masked treatment. Field-independent subjects spent significantly less time with the self-instructional slide sequence than did less field-independent subjects at a significance level of less than .01. This level suggests that the data give strong evidence that the true contrast of the differences is not zero (Cox, 1958, p. 159.

The visually-compressed (masked) slide sequence also provided strong evidence that the true contrast of the differences was not zero with an F ratio of 8.88 which yielded a level of statistical significance of less than .01.

Table 21. Analysis of Variance Summary Table for Slide Sequence Viewing Time

Source	df	ss	ms	F
Cells	3	3,158,602.01		
Field-Dependence	1	1,322,836.00	1,322,836.00	7.26**
Slide Treatment	1	1,618,682.00	1,618,682.00	8.88**
Field-Dependence X Slide Treatment	1	217,084.00	217,084.00	1.19
Within Groups	56		182,188.93	
Total	59			

Required F (1,56) = 4.01, P= < .05
**Significant at P < .01, (.0093, .0043)

Both main effects of field-dependence and slide treatment yielded significant differences which supported hypothesis 1 and hypothesis 2 when two-way analysis of variance was used.

There were no interactions between main effects which were significant.

Written Review Task Scores

The subjects were given a written review test during the training program which was scored. The maximum number of points possible was 15. The analysis of this data is a check on success in the training program, but is not

directly related to one of the six hypotheses. Table 22 summarized the results of a two-way analysis of variance performed on this measure. There was statistical significance for the main effect of field-dependence. Subjects who were field-independent scored higher on a written test of the content taught in the self-instructional slide sequence than did less field-independent subjects. The difference was significant at less than the .01 level. This lends support to hypothesis 2 which stated that field-independent subjects will spend less time in self-instruction than less field-independent subjects regardless of the program (masked or unmasked) they are given.

Table 22. Analysis of Variance Summary Table for the Written Review Task

Source	df	ss	ms	F
Cells	3	84.67		
Field-Dependence	1	48.60	48.60	8.33**
Slide Treatment	1	6.67	6.67	1.14
Field-Dependence X Slide Treatment	1	29.40	29.40	5.04**
Within Groups	56	326.67	5.83	
Total	59			

Required F (1,56) = 4.01, P= < .05
*Significant at P < .05, (.0287)
**Significant at P < .01, (.0055)

There was a significant interaction between the main effects of field-dependence and slide treatment which was significant at the .05 level when the measure was a score on the written review task.

Replication Task Scores

A summary of two-way analysis of variance for scores obtained on the replication task within the training program is reported in Table 23. The replication task consisted of actual performance in duplication of the process of making both incident and reflected light readings in the same manner as taught in the self-instructional slide sequence. The same meter and camera were used but the ASA numbers were different. The total possible scores was six points.

Results produced one significant main effect on slide treatment. Subjects which were trained with the masked slides performed better on the replication task at a level of significance which was less than .01. Field-dependence as a main effect did not yield a significant difference. There was no significant interaction between main effects.

Replication Task Time

The time subjects spent in performing the replication task within the training program was recorded to the nearest second for each subject. The results of a two-way

Table 23. Analysis of Variance Summary Table for Replication Task Performance

Source	df	ss	ms	F
Cells	3	23.80		
Field-Dependence	1	4.27	4.27	2.25
Slide Treatment	1	19.27	19.27	10.17**
Field-Dependence X Slide Treatment	1	0.27	0.27	< 1
Within Groups	56	106.13	1.90	
Total	59			

Required F (1,56) = 4.01 = P < .05
**Significant at P < .01, (.0023)

analysis of variance are summarized in Table 24. Only field-dependence approached significance at close to the .05 level (.0721). Field-independent subjects spent less time in performing the replication task regardless of which slide treatment they received during instruction. This lends support to H_2 which states that field-independent subjects will spend less time in self-instruction (the task is part of the self-instruction program) than less field-independent subjects. The slide treatment of masking did not produce any significant differences in the scores. There was no interaction detected between main effects.

Table 24. Analysis of Variance Summary Table for Replication Task Time

Source	df	ss	ms	F
Cells	3	69,408.81		
Field-Dependence	1	44,173.06	44,173.06	3.36*
Slide Treatment	1	17,069.06	17,069.06	1.30
Field-Dependence X Slide Treatment	1	8,166.69	8,166.69	< 1
Within Groups	56	735,580.90	735,580.90	
Total	59			

Required F (1,56) = 4.01 = P < .05
*Significant at P < .10, (.0721) This is closer to .05 level than .10 level.

Transfer Task Scores

The results of a two-way analysis of variance on the measured variable of transfer scores are summarized in Table 25. When the variable measured was a score on the transfer task a two-way analysis of variance yielded a significant difference for the main effect of slide treatment. Subjects trained with the masked (visually-compressed) version of the slide sequence performed better on the transfer task. The significant difference between the means favored the masked slide sequence at less than the .01 level.

Table 25. Analysis of Variance Summary Table for Transfer Task Performance

Source	df	ss	ms	F
Cells	3	59.27		
Field-Dependence	1	9.60	9.60	2.48
Slide Treatment	1	38.40	38.40	9.91**
Field-Dependence X Slide Treatment	1	11.27	11.27	2.91
Within Groups	56	217.07	3.88	
Total	59			

Required F (1,56) = 4.01 = P < .05
**Significant at P < .01, (.0026)

The main effect of field-dependence was just less than .12 (.1209) which is not significant. There was no significant interaction between main effects.

The data from the two-way analysis of variance summary table support hypothesis 6.

Transfer Task Performance Time

The time it took subjects to perform the transfer task was analyzed with a two-way analysis of variance which is summarized in Table 26. The results revealed significance for the differences of both main effects.

Table 26. Analysis of Variance Summary Table for Transfer Task Performance Time

Source	df	ss	ms	F
Cells	3	843,387.75		
Field-Dependence	1	499,958.75	499,958.75	7.90**
Slide Treatment	1	329,596.75	329,596.75	5.21*
Field-Dependence X Slide Treatment	1	13,832.25	13,832.25	.22
Within Groups	56	3,544,305.75	63,291.17	
Total	59			

Required F (1,56) = 4.01 = P < .05
*Significant at P < .05, (.0263)
**Significant at P < .01, (.0068)

Subjects who were field-independent took significantly less time in performing the transfer task than subjects who were less field-independent. The difference was significant at less than the .01 level.

The slide treatment which used masked visuals had a significant effect upon the amount of time required to perform the transfer task. The difference was significant at less than the .05 level. Subjects trained with the series of masked slides performed the transfer task in less time. This data supports hypothesis 6 and suggests that the masked slides benefited the field-independent subjects more than the less field-independent subjects.

Analysis of Variance Summary

Appendix S contains Tables 29 through 34 which summarizes the results of the seven groups compared with one-way analysis of variance on each of the six measured variables and the two-way analysis of variance for each of the same variables. These forty-eight separate analyses are summarized on a table for each dependent variable. The comparisons test nearly all possible differences for significance.

Summary of the Means

Table 27 summarizes the means on all measured variables to permit quick comparisons of the groups for predicted directions. The groups include the experimental and control treatments for field-independent and less field-independent subjects, combined experimental group, combined control group, and all subjects combined. Complete tables for the means, variance, standard deviation, median and mode are found in Tables 35 through 41 in Appendix T.

The summary of the means on Table 27 lends directional support to the hypotheses proposed in this study. The differences between all the means were not significant, but the predicted directions of the differences are of interest.

Table 27. Summary of the Means of the Measured Variables

Group	N	CF Score	Slide Viewing Time	Written Review Task (15)	Performance Task (6)	Performance Task Time	Transfer Task (10)	Transfer Task Time
Field-Independent-Experimental	15	100.33	1680*	12.6	5.4	185*	7.8	522
Field-Independent-Control	15	99.87	2129	10.5	4.4	195	5.3	640
Less Field-Independent Experimental	15	56.33	2091	9.4	5.0	216	6.1	674
Less Field-Independent Control	15	55.07	2305	10.1	3.7	272	5.4	852
Combined Groups Experimental	30	78.30	1890	11.0	5.2	200	7.0	598
Combined Groups Control	30	77.50	2220	10.3	4.0	234	5.4	746
All Subjects Combined	60	77.9	2052	10.7	4.6	216	6.2	672

Times are recorded to nearest full second.
()Figures in parentheses indicate maximum possible score.

Hypothesis 1 predicted masked visuals in self-instruction would save time in self-instruction. The combined experimental group mean was 1890 seconds compared to 2220 seconds for the control group.

Hypothesis 2 predicted that field-independent subjects would spend less time in self-instruction regardless of experimental treatment. Field-independent subjects receiving the experimental treatment took less time than any group with a mean of 1680 seconds, but the less field-independent group receiving the experimental slide treatment had the second lowest mean for time with 2091 seconds. The field-independent control group did spend less time with the slide series than the less field-independent control group with a mean of 2129 seconds compared to 2305 for the less field-independent group. The hypothesis was supported on all but the one measure of the means.

Hypothesis 3 predicted that the less field-independent subjects would have greater reduction of time spent with the self-instructional visuals when trained with the masked visuals than the field-independent subjects. The reverse was true. The difference between the means of the experimental and control treatments for the field-independent subjects was 549 seconds favoring the experimental group. Less field-independent experimental and control group differences were only 204 seconds in

favor of the experimental treatment. Field-independent subjects benefited the most from the masked slide treatment when the measure was the time spent viewing the self-instructional slide sequence. There was no support for H_3.

Hypothesis 4 predicted that subjects taught with masked visuals would receive higher scores on the replication task within the training program. All the differences between the means were in the predicted direction. Out of a possible six point score, the combined experimental group scored 1.2 points ($\bar{X}$ difference) higher than the combined control group. The field-independent, experimental group scored 1.0 point ($\bar{X}$ difference) higher than the control group. The less field-independent, experimental group outscored the less field-independent control group with a mean difference of 1.3 points. All these mean differences support the hypothesis.

Hypothesis 5 predicted that subjects trained with masked visuals would perform the transfer task in less time. The differences between the means supported the hypothesis on all measures. Mean differences favoring the experimental treatment were 118 seconds for the field-independent subjects, 178 seconds for the less field-independent subjects, and 148 seconds for the combination of field-independent and less field-independent subjects

receiving the experimental treatment. The greatest performance differential was for the less field-independent subjects.

Hypothesis 6 predicted that subjects trained with the masked visuals would acheive higher scores on the transfer task than subjects trained without the masked visuals. All the differences between the means support this prediction. The combined experimental group had a mean of 7.0 out of 10 possible points compared to a mean of 5.4 for the combined control group for a difference between means of 1.6 in favor of the experimental treatment. The difference between the experimental and control means for the field-independent subjects was 2.5 (7.8-5.3). Mean difference for experimental and control treatments for less field-independent subjects was .7 (6.1-5.4) in favor of the experimental treatment. Performance favors the field-independent group receiving the masked slides. This group outscored all other groups on the transfer task.

Correlations Among Variables

The relationship of variables to one another was examined through a computer generated correlation matrix for each of the seven measured variables including field-dependence which was an independent variable. The resulting correlation coefficients were checked for significance on the Fisher and Yates (1942) Statistical

tables, with levels of significance for a one-tailed test using fifty-eight degrees of freedom. The correlation results are shown in Table 28.

Significant correlations which resulted were as follows:

Field-Dependence and . . .	Significance Level
time spent viewing slides	negative correlation at < .025
written review task	positive correlation at < .005
transfer task	positive correlation at < .05
transfer task performance time -	negative correlation at < .025

Time Spent Viewing Slides and . . .	
field-dependence	negative correlation at < .025
written review task	positive correlation at < .05
replication task	positive correlation at < .005
transfer task performance time -	positive correlation at < .025

Written Review Task and . . .	
time spent viewing slides	negative correlation at < .05
field-dependence	positive correlation at < .005
replication task	positive correlation at < .005
transfer task	positive correlation at < .005
transfer task time	negative correlation at > .05 < .10

Replication Task and . . .	Significance Level
time spent viewing slides	negative correlation at < .005
written review task	positive correlation at < .005
replication task time	negative correlation at < .005
transfer task	positive correlation at < .025
transfer task time	negative correlation at < .005
Replication Task Time and . . .	
replication task	negative correlation at < .005
transfer task	negative correlation at < .005
transfer task time	negative correlation at < .005
Transfer Task and . . .	
field-dependence	positive correlation at < .05
written review task	positive correlation at < .005
replication task	positive correlation at < .025
replication task time	positive correlation at < .005
Transfer Task Time and . . .	
field-dependence	negative correlation at < .025
time spent viewing slides	positive correlation at < .025
written review task	negative correlation at > .05 < .10
replication task	negative correlation at < .005
replication task time	positive correlation at < .005

The correlations yielded some expected relationships between the variables of the study. Field-dependence

Table 28. Correlation Matrix for Measured Variables

Variables	CF Score	Slide Viewing Time	Written Review Task	Replication Task	Replication Task Time	Transfer Task	Transfer Task Time
CF Score	1.000						
Slide Viewing Time	-.283**	1.000					
Written Review Task	.338****	-.228*	1.000				
Replication Task	.122	-.372****	.397****	1.000			
Replication Task Time	.183	.058	.181	-.432****	1.000		
Transfer Task	.227*	-.142	.419****	.294**	-.418****	1.000	
Transfer Task Time	-.264**	.297**	-.206	-.382****	.476****	-.165	1.000

Required Critical Value for Significance at .05 Level One-Tailed Test
*Significant at < .05, **Significant at < .025, ***Significant at < .01, ****Significant at < .005

was correlated negatively with time spent viewing the instructional slides and time spent performing the transfer task.

Field-Dependence Correlations

When scores on the field-dependency measure were lower, time required to view the slides and perform the transfer task was lower. Higher measures of field-dependency were associated with less time required to view slides and perform the transfer task. Field-dependence had a strong positive correlation with performance on the written review task and the transfer task. Higher scores were associated with better performance.

Viewing Time Correlations

When subjects spent more time viewing either of the two self-instructional slide sequences, more time tended to be correlated with better performance on the written review task and replication task which both were part of the total training program. The viewing time was negatively correlated with field-dependence and positively correlated with the amount of time required to perform the transfer task.

Chapter Summary

This chapter provided an analysis of the results of testing the six experimental hypotheses with both one-way and two-way analyses of varinace. The two common

transfer formulas for time measures and the three common transfer formulas for score measures were used to assess the percentage of positive transfer. A computer generated correlation matrix was used to analyze relationships between the measured variables.

The data from each of the different types of analysis appear to support one another. All subjects were assisted by the experimental slide treatment which employed a density mask. The technique helped field-independent and less field-independent subjects in different ways and with a different degree of effectiveness. The field-independent subjects were aided the most when trained with masked visuals.

Field-independent subjects trained with masked visuals spent significantly less time with the slide sequence, and performed significantly better on the written review task, and the transfer task than any of the groups taught with unmasked slides and the less field-independent group taught with the masked slides. The field-independent group spent significantly less time in performing the transfer task than either the experimental or control groups of the less field-independent subjects.

Less field-independent subjects were also helped by the masked visuals but to a lesser extent than the field-independent subjects. The summary of the means of

all measures indicates that masking aided performance on five of the six measures. The written review task mean for the less field-independent control group was slightly better.

The density of the mask used in masking the slide and the manner in which the slide program was designed may in part answer why the field-independent subjects were helped so much by the experimental slide treatment.

The common transfer formulas provided positive transfer percentages for both time and score measures with each of the five different formulas.

Significant correlations between some of the variables suggest that field-dependence is related to time spent in learning with a slide sequence, transfer performance, and time and performance on the written review task. There was a strong correlation between the amount of time spent viewing the slides and performance of the task learned. The correlation between the amount of time spent viewing the self-instructional slides and both the written review task and transfer task performance time was considerably less.

There was a strong correlation between performance on the written review task which in turn was significantly correlated with performance on the transfer task. Performance on the transfer task is also significantly correlated (negative correlation) with the amount of time it took subjects to perform the replication task.

In summary, the masked slide treatment used in training improved learning efficiency by subjects requiring less time to learn, performing the learned task better (higher scores) and performing a non-specific transfer task faster with better results. Significant differences with a high reliability favored the field-independent group.

Chapter V, the final chapter, will discuss the implications of these results and provide suggestions for future research.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

This study attempted to examine the effects of field-dependence as a form of perceptual style and the effects of visual-compression in the form of masked slides upon performance in self-instruction and a related transfer task.

Overview

Subjects were college students in the basic audio-visual courses. Content of the self-instructional program and the transfer task was related to audiovisual interests, but it is not usually covered in a beginning course.

Subjects were tested for field-dependence. Those who had prior knowledge of the content or had color receptivity problems, such as color blindness, were eliminated from the study. A 2 X 2 factorial design was used to separate field-independent from less field-independent subjects while allowing for half of each group to receive either a self-instructional slide program with masked (screened) visuals or the slide program with regular unmasked visuals. The masking was not applied to slides with verbal content. Time and score measures were taken

during self-instruction with slides and during replication of the task learned. A written review was part of the total training program which preceded the replication attempts.

A transfer task immediately followed the self-instructional training program which took place in a SLATE (Student Learning and Teaching Environment) containing apparatus for rear projection of the slides and equipment necessary for both the training and transfer task. The transfer task required application of the principles learned to a different piece of equipment used in a related but different manner. Sixty subjects participated in the training and transfer tasks.

Conclusions

Conclusion 1: Field-independent subjects performed better in the self-instruction program in terms of time required and scores obtained than any group of less field-independent subjects.

Field-dependence as a measure of individual perceptual style and visual-compression in the form of masked visuals used in self-instruction appear to be major variables. These variables affect both the learning during a training task and the ability to transfer that learning in a non-specific way to a transfer task. Train- and transfer tasks required considerable ability to differentiate specific cues which may have favored the field-independent subject.

Field-dependence as a measure of psychological differentiation within an individual seems to be an effective prediction of how an individual will perform in a self-instructional setting for objectives and tasks which demand the ability to discriminate among cues in a visual. Specifically, those who have attained a lesser degree of psychological differentiation in their development (as measured on the revised Thurstone and Jeffrey Closure Flexibility Test) take more time in learning from a series of instructional slides than those individuals who score high on clusure flexibility. Low scores on the closure flexibility measure of field-dependency affected the learning scores.

Field-independent subjects attained higher scores on all measures of learning within the context of this research when compared with less field-independent subjects receiving the same instructional treatment. The experimental slide masking treatment did not significantly raise the performance scores or save subjects time when they had been in the less field-independent group. The inability of the "visually-compressed" (masked)slide treatment to assist subjects exhibiting less field-independence as major perceptual style is consistent with the results of Dickie's (1969) study which used a very short sequence of pictorial slides. Dickie's use of the experimental treatment with black and white slides

resulted in significant reduction in time spent learning with the slides, but the treatment in his study failed to improve significantly the single measure of learning in the procedural task.

Conclusion 2: Use of masking in the self-paced instructional slide series shortened learning time and improved learning performance in terms of actual and written performance for both field-independent and less field-independent groups.

The success of the masked visual (visually-compressed) sequence suggests support for this technique of differentiating the important visual cues from the visual background when the instructional tasks involves a high degree of discrimination with visual details. Travers (1964) had discussed visual-compression as a process of discarding the aspects of transmission which furnish the least amount of information and emphasizing the aspects which provide the most information. While the technique labeled as "visual-compression" in this study does not discard the less important or irrelevant cues, the technique does emphasize the important cues which are directly related to the verbal message on each preceding slide. The less important cues held back by high contrast negative masking served to deemphasize the irrelevant cues by having them appear as a dull gray amorphous background. The mask also isolated the

important cues by having them appear highlighted. A spotlight effect was apparent during projection.

The shape of the high contrast mask was different than the masking used on black and white slides in Dickie's (1969) study. Dickie worked with a single object (16mm projector). The task in this study required masking to isolate parts on several items (meter, camera, cable release, picture, copystand, gray card). The masks were designed to have a smooth but rather nebulous shape with the exception of a few arrow shaped masks which were possible and which may be the basis of another masking technique using directional (arrow) shapes.

The results lend support to the cue summation principle as discussed by Severin (1967) and stimulus generalization. This support is probably due to the emphasis of working with the real objects during training. All of the cues of the realistic visual are present if the learner needs them, but the masking serves to differentiate the major cues. Gagne (1965) had also stressed the importance of the learner's ability to differentiate the criterional stimulus from the background stimuli.

Both field-independent and less field-independent subjects improved their learning efficiency when taught with the masked slide sequence. They learned more in less time. It had been hypothesized that less field-independent subjects would have the greatest gains, but

instead field-independent subjects performed much better in less time when instructed with the masked visuals.

Conclusion 3: Masking self-instructional visuals to isolate important cues assisted most subjects, but the field-independent subjects were helped the most.

It is supposed that masking properly employed can assist all learners, but the process cannot bring about a situation where the less field-independent subjects will out-perform the field-independent subjects if both groups get the same treatment when the learning tasks emphasize cue differentiation. It is possible that a masking technique employing a mask which is more opaque might assist the less field-independent subject more through greater differentiation or alteration of the figure-ground (cue to background) relationship. The same technique would probably assist the field-independent individuals equally well. It would appear that the less field-independent subjects would perform better when the tasks are more global in approach and the subjects are trained with more human interaction. In this study (Table 26) masking did not hinder the less field-independent experimental group which approached and even surpassed the field-independent control (unmasked slide) group on measures of replication task performance and transfer.

Conclusion 4: Masking visuals in a verbal-pictorial self-paced instructional slide sequence improved performance on a transfer task.

All subjects trained with the masked visuals performed the transfer task more rapidly and with higher scores. These results are quite significant since the program design in both masked and unmasked versions resulted in highly effective transfer. The program had been carefully designed to teach for transfer with or without the presence of masking. The tutorial (individual tryout and interview) approach was used during design stages. The differentiation of relevant cues through the technique of masking is an important variable in accomplishing positive transfer, but not nearly as important as the process of design which attempts to utilize principles of transfer prior to masking. It makes little sense to ignore important design considerations and then try to observe the effects of manipulations with less important variables.

Conclusion 5: Successful transfer of learning is directly related to performance on the training task and time spent with the training task.

The principles of transfer outlined by Ellis (1965) have shown the relationships of training to transfer success, but the correlations in this study also shed light on the linkage of training aspects to transfer. The correlation matrix on Table 27 suggests some strong

relationships. Observing only <.005 level correlations the link appears as follows. Field-independence (high CF score) is strongly correlated with performance on the written review task which is highly correlated with the replication task which is highly correlated with the amount of time required to view the slide series, and also highly correlated with the time required to perform the replication task. Finally, the replication task is highly correlated with performance on the transfer task for both time and score measures. This connection between all measures might have been overlooked were it not for the correlation matrix. The interrelationships among and between variables is important to consider in the design process. It is the whole pattern of design which affects learning and transfer of that learning, not just a single segment.

Heuristics

Five of the six hypotheses tested were either entirely or partially supported and the conclusions based on these hypotheses have been stated, but the heuristics or rule-of-thumb strategies are perhaps the most important statements in the study. Heuristics are the rules or stragegies derived in retrospect from the entire study. They can perhaps suggest a starting point, or at least a consideration, for future research.

Heuristic 1: Programs designed with the principles of transfer as a framework can improve the usefulness of what the student learns.

Program designers would do well to look beyond the achievement of learning the specific information or skill and ask themselves how the learning could be transferred to new problem situations which involve specific or non-specific transfer of that learning. In this study students taught with either the experimental or control treatment performed well on the transfer task. The program had been designed with constant attention to the principles of transfer outlined by Ellis (1965). It is suggested that the better one can design his program with these principles as a framework, the better the immediate learning will be and transfer of that learning will be more effective.

Heuristic 2: Programs designed for involvement and mastery of principles should result in more permanent learning and provide the learner with greater problem solving capability.

This study has reinforced the view that learning will be more permanent when the student is actively involved and challenged to think in terms of principles or rules rather than memorize bits of information in absence of the broader context of principle learning. Students in this study spent an hour or more with a fairly complicated task, yet the level of learning was

high in terms of mean scores and most subjects enjoyed the experience. Comments in Appendix V suggest that this type of learning can be enjoyable even when the task is completely unrelated to prior experience.

Observations of students performing the replication task and the transfer task indicated that the students were not just following a memorized series of steps. Most students during these tasks appeared to perform from a problem solving mode. They would spend more time thinking than doing yet the level of performance was consistently high. Brief interviews with the students after leaving the SLATE revealed some of the following comments:

> This program was fun and I was surprised that I could apply what I learned.
>
> I went through the program quickly at first until I realized that the program wasn't going to give me all the answers, that I had to think about what I was learning. I had to back the slides up and start again.
>
> This program is so different than most programmed instruction I had in high school or the programs I went through in the lab (self-instructional equipment programs). I had to think. I liked it.
>
> I was angry with myself on Package "B" (the transfer task) because I could have done better if I had known that I was going to have to really apply all the stuff learned in the slide program. I didn't really try to answer all the questions, I just wanted to learn to work the camera and meter.

The students were not used to being called upon to derive rules or principles. Negatives produced by subjects during the transfer task indicated that problems can

best be solved when you can apply the principles involved in similar (replication task) or different (transfer task) settings. It is difficult to remember many small steps and memorize a lot of facts, but a rich experience in which only a few generalizations have to be retained can be remembered a long time.

Heuristic 3: The tutorial approach during formative evaluation can be an effective means of developing better programs.

The approach used to test the prototype programs of this study was tutorial with one student at a time. Horn's Tryout Checklist and Intervention Principles in Appendix M provide an indication of how the process works. Students were selected who were interested in the content to be learned and anxious to assist in the evaluation process. None of the students selected for evaluating a prototype were complete strangers to the program designer. Good rapport is absolutely essential to successful evaluation. There must be as little anxiety or fear of failure as possible. Sincerity and warmth must be present in the relationship if little subtleties are to be revealed in program deficiencies.

After each student evaluated the prototype, major problems were immediately eliminated by adding or deleting slides or by changing the verbal content on the tape recorder.

Heuristic 4: Visual-verbal self-instructional program costs can be reduced through program evaluation prior to photography.

Photographic costs can be reduced by involving interested students during the early stages of the design phase. This study involved the tutorial approach prior to development of the final planning board cards prior to photography. The objects which would eventually be photographed were manipulated by the program designer to simulate how they would be seen on a slide. This manipulation included tilting, twisting or highlighting details by bringing the object or subject closer to one another. During this manipulative process verbal instructions simulated the verbal information which would eventually be provided in the program. This stage was so successful that no new pictorial slides had to be developed later in the design process. Crude photographic planning cards were produced following this activity which served as the basis for photography.

The verbal information eventually used in slide form required changes after every tutorial evaluation. It would have been costly in time and materials to produce the slides of verbal information prior to final revision. A tape recorder paced by the volunteer evaluator was used to readily change content. When the evaluation, which used several students, was completed, the verbal information was then typed and photographed.

This process saved time, money, and probably resulted in a better program. A program author is more resistant to change after everything is produced in final form.

Heuristic 5: Field-dependency is an important variable which must be considered in the design stage of instructional programs.

This study failed to incorporate the field-dependency dimension in the program design phase. It is now believed by this writer that the tutorial approach would be even more valid if subjects who were field-independent and less field-independent were selected for the formative evaluation process. The degree of field-dependence could be measured on the Thurstone and Jeffrey Test for Closure Flexibility since the results of this study suggest rather dramatic performance differences between subjects scoring higher (field-independent) and lower (less field-independent) on this measure.

Subjects used for formative evaluation were tested at a later date. It was determined later that all the subjects were inclined to be field-independent. In fact, the highest score achieved from over 1,300 students tested by Dickie (1969) and in this study was made by one of the student evaluators. The less field-independent person proceeds more slowly, has more trouble seeing details, and is more anxious in the self-instructional setting. For these reasons, the less

field-independent learner must be represented in the tutorial approach in formative evaluation to provide information on program problems. These subjects need even more help.

Heuristic 6: Studies which evaluate the effectiveness of self-instructional programs should consider the variability of field-dependence in learners.

Studies on programmed instruction or self-instructional programs in general have often ignored learner variability. The significant results of this study and Dickie (1969) suggest that field-dependency is an important learner variable which reflects the degree of psychological differentiation. The variable affects performance and attitudes in self-instructional settings for certain types of tasks. Less field-independent individuals prefer to be with people, they are more influenced by the group, they have difficulty seeing the details of a visual field, but they can perform very well when the conditions for learning and the training tasks assist rather than hinder them.

Heuristic 7: Training with realistic visuals with less relevant cues present and with relevant cues emphasized can improve learning and transfer when both tasks require the use of real objects which are alike or similar to those in the training visuals.

It is extremely unwise to arbitrarily and totally eliminate cues in the training situation which may be

necessary to the learning task and critical to performance on the transfer task. This is not to say that all training should be done with realistic visuals. The stimuli or specific cues present in the training sequence visuals should be the same as those used in the replication of the training task and similar to those which might ultimately be used in a transfer task. The program designer typically decides which cues are relevant or irrelevant to the task in a fashion which is at best arbitrary. The program designer should not eliminate cues from the training task which he thinks are irrelevant. The program designer can easily overlook the conceptual naivete of the learner exposed to something completely new. The visuals used (pictures, drawings, line drawings) should reflect the task being learned.

The replication task and transfer task in this study required the manipulation and problem solving situations concerned with real objects. Realistic visuals with masking (masking which does not completely block out the cues) served to highlight the relevant cues which were very critical to the message function of the visual and deemphasize the less relevant cues. When the relevant detail is, for example, an automatic/manual mode switch on the lens, the less relevant cues of the entire camera still serve a locational function. Completely irrelevant details such as objects in the background are eliminated

through photography. Masking is only one of many possible ways to accomplish visual separation without complicating the process of interpreting the message function of a particular visual. The visual information was compressed to separate the figure (relevant) cue from the ground (less relevant) cues to facilitate information processing.

Recommendations for Further Research

This study has examined the effects of field-dependency and a technique of separating important cues from less important cues in a visual (visual-compression) upon self-instruction and transfer.

Research Related to Field-Dependence

Field-dependence should be considered in studies of learning. Specifically, the whole problem of instructional design as related to learner variables must focus upon those separate but rather stable human differences which affect the way they learn. Most research with field-dependency has centered about the relationships between the instruments used to measure analytical functioning (field-dependence) and intellectual and verbal skills rather than the relationship of field-dependence to specific tasks which require a particular type of intellectual functioning or verbal comprehension.

If a researcher is interested in the instructional efficiency of a given program or program style, and performance, it would seem necessary to include such a common and dramatic difference in individual perceptual style and intellectual functioning. The particular cognitive style or cognitive functioning of an individual is represented in both the intellectual and perceptual behavior of that individual. Despite this relationship, no studies were located which looked at the effects of field-dependence upon self-instruction and transfer.

It is suggested that perceptual style as exhibited in personality, the instructional task, ahd the methodology, are the key variables in designing instruction.

Studies are suggested which examine the relationships and effects of field-dependence upon self-instruction programs which deal with analytical functioning in intellectual activity, perceptual functioning where the individual must overcome an embedding context, and verbal functioning where linguistic behavior reaches a stage of differentiation not present in describing on-going events as in a test of relations among concepts or tests of definitions. The field-dependency construct which assumes a linear development continuum is under some attack. A technological society tends to emphasize and value growth toward a more highly differentiated state of being.

Sex and Field-Dependence Research Considerations

This study did not look at sex as a variable, but Appendix W shows that the means of male subjects tend to be higher than those of female subjects on most measures. It is consistently shown that females generally are less field-independent than males but Witkin (1962, p. 221) has suggested that the clearcut and pervasive sex differences are slight compared to the range of individual differences within each sex. This study verifies the comment sufficiently. It is suggested that learning research center on the specific individual differences related to learning style.

Research and the Design of Visual Programs

This study used a single technique to differentiate stimuli in a visual training sequence. The technique of masking (termed visual-compression in the study) used the same density for every mask. The visuals in this study were in a particular embedding context which stressed somewhat similar intellectual and perceptual functioning. The training program required an analytical mode of attack which would favor the performance of field-independent learners.

Research is suggested with varying densities for the masks used with short visual sequences using the same verbal embedding context. One might also work with

visuals alone and vary both the density and the tasks. Masking could profitably be compared with more traditional techniques of highlighting the most relevant cues such as circles, pointing, arrows, different colors and other graphic techniques. The masking technique could be contrasted with photo sketch manipulations whereby part of the visual is realistically portrayed and the least important cues appear as line drawings. This technique is best accomplished with black and white visuals. Black and white masking of the type used in Dickie's (1969) study should be compared with full color masking effects used in this study.

One point remains quite clear. Differentiation of important visual stimuli is important in most types of learning, but masking is only one potentially effective technique. The variations on the masking technique are numerous.

Research is suggested which looks at relationships between a particular masking technique and different verbal contexts for the visual as they relate to measures of performance.

Summary

It is imperative that greater concern be given to the relationship between programmed instruction and the transfer of learning. This study found that masking

slides in a visual training sequence aided transfer for most subjects. It was also determined that transfer was improved when a self-instructional program was designed for transfer. Relatively few transfer studies are concerned with learning content which is more typical of that taught in schools. It would assist future program designers and teachers if the relative importance of the principles of transfer were systematically controlled in relation to particular types of intellectual (analytical/global) functioning and particular cognitive styles of the individual.

Conclusions of the study suggested that (1) field-independent learners did better on all measures of training and transfer, especially when trained with the masked slide treatment, and (2) masking to highlight important visual cues helped all learners perform better during training and transfer tasks, but the technique helped field-independent subjects more.

Several strategies or heuristics were suggested: (1) self-instructional programs should be designed for transfer by using the principles of transfer as a framework for design, (2) active involvement, variety, and learning of principles can improve performance in training and transfer, (3) effective programs can be developed at less cost when individuals are involved in the formative evaluation process during and after the

development of a prototype program, (4) field-dependency is an important learner variable during formative evaluation of the program and in evaluating the effectiveness of a particular program in its final form, (5) it is important to differentiate stimuli important to the message function in a visual training sequence, (6) masking is one useful technique to differentiate stimuli, and (7) all aspects of the training procedure are linked to an individual's performance on a transfer task.

Concluding Remarks

If we are to meet the needs of individual learners as we move towards more self-instruction and independent learning activity, then programs and materials must either be matched to the learning style of the individual, or the individual must have access to materials and activities which match his cognitive style and intellectual functioning.

It is hoped that this study will interest others in the development of programs which not only teach for a specific task, but teach for the higher order of learning which helps learners apply their learning to new situations.

Individual differences in cognitive style and transfer of learning are important considerations in the planning and design of educational experiences.

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APPENDICES

APPENDIX A

EXPERIMENTAL AND CONTROL VERSIONS OF THE SELF-INSTRUCTIONAL SLIDE SEQUENCE

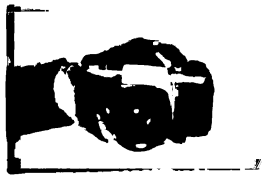
Determining Exposure

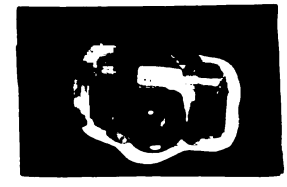
on a

Photographic Copystand

Written information will precede each picture. Go through the program at your own pace. You may repeat specific written information by pressing the reverse button.

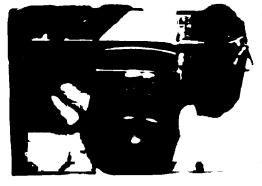
A single-lens reflex camera lets you look through the lens. It is ideal for closeups on a copystand.





The camera used in this program has an automatic lens with three controls:

1. Focus
2. Aperture
3. Auto/manual mode switch



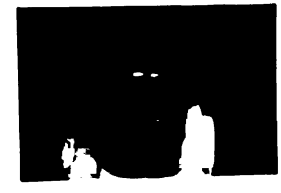
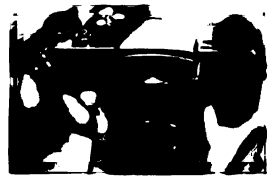


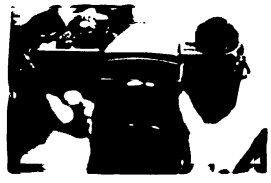
Figure 1. Self-Instructional Slikes: Masked and Unmasked

Since you can see the focus as you look through the finder, you can ignore the distance setting numbers listed in both feet and meters, as well as the numbers on either side of the orange diamond.

The second control on the lens is the aperture. The aperture determines the intensity or brightness of the light reaching the film. The aperture is set by rotating the large ring close to the camera body.



Yellow numbers on the aperture are called f stops, which determine the size of a circular opening inside the lens. The next slide shows the lens set at f/11.



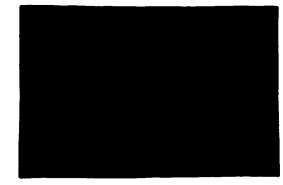
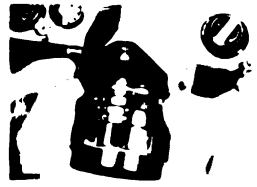


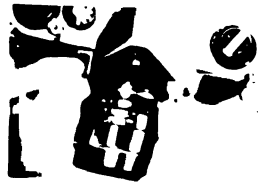
Figure 1. (Continued)

The third control is the auto/manual mode switch. The lens is in automatic mode when the "A" shows. In auto mode, the lens automatically closes to the f stop you selected as the picture is taken.



With the lens in auto mode ("A" is [illegible] is brightness affected as you look through the eyepiece and move the switch to different f stops?

Place the lens in manual mode by covering the "A".



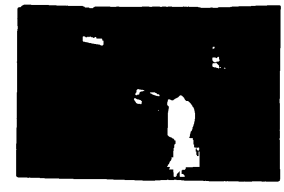
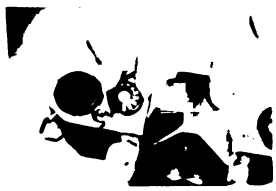


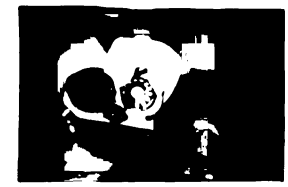
Figure 1. (Continued)

Move the aperture to different f stops again and observe the brightness of your view. Which f stop gives the brightest view?

Is it easier to focus at this f stop also?

The shutter speed knob controls the time of exposure. The number 1 is one second; the number 2 is 1/2 second; 30 is 1/30 second; etc. The red x is a shutter speed used with electronic flash units. The next slide shows the shutter speed knob set at 60. What does this mean?

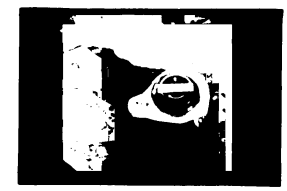




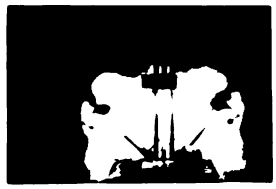
For practice, set the shutter speed to 1/250 second. The letters B and T on the knob are for exposures longer than one second.

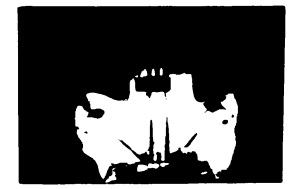
Figure 1. (Continued)

The knob near the Hla is a film reminder dial which has no mechanical function.



A copystand is used to hold the camera steady while lights illuminate the picture.





Uncover the "A" (auto mode) then mount the camera on the copystand camera bracket by threading the screw in the tripod socket on the bottom of the camera. Point the camera straight down and be certain it is not crooked. A crooked camera would distort the picture.

Figure 1. (Continued)

Cameras without built-in meters require separate hand-held exposure meters to measure the amount of light present and give the range of correct shutter speed and f stop combinations from which you can choose. Can you locate the scale for f stops and shutter speeds?

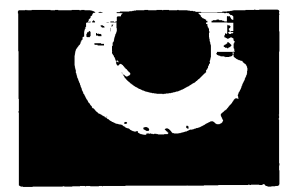
The exposure meter must first be set for the type of film being used. Different films have different sensitivity to light. ASA numbers represent the sensitivity of the film. Higher numbered films are more sensitive. The exposure meter used in this program has two windows to permit more accurate ASA settings. Set your meter to ASA 100 for practice.

When the gloss honeycomb is exposed the meter is ready to measure reflected light. The honeycomb receives light and converts it to electricity.

Figure 1. (Continued)

Electricity from converted light energy received moves a needle which indicates the amount of light present. Does the needle move farther as the light received is brighter?

The needle will be used to set the position of the aperture and shutter speed scales which are read as ratios. We will soon need to know how to set these scales.



The red E V scale is not used with your camera. This scale is for cameras with f stops and shutter speeds which move together.

Figure 1. (Continued)

Focus the camera upon the picture provided as sharply as you can.

Move the picture so that its edges are not seen in the finder. Remember, most single-lens reflex cameras photograph just a bit more than you see.

The exposure meter in this program can measure either reflected or incident light. When the cells are exposed, the meter is set to measure <u>reflected light</u>.

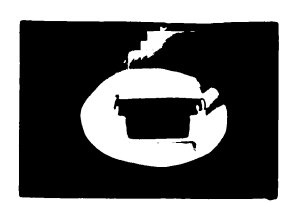
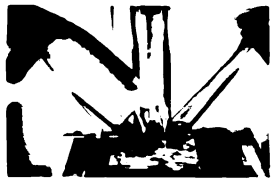


Figure 1. (Continued)

When measuring reflected light, avoid shadows, and point the meter toward the subject. Cameras with meters built-in measure reflected light. Reflected light poses a problem, however.

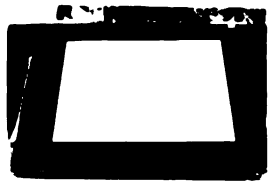


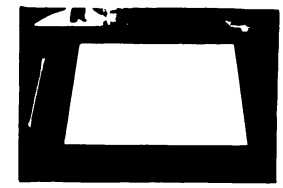
Reflected measurements (or readings) can cause problems because different colors reflect different amounts of light. Look at the way the meter is pointed and see if the white needle moves as you pass over different colors while avoiding your own shadows.

A Kodak Neutral Test card or gray card is used to average reflected light. This card should be used when making reflected readings.

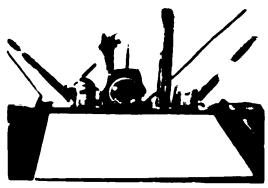
Figure 1. (Continued)

The gray card is placed directly over the subject being photographed to permit the card to receive the same amount of light. What if the card is placed closer to the light source than your subject?





The thin white needle on the meter responds to the reflected light and stops on the unmasked scale. Observe the needle on your meter as you point to the gray card. Your needle will not be in the same position because your light level is less. Note the position of the meter.



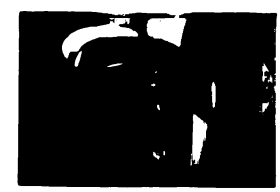
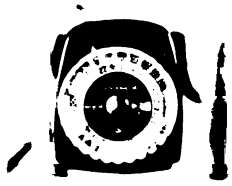


Figure 1. (Continued)

You must set the outer dial (without moving the inner dial) while the needle is reading the light correctly. Rotating the large outer dial moves the yellow arrow toward the needle while the shutter speed scale is also moving.

When the arrow and needle are aligned, you can move the meter for better viewing. Large numbered f stops are the best aperture settings for copywork because the range of sharp focus is greater. The next slide shows the arrow and needle aligned and a shutter speed of 1/60 paired with f/11. Actually, any of the paired shutter speeds and aperture settings could be used, but f/11 is a good choice for copywork.



With the lens in automatic mode, the aperture is set at f/11. If your meter scale pairings of f numbers and shutter speeds didn't align perfectly, minor adjustments are made with the aperture settings by settings between the f stops on the camera.

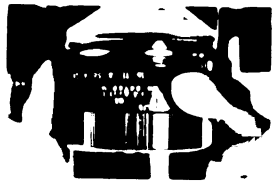
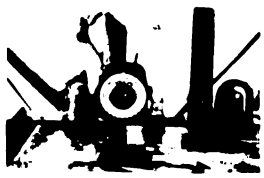


Figure 1. (Continued)

The next slide shows the shutter speed knob being set at 1/60 which was paired with the f/11 when the needle and arrow were aligned. Set your camera according to your settings and select the shutter speed closest to f/11. It will probably be slower than 1/60 because your light level is lower.

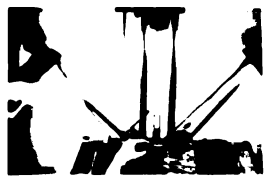
A reflected reading is always made by pointing hand held meter or meter in the camera directly at the subject. What accessory is missing in the next slide which is used to average the light?



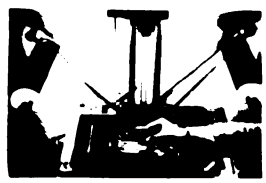
Some hand held meters can also measure the source of light, that is, the light which falls upon the subject. This is called incident light. A baffle covers the honeycomb cells during incident readings. The baffle is closed as shown on the next two slides.

Figure 1. (Continued)

Incident light readings average the light falling upon the subject so the meter is placed on the subject. Which way is the meter aimed?



The meter is placed on the subject and aimed at the camera for incident readings. All other procedures are the same as with reflected light. Do you need a gray card for incident light?



Let's get ready to shoot the picture. The shutter release button is beside the shutter speed dial. The button has a small threaded hole in the middle.

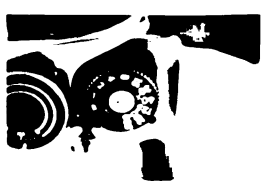
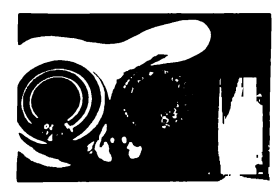


Figure 1. (Continued)

A cable release is used to prevent any camera movement while depressing the shutter release button. Thread the cable release into the cable release socket by twisting the cable.

The film advance lever next to the shutter speed dial both cocks the shutter and advances the film. The number in the window (19) indicates the particular exposure number. The cable release was removed to give you a better view.



The shutter is cocked and the film is advanced by cocking the film advance lever as far to the left as it will go. If the lever won't move, the shutter is cocked already and set to shoot.

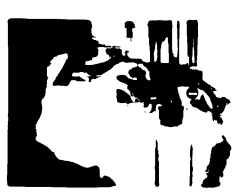
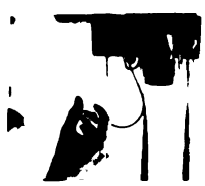


Figure 1. (Continued)

Make one last check of alignment and focus. Remember the camera takes just slightly more than you see.

Make a last minute check on focus and grab the cable release with either hand.

Squeeze the release until the shutter clicks then release the plunger. The picture has just been taken.



Turn off the slide projector and grab package A. Open package A and proceed as per instructions inside the package.

Figure 1. (Continued)

APPENDIX B

STUDENT INFORMATION FORM

Information Sheet, Fall 1971

Name_____ Class (circle one) Jr Sr Spec Gr

AV Instructor_____ Class Meeting Times_____

Local Address_____ Local Phone_____

Home Address_____ Home Phone_____

Will you be on campus next term (winter)? Yes___ No___

Local Address During Winter Term_____

How many self-instructional programs have you been instructed with in the learning laboratory? _____ Please list them by topic: _____

What is your opinion of your learning experiences related to the self-instructional programs in the learning laboratory? (circle one)

Very Unfavorable	Not too Favorable	Satisfactory	Quite Favorable	Very Favorable

How would you describe your interest in the activity of producing slides for your use in teaching?

Very Unfavorable	Not too Favorable	Satisfactory	Quite Favorable	Very Favorable

Specifically describe your skill and experience(s) with each of the following:

An Exposure Meter:

A Camera with Adjustable Settings (focus, shutter, lens openings):

A Photographic Copystand:

APPENDIX C

SAMPLE STUDENT RESPONSES

RELATED TO PRIOR KNOWLEDGE

SAMPLE STUDENT RESPONSES
RELATED TO PRIOR EXPERIENCE

The following quotes are representative of student responses when asked to describe specifically skill and experience(s) with: (1) an exposure meter, (2) a camera with adjustable settings, i.e., focus, shutter, lens openings, and (3) a photographic copystand. Comments marked with an asterisk (*) indicate that the subject knew too much about the content to participate in the self-instructional program. Each set of quotes represents a different individual. An underlined quote indicates a comment which appeared several times.

An Exposure Meter:

"None"

"No experience"

*"I used to work as a photographic assistant. It was then that I learned to use an exposure meter."

*"Occasional use"

*"Recreational use"

"Very little, it was built in the camera."

"Unskilled"

*"Varied use"

"Knowledge of its use only"

"I have not used a hand meter."

"Never used one."

*"Average--I have used it."

*"Pentax and outside meter."

*"I have one (borrowed)."

*"Use one on 16mm for football games and on regular home movie camera."

*"Read it a few times--shown by friends."

"One, one picture a couple of years ago."

"?"

A Camera with Adjustable Settings:

"None"

"No experience"

"?"

*"Very little experience--just through friends who are camera bugs. 'Showed' me how they worked and I tried it out a few times."

*"Home use with a small variety of skills."

"None. My husband has one, though."

*"Just a family camera, a 35mm Japanese, light reading and focus."

*"35mm Agfa Optima--very simple, had it 3 years. Only used on holidays or on vacation and overseas, not much to it."

"Zero!"

*"Experienced"

*"With Instamatic very good, with Pentax good."

*"Very good"

*"I use an SLR w/various lenses and extension tubes for my photowork."

*"Great skill"

*"My boy friend has a Pentax camera that I have become familiar with. It must be focused according to light readings which are set before the picture is taken."

*"I have used cameras of different brands--all having adjustable settings."

*"Great amount. Am a professional photographer."

*"Have used various 35mm cameras and am well familiar with all parts and their functions."

*"I have a Canon camera. . ."

*". . .produced six or seven instructional units in metal working technology for a seminar and for myself."

*"I do a great deal of photographic work so all this hardware is familiar."

A Photographic Copystand:

"?"

"None"

"Never used one"

"A what?"

"I used a Visualmaker with the Instamatic camera."

*"I am a professional photographer."

*"I used one with my SLR."

*"I don't remember where I became familiar with it, but I know it is used for taking pictures out of magazines and for reproducing photographs."

*"Not too much experience."

*"About 3000 frames shot from a copystand."

"Used one once a long time ago, but someone else set my camera."

*"A number of slides were produced via copystand."

"Know what it is."

*"Yes--high contrast B & W and color for AVT 'mini' course."

"Produced some slides for one class at WMU with the Kodak Instamatic copystand."

*"Enough to use one."

*"Much skill."

"Visualmaker--it wasn't difficult for me. It was actually fun."

*"Just experimental for Dr. Curl in TEED 550, but not for a class project."

*"Copying book and illustrations."

"Little, I made a set of slides, didn't turn out very good."

*"I have used a photographic copystand four times since Dr. Jay Smith showed me how to use a single-lens reflex camera last summer."

"Is that the machine in the library you pay money to use?"

APPENDIX D

CRITERIA TO EVALUATE

KNOWLEDGE OF CONTENT

CRITERIA TO EVALUATE KNOWLEDGE OF CONTENT

Appendix C provided samples of student responses regarding their experience or skill with an exposure meter, a camera with adjustable settings or a photographic copystand. The criteria used to establish the fact that a subject had no prior knowledge of using an exposure meter on a copystand is based on the subject's responses related to each of the three areas. The criteria were established in the form of questions to be matched against typical responses and some key statements. Criteria for each area follows.

An Exposure Meter

Any prior experience with hand held meters or manually controlled meters on adjustable cameras automatically eliminated the subject regardless of responses in the other two areas.

Has the subject operated a hand held meter?

Has the subject used a meter built into an adjustable camera?

Did the subject indicate he understood how to use meters?

Has the subject used a copystand extensively?

Does the subject use an adjustable camera often?

Does the subject process his own film?

Is the subject a photo enthusiast?

Does the subject work in photography?

Does the subject provide any clues about any special knowledge of an exposure meter's use?

A Camera with Adjustable Settings (focus, shutter, lens openings)

The major emphasis of the self-instructional program in the study is determination of exposure on a copystand, but individuals with average or extensive experience with an adjustable camera learn some of the key principles of exposure.

Does the subject own a good camera?

Does the subject shoot a lot of pictures with an adjustable camera?

Has the subject learned to set a complex camera?

Does the subject know what complex cameras will do?

Does the subject provide any clues which indicate he he has had experience with cameras?

A Photographic Copystand

Prior experience with a Kodak Visualmaker did not disqualify a subject. Slides produced on a copystand where a lab assistant or friend set exposures without explanation would not disqualify the subject. Again, the program emphasis is experience with incident and reflected light readings with a gray card. The copystand is not the critical factor, rather it is the copystand combined with the use of the meter and a camera with adjustable settings.

Has the subject used a copystand with lights?

Has the subject measured light on a copystand?

Has the subject used a meter on a copystand?

Has the subject used an adjustable camera on a copy-stand?

Has the subject learned about making exposures on a copystand?

Does the subject provide any clues about his experience with a copystand with lights?

A Final Check

A final check for prior knowledge took place in the SLATE environment. The subject was handed a meter and asked to explain how to make reflected and incident light readings. Subjects were asked to point to parts on a Pentax camera and explain their function. Subjects were also asked to identify parts or functions during a brief demonstration with the meter.

Explain:
What is a reflected reading?

What is an incident light reading?

How do you make a light reading?

Why are there so many numbers on an exposure meter?

Point to the:
light baffle

ASA setting

aperture settings

shutter settings

auto/manual lens mode switch

cable release socket

Identify:
What kind of reading is being made? (incident or reflected?)

What does this (ASA number) setting mean?

What is this? (Kodak gray card)

What is this? (auto/manual mode switch)

What is this? (aperture scale)

APPENDIX E

ADAPTED FORM FOR THE ISHIHARA COLOUR TEST

Results
Ishihara (14 Plates)

- Mo. ☐☐ Day ☐☐
- ☐ Pass, Fail Other
- ☐ Type

ISHIHARA TEST (14 Plate)

Examiner _____ Date _____

Does subject have glasses on? ___ no; ___ yes. If yes, are they tinted? ___ no; ___ yes. (Note: No sunglasses are to be worn during testing.)

Pretest Results of numeral cards:	O.K.	Problems
individually....		
two digits.....		

If subject responded quickly and accurately, use middle column b; if subject had problems, use columns a and c. Write responses in the appropriate column.

No. of Plate	a How Many?	b What	c Trace Them
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

FOR THE FOLLOWING PLATES No. 11-14: If the plate cannot be read or traced, place an X in the last column; otherwise, circle the most appropriate description of the responses. Note: The numbers and winding lines in parenthesis show that they can be read or traced but they are comparatively unclear.

	can trace					unable to trace
	Normal Response	Protan Strong	Protan Mild	Deutan Strong	Deutan Mild	Unable to Read or trace
12	___	___	___	___	___	
13	___	___	___	___	___	
14	can trace two lines	violet	(red) violet	red	red (violet)	

___ normal responses to Plates #1-#11. ___ Pass, ___ Fail ___ Other

Type _____ (see key)

UNABLE TO TEST _____ Reason unable to test:

Adapted from Ishihara Test Book
by A. C. N. Cook as part of
USOE Grant [OEG-5-71-0076(509)]

Figure . Adapted Form for the Ishihara Color Test

APPENDIX F

CORRELATIONS BETWEEN CLOSURE FLEXIBILITY AND OTHER MEASURES OF FIELD-DEPENDENCY

CORRELATIONS BETWEEN CLOSURE FLEXIBILITY AND OTHER MEASURES OF FIELD-DEPENDENCY

Closure flexibility is identified by Thurstone as a dimension of perceiving and appears to involve the ability to shake off one set in order to take on a new set. Witkin (1962) became interested in the dimension of closure flexibility because the definition paralleled the definition of field-dependency.

Thurstone identified the flexibility of closure factor by using modified Gottschaldt Figures, hidden pictures, and two-hand coordination tests. Witkin has noted (1962, p. 49) that these tests are significantly related to the perceptual battery used in Witkin's study.

The Embedded Figures Test of Witkin also uses modifications of Gottschaldt's (1926) original figures. There is a very high relation between the two tests.

The Hidden Pictures Test has not proven to be as loaded on the closure flexibility factor as the concealed figures used by Thurstone. The Hidden Pictures Test did not correlate as closely with the measures used to identify field-dependence in Witkin's battery of tests.

Witkin (1962) also indicated that other measures of closure flexibility used by Thurstone related significantly to measures of field-dependence. A large battery of perceptual, intellectual, and personality tests were factor analyzed including two tests to represent the field-dependence

dimension (Embedded Figures Test and Rod and Frame Test) and the Concealed Figures Test and Concealed Design Test. All four tests were found to have their major loadings on the same factor. Witkin concluded that tests loaded with closure flexibility were bearing upon the field-dependence dimension.

APPENDIX G

REVISED AND ORIGINAL VERSIONS OF THE CLOSURE FLEXIBILITY TEST

CLOSURE FLEXIBILITY

(Concealed Figures)

(Form A)

Please fill in:

Name _____

Age _____ Sex _____ Date ____

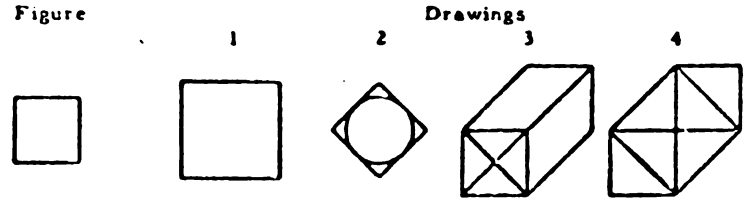
Occupation _____

_____

Developed by: L.L. Thurstone, Ph.D. and T.E. Jeffrey, Ph.D. • The Psychometric Laboratory • The University of North Carolina

Directions:

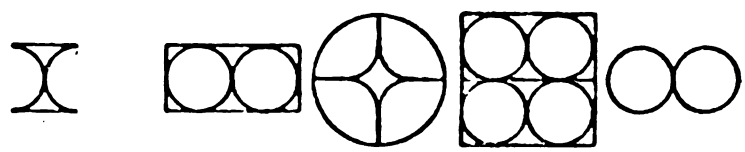
The row of designs below is a sample item of this test. The parts have been labeled to make description easier. These labels do not appear in the test items. The left hand design in each row is the figure. You are to decide whether or not the figure is concealed in each of the four drawings to the right. Put a check mark (✓) in the parentheses under a drawing, if it contains the figure. Put a zero (0) in the parentheses under a drawing, if it does not contain the figure. Look at the row of designs below.



In the row above a zero (0) has been written in the parentheses under drawing 1. The first drawing is a square but it is larger than the figure. A zero (0) has been written under drawing 2. Although the second drawing contains a square of exactly the same size as the figure, it has been turned. Check marks (✓) have been written under the third and fourth drawings since they each contain a square of exactly the same size as the figure and have not been turned. It does not matter that the figure contained in drawings three and four is on a different level from the figure at the left.

Sample:

Here is another example for practice. Try it.



You should have placed check marks (✓) in the parentheses under the first and third drawings and zeros (0) in the parentheses under the second and fourth drawings.

WHEN YOU GET THE SIGNAL TO BEGIN, turn the page and mark more problems of the same kind. Work as fast and as accurately as you can, but do not guess. Wrong answers will count against you. You are not expected to finish in the time allowed. You will have exactly ten minutes to do as much as you can.

Copyright 1956 by Thelma G. Thurstone and T.E. Jeffrey
Published by Industrial Relations Center, 1225 East 60th Street, Chicago, Illinois 60637
Please use number TMNF-119 when reordering.

CLOSURE FLEXIBILITY

(Concealed Figures)

(Form A)

REVISED

DIRECTIONS

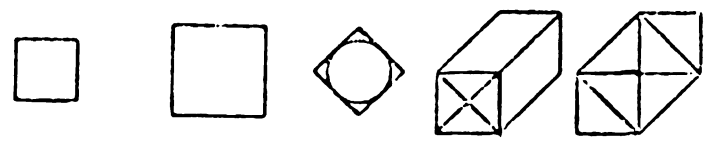
Developed by L.L. Thurstone, Ph.D. and T.E. Jeffrey, Ph.D. - The Psychometric Laboratory - The University of North Carolina

Directions:

The row of designs below is a sample item of this test. The parts have been labeled to make description easier. These labels do not appear on the test items. The left hand design in each row is the figure. You are to decide whether or not this same figure is concealed in each of the four drawings to the right. Blacken in the space(s) on the answer sheet having the same number as the drawing(s) containing the figure. Note: There may be more than one correct response. Leave the response on the answer sheet blank if the drawing does not contain the figure. Look at the row of designs below.

Figure Drawings

1.



(1) (2) (3) (4)

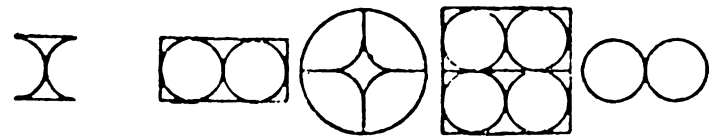
1. 1 2 3 4 (response recorded on answer sheet)

In the row above, the response areas on the answer sheet have been left blank for drawings 1 and 2; the first drawing is a square but is larger than the figure and although drawing 2 contains a square of exactly the same size as the figure it has been turned. The response areas for drawings 3 and 4 have been blackened in because they each contain a square of exactly the same size as the figure and have not been turned. It does not matter that the figure contained in drawings 3 and 4 is on a different level from the figure at the left.

Sample:

Here is another example for practice. Try it.

2.



(1) (2) (3) (4)

You should have selected drawings 1 and 3, and would have blackened in these response areas on the answer sheet and the response areas for drawings 2 and 4 would have been left blank.

WHEN YOU GET THE SIGNAL TO BEGIN, turn the page and answer more problems of the same kind by marking the appropriate response(s) on the answer sheet. You should respond to items in sequential order; to not skip any items or choices within an item. Respond to each choice; however, work as fast and as accurately as you can. Error answers will count against you. You are not expected to finish in the time allowed. You will have exactly ten minutes to do as much as you can.

APPENDIX H

PROCEDURE FOR ADMINISTERING THE CLOSURE FLEXIBILITY TEST

PROCEDURE FOR ADMINISTERING THE CLOSURE FLEXIBILITY TEST

1. Instructors were personally contacted for obtaining permission to administer the Closure Flexibility Test in their class. Seven classes were tested for the study and ten classes were tested overall to establish a 1971-1972 school year mean for the audiovisual courses.

2. The student was provided with a sharpened pencil with an eraser and given a standard #9-150 Western Michigan University Testing Service Response Sheet and a copy of the Closure Flexibility Test.

3. The students were instructed to keep the test booklets closed and face up. The W. M. U. answer sheet was explained with special emphasis on the horizontal sequence of the form and the extra column (column 5) which would not be used.

4. Students were asked to read the instructions on the test booklet cover and mentally complete the examples provided in the instructions.

5. After the students had read the instructions, questions were solicited to help explain the problem examples.

6. Students were told to work quickly, but accurately. They were instructed not to skip any problems. The last paragraph of the cover was read aloud and the signal to begin was given.

7. The test was timed with a sweep second hand for ten minutes after which the students were told to stop and turn in their booklets and pencils.

8. The test was explained as part of a total testing program to help design better self-instructional programs for students.

APPENDIX I

ANSWER SHEET USED FOR CLOSURE FLEXIBILITY TEST

WESTERN MICHIGAN UNIVERSITY - TESTING SERVICES

LAST NAME

FIRST NAME MIDDLE INITIAL

BIRTH DATE MO DAY YR

SEX [ ] M [ ] F

GRADE OR CLASS

COURSE SECTION

INSTRUCTOR

NAME OF TEST

TEST FORM

MO DAY YR

USE NUMBER TWO PENCIL ONLY

0	1	2	3	4		5	6	7	8	9
0	1	2	3	4		5	6	7	8	9
0	1	2	3	4		5	6	7	8	9
0	1	2	3	4		5	6	7	8	9
0	1	2	3	4		5	6	7	8	9
0	1	2	3	4		5	6	7	8	9
0	1	2	3	4		5	6	7	8	9
0	1	2	3	4		5	6	7	8	9
0	1	2	3	4		5	6	7	8	9

T F

1 2 3 4
5 6 7 8
9 10 11 12
13 14 15 16
17 18 19 20
21 22 23 24
25 26 27 28
29 30 31 32
33 34 35 36
37 38 39 40
41 42 43 44
45 46 47 48
49 50 51 52
53 54 55 56
57 58 59 60
61 62 63 64
65 66 67 68
69 70 71 72
73 74 75 76
77 78 79 80
81 82 83 84
85 86 87 88
89 90 91 92
93 94 95 96
97 98 99 100
101 102 103 104
105 106 107 108
109 110 111 112
113 114 115 116
117 118 119 120
121 122 123 124
125 126 127 128
129 130 131 132
133 134 135 136
137 138 139 140
141 142 143 144
145 146 147 148
149 150

USE NUMBER TWO PENCIL ONLY

TESTING SERVICES DOCUMENT 9 150 4 66

APPENDIX J

SCORES ON THE CLOSURE FLEXIBILITY TEST FOR SUBJECTS IN THE PRESENT STUDY COMPARED WITH SUBJECTS IN THE 1969 STUDY BY DICKIE

CLOSURE FLEXIBILITY SCORE COMPARISONS BETWEEN THIS STUDY AND DICKIE'S 1969 STUDY

Dickie 1969 Study

Dickie tested 900 students enrolled in the Teaching and Learning Courses (TEED 300) during 1969. Means were determined on a sex basis as follows:

Table 42. Analysis of Data by Sex for Students Taking the Closure Flexibility Test During 1969

	N	Mean	Median	SD
Males	393	66.97	66	22.0233
Females	507	62.51	63	20.5699
Total	900			

The sample of 40 used by Dickie in his study had a mean of 30.25 for the field-dependent group of 20 and a mean of 95.60 for the field-independent group of 20. The difference between these two means is 65.35.

Present Study

The population tested in the present study included the 218 students enrolled in beginning audiovisual courses (TEED 548, 646) during fall 1971 and winter 1972.

Table 54 Analysis of Data for Students Taking the Closure Flexibility Test During 1971 and 1972.

	N	Mean	Median	SD
1971-72	217	78.12	78	20.24
1971-72*	327	84.05	81	19.68
	544			

*All students enrolled in TEED 548 during the spring term of 1972 were tested and included in the population tested for this study.

The mean of students enrolled in audiovisual courses from fall 1971 through spring 1972 is 84.05. This is 17.08 difference when compared to the male mean of the 1969 population and a 21.54 difference when compared to the female mean of the 1969 population tested.

The large differences between these means suggest the possibility that more field-independent students elect audiovisual courses.

The sample of 60 used in the present study had a mean of 100. for the field-independent subjects and a mean of 55.7 for the 30 subjects labeled less field-independent. The difference between these two means is 44.3. This gap between high and low score groups in the sample is 21.05 less than the gap in the 1969 sample of 40 students. This suggests that there is more homogeneity of closure flexibility performance scores in audiovisual courses when compared with performance scores on closure flexibility for the non-elective teaching and

learning courses. The sample from audiovisual courses had a mean of 77.9 compared with a mean of only 62.9 for the students enrolled in the required teaching and learning courses (TEED 300) during 1969. The difference is an impressive 15.0 points.

APPENDIX K

RESULTS OF THE TESTED POPULATION AND SELECTION OF THE STUDENT SAMPLE

RESULTS OF THE TESTED POPULATION AND SELECTION OF THE STUDENT SAMPLE

Rank Order of 189 Subjects from which the Student Sample was Drawn

(Twenty-eight have already been eliminated because of prior knowledge or color defectiveness.)

No.	Score	No.	Score	No.	Score	No.	Score
1	125	38	85	75	81	112	77
* 2	124	39	85	76	80	113	77
3	122	40	85	77	80	114	77
4	120	41	84	78	80	115	77
* 5	119	42	84	79	80	116	77
* 6	116	43	84	80	80	117	76
* 7	116	44	84	81	80	118	76
* 8	115	45	84	82	80	119	76
* 9	113	46	84	83	80	120	76
*10	109	47	83	84	80	121	76
*11	109	48	83	85	80	122	76
*12	103	49	83	86	80	123	76
*13	103	50	83	87	80	124	76
*14	101	51	83	88	79	125	75
*15	100	52	83	89	79	126	75
*16	100	53	83	90	79	127	75
*17	99	54	83	91	79	128	75
*18	98	55	83	92	79	129	75
*19	97	56	83	93	79	130	75
*20	96	57	82	94	79	131	75
*21	96	58	82	95	79	132	75
*22	95	59	82	96	78	133	75
*23	95	60	82	97	78	134	75
*24	94	61	82	98	78	135	74
*25	93	62	82	99	78	136	74
*26	93	63	82	100	78	137	74
*27	93	64	82	101	78	138	74
*28	92	65	82	102	78	139	74
*29	90	66	82	103	78	140	74
30	88	67	81	104	78	141	74
*31	87	68	81	105	78	142	73
*32	86	69	81	106	78	143	73
*33	86	70	81	107	78	144	73
34	86	71	81	108	78	145	72
*35	85	72	81	109	77	146	72
36	85	73	81	110	77	147	71
37	85	74	81	111	77	148	71

No.	Score	No.	Score	No.	Score	No.	Score
149	70	*159	65	*169	60	*179	54
150	69	*160	64	*170	59	*180	52
151	68	*161	64	171	59	181	52
152	67	*162	64	*172	58	*182	51
153	67	*163	63	*173	58	*183	48
154	66	*164	63	*174	57	*184	44
155	66	*165	63	*175	56	*185	43
156	65	*166	62	*176	56	*186	42
157	65	*167	61	*177	56	*187	41
*158	65	*168	61	*178	55	188	34
						*189	31

*Indicates the subject participated in the entire study.

APPENDIX L

SAMPLE WEEKLY SCHEDULE WITH FIXED TIME BLOCKS

Month Week of

Write name in block. If you must cancel, phone 283-4014 or 327-5367

Mon	Tues	Wed	Thur	Fri	Sat	Sun
8:30						
10:00						
11:30						
1:00						
2:30						
4:00						
5:30						
7:00						
8:30						

APPENDIX M

TRYOUT "CHECKLIST" AND INTERVENTION PRINCIPLES

TRYOUT "CHECKLIST" AND
INTERVENTION PRINCIPLES

The Tutorial Approach

1. The programmer should first explain to the tryout student that the materials he is to be given are intended to help him learn subject matter designated in the title.

2. The programmer should emphasize that the role of the student is to help the programmer evaluate some new education materials. Comments and suggestions that the student makes will help the programmer make revisions.

3. The programmer should then explain that he has to know how much the student already knows about the subject matter and whether or not the student has all of the prerequisites to learn from the materials. He should then give the student the pre-test (always) and the prerequisites test (if required) timing the student on both. Both of these may be done when the test subjects are being selected.

4. When the tests have been completed, the programmer should show the student the program and explain again that it is the material, not the student, that is to be tested from now on. This is an especially important point about which the student should have no question.

5. The student should be given a ball point pen with which to write his answers. (This will prevent him from erasing potentially valuable information for revising the program.) He should be provided with answer sheets, if any.

6. Tell the student to put an "X" next to the items he thinks he got wrong after he has checked his answer. If the program contains open-ended questions, tell the student about this.

7. Explain to the student that if he doesn't know an answer, he should take a guess and write "guess" on the answer sheet. If he simply can't think of an answer, he should leave the answer blank and place an "X" next to the item on the answer sheet.

8. Tell the student the time limits placed on the tryout session and that he can take a break whenever he feels like stopping.

9. Re-emphasize that any comments he wants to write or express to the programmer will be useful and welcomed.

10. Then ask the student to commence with the materials. (If the student asks what he sould do or asks if he's doing it right, the programmer should gently insist that all the directions necessary are given in the materials. It is important to try out the directions, too.)

11. The programmer should not carefully the time at the beginning and end of each tryout session and keep track of "break time."

Checklist for the First Tryout Sessions (Horn, 1966, p. 6 and Abedor, 1971, Appendix H)

Principles

I. If the student can continue through the program even though he has difficulty with an item, it is best to let him continue. Ask him about the difficulty at the end of the tryout session. Watch him very carefully for three or four frames. If he's consistently in trouble, it may be well to interrupt.

II. If the student has so much difficulty with an item that he cannot proceed with the rest of the program, the programmer should intervene. His first step should be to try to revise the program on the spot, presenting a revised or new item to the student. This may be done orally or the programmer may make written changes in the program. He should do this with a minimum of explanation to the student.

III. If these on-the-spot revisions do not work or if the programmer can't figure out the difficulty, he may then query the student directly with such open-ended questions as: "Will you tell me about this difficulty?" or "What seemed to be the trouble with this item?"

How to Intervene in the Tryout Process (Horn, 1966, p. 12 and Abedor, 1971, Appendix H.)

APPENDIX N

TECHNIQUE FOR MASKING THE EXPERIMENTAL SLIDE SEQUENCE

TECHNIQUE FOR MASKING THE EXPERIMENTAL SLIDE SEQUENCE

1. Shoot and process the original slide set.

2. Make a paper negative enlargement on 8 X 10 inch single weight enlarging paper by placing slide in negative carrier. Use cardboard strips to keep slides in registration. Also tape the enlarging easel. Every paper negative should be the ame size and in perfect registration.

3. After processing and drying the paper negative enlargements trace out the area to be masked directly on the paper negative or on tracing paper registered with the paper negative with the aid of a three hole punch.

4. Transfer the lines of the marked area to dull, thin, white paper. Zinc coated copy paper is excellent. The transfer is accomplished with the aid of carbon paper. The white paper should be registered with the enlargement by using the three hole punch again.

5. Cut out the outlined figures. The hole will become the unmasked area. Register the mask (sheet with hole in it) by using a ground glass or frosted acetate at the film plane with the camera back open. Use black felt under the hole (most black paper isn't black enough). Construct a simple three peg jig or overhead transparency taped at one end to register each sheet to be photographed.

6. Use Kodak High Contrast Copy film (very fresh) and shoot from incident light readings made at the copy surface. Process as directed or use Ektaflow diluted 3 to 1 for 5½ minutes at 68 degrees. Do not mount the processed negatives.

7. Use a repronar to superimpose the negative mask and the original slide. Dupe the original slides without the mask so both the masked and unmasked slides are the same level of contrast. Use films from the same emulsion batch.

APPENDIX O

WEEKLY RECORD OF SUBJECTS SCHEDULED

WEEKLY RECORD OF SUBJECTS SCHEDULED*

Exposure Program
(April 17-22)

Place a check before name
after completion.

Monday	Name	Program Version ("E" or "C")	Home Phone	Reschedule Time and Date
8:30				
10:00				
11:30				
1:00				
2:30				
4:00				
5:30				
7:30				
8:30				

*Sample shows only Monday, same format used entire week.

APPENDIX P

PACKAGE "A" WRITTEN REVIEW TEST

AND REPLICATION TASK

Package "A" for the program on Photographic Exposure

What time is it? __:__ Name_____ Student Number_____

You have just completed a self-instructional program concerned with exposure on a photographic copystand. Be sure you have turned off the slide projector. Do not return to the slide program again.

During the process of determining proper exposure and the steps taken through actual shooting of a picture, certain statements listed below apply to the particualr type of meter reading made, i.e., incident or reflected or either type of reading. Mark either an I (incident reading), an R (reflected reading), or both an I and an R in the space provided beside each statement.

_____requires use of a Kodak gray card

_____meter is aimed toward the camera lens

_____baffle is closed over the light cells of the meter

_____light cells of the meter are exposed as baffle is left open

_____meter is aimed toward the subject being photographed

_____a gray card (Kodak Neutral Test Card) is not used

_____ASA number is set on the meter

_____meter is held just above the subject

_____shadows are carefully avoided during the reading of the meter

_____meter is placed at or on the subject

_____camera lens is placed in automatic mode

_____an aperture of about f/11 is used during exposure

_____the arrow and needle are aligned before determining camera settings

_____reading is like that of built-in meters on cameras

_____any shutter speed paired with the selected aperture can be used

Go to the next page

Package "A"
Page 2

The next two tasks are timed by you. Work at a quick but careful pace. Please record the time you begin and finish this two step task by marking the hour, minutes and seconds shown on the digital clock above and to your left.
Example: hour____: minutes____ seconds____

Record the Start time from the digital clock now!

hour____: minutes____ seconds____

Make an incident light reading at ASA 200 and record data below.

aperture or f stop selected f/_____
shutter speed determined _____
Was a gray card used? _____

Now make a reflected reading at ASA 650 and record data below.

aperture or f stop selected f/_____
shutter speed determined _____
Was a gray card used? _____

Record your Finish time now!

hour____: minutes____ seconds____

Place these papers back in the package "A" envelope. You will be returning these with the brief paper used with the next and final task.

Note: Remove the camera from the copystand.

Please reach for Package "B" and proceed.

APPENDIX Q

TRANSFER TASK INSTRUCTION AND DATA SHEETS FROM PACKAGE "B"

Package "B" for the Program on Exposure

This package contains a Ricoh Singlex camera which is already loaded with film. If you should trip the shutter accidentally prior to completing this task cock the shutter again and inform the lab supervisor when you are leaving of how many exposures you made. Also included in this package are three items which contain information you will need to complete the task to be described. The three items are:

* operating instructions for the Ricoh Singlex Camera

* display card with a picture of the Ricoh Singlex Camera

* empty film box for the film already in the Ricoh camera

Again you will need to record the start and finish times of this task. Use the above items as necessary and actually photograph the mounted picture used throughout this program. If you accidently trip the shutter, just take another picture.

Record your start time now!

START hour____: minutes____ seconds____

FINISH hour____: minutes____ seconds____

Be sure you have recorded your finish time immediately after taking the picture.

After the finish time has been recorded, please complete the short data and question form attached.

Package "B" - Photographic Exposure
Page 2

Name_____ Student Number_____

Data from the picture just taken with the Ricoh Singlex. Be certain you have recorded your finish time before doing this.

aperture used _____

shutter speed _____

Was an incident reading used? _____ (yes or no)

Was a reflected reading used? _____ (yes or no)

Was a gray card used? _____ (yes or no)

Was a cable release used? _____ (yes or no)

Did you use the meter in the camera? _____ (yes or no)

What ASA setting did you use? _____

Were all four lights on the copystand working at the time you exposed the film? _____ (yes or no)

Comments about this experience

What is the time now? ____:____ (from either the digital or wall clock)

Return all forms to the lab supervisor and please return the Ricoh camera to Package "B". Thanks very much for your time and help!!!

APPENDIX R

CRITERIA FOR EVALUATING THE STUDENT EXPOSURES

CRITERIA FOR EVALUATING STUDENT EXPOSURES

Each student exposed one negative on High Contrast Copy film. The negative was evaluated directly with the aid of a magnifier and photo enlarger. A maximum of three points could be obtained from the product. Examples of small enlargements from student negatives and the test negative appear in Figures 5, 6, 7, 8, 9, 10, and 11. Criteria for evaluating the student negative follow:

	Perfect	Fair to Good	Unsatisfactory
Alignment	1 point	½ point	no score
Focus	1 point	½ point	no score
Exposure	1 point	½ point	no score

Figure 5. Daily Test Exposure
(example of one point credit)

Figure 6.
Alignment Problem
(½ point awarded)

Figure 7.
Focus Problem
(½ point awarded)

Figure 8.
Exposure Problem
(½ point awarded)

Figure 9.
Alignment Problem
(no points awarded)

Figure 10.
Focus Problem
(no points awarded)

Figure 11.
Exposure Problem
(no points awarded)

APPENDIX S

SUMMARY OF ONE-WAY ANALYSIS OF VARIANCE FOR SIX DEPENDENT MEASURES

Table 29. Camparisons of Time Spent Viewing Self-Instructional Slides

Group	Treatment	F-D	N	Max. Score	Sum of X's	Mean	Std Dev	df	Anova	F	Prob.
1	E	FI	15	N.A.	25,199	1680	336.44	28		***16.87	.0003
	C		15		31,931	2129	256.73				
2	E	LFI	15		31,458	2109	318.81	28		1.18	
	C		15		34,581	2305	669.34				
3	E	FI	15		25,199	1680	336.44	28		**12.16	.0016
		LFI	15		31,458	2109	318.81				
4	C	FI	15		31,931	2129	256.73	28		< 1	
		LFI	15		34,581	2305	669.34				
5	E	FI & LFI	30		56,657	1890	385.67	58		**8.00	.0064
	C		30		66,512	2220	506.14				
6	E	FI	15		25,199	1680	336.44	28		**10.46	.0031
	C	LFI	15		34,581	2305	669.34				
7	E	LFI	15		31,931	2129	256.74	28		< 1	
	C	FI	15		31,458	2109	318.81				
8	Field-Dependence		60		N.A.	N.A.	N.A.	56	2-way	**7.26	.0093
9	Slide Treatment									**8.88	.0043
10	Field-Dependence X Slide Treat.									1.19	

Required F for P < .05 (1,28) = 4.20; (1,56) = 4.02; (1,58) = 4.01
*Significant at P < .05
**Significant at P < .01
***Significant at P < .001

FI = Field-Independent
LFI = Less Field-Independent
E = Experimental (Masked Slides)
C = Control (Unmasked Slides)

Table 30. Comparisons of Performance on Written Review Task

Group	Treatment	F-D	N	Max. Score	Sum of X's	Mean	Std. Dev.	df	Anova	F	Prob.
1	E	FI	15	15.00	189	12.6	2.10	28		*6.17	.0192
	C		15		158	10.5	2.45				
2	E	LFI	15		141	9.4	2.23	28		< 1	
	C		15		152	10.1	2.83				
3	E	FI	15		189	12.6	2.10	28		***16.39	.0004
		LFI	15		141	9.4	2.23				
4	C	FI	15		158	10.5	2.45	28	1-way	< 1	
		LFI	15		152	10.1	2.83				
5	E	FI & LFI	30		330	11.0	2.68	58		< 1	
	C		30		310	10.3	2.60				
6	E	FI	15		189	12.6	2.10	28		*7.37	.0134
	C	LFI	15		152	10.1	2.83				
7	E	LFI	15		158	10.5	2.45	28		1.76	
	C	FI	15		141	9.4	2.23				
8	Field-Dependence		60		N.A.	N.A.	N.A.	56	2-way	**8.33	.0055
9	Slide Treatment									1.14	
10	Field-Dependence X Slide Treat									*5.04	.0287

Required F for P < .05 (1,28) = 4.20; (1,56) = 4.02; (1,58) = 4.01
*Significant at P < .05
**Significant at P < .01
***Significant at P < .001

FI= Field-Independent
LFI= Less Field-Independent

E= Experimental (Masked Slides)
C= Control (Unmasked Slides)

Table 31. Comparisons of Replication Task Performance

Group	Treatment	F-D	N	Max. Score	Sum of X's	Mean	Std. Dev.	df	Anova	F	Prob.
1	E	FI	15	6.00	81	5.40	.99	28		*6.33	.0179
	C		15		66	4.40	1.19				
2	E	LFI	15		75	5.00	1.20	28		*4.22	.0404
	C		15		56	3.73	1.94				
3	E	FI	15		81	5.40	.99	28		1.00	
		LFI	15		75	5.00	1.20				
4	C	FI	15		66	4.40	1.19	28		1.29	
		LFI	15		56	3.73	1.94				
5	E	FI & LFI	30		156	5.20	1.10	58		**10.10	.0024
	C		30		122	4.07	1.62				
6	E	FI	15		81	5.40	.99	28		**8.77	.0062
	C	LFI	15		56	3.73	1.94				
7	E	LFI	15		66	4.40	1.19	28		1.19	
	C	FI	15		75	5.00	1.20				
8	Field-Dependence		60		N.A.	N.A.	N.A.	56	2-way	2.25	
9	Slide Treatment									**10.17	.0023
10	Field-Dependence X Slide Treat									<1	

Required F for P< .05 (1,28) = 4.20; (1,56) = 4.02; (1,58) = 4.01
*Significant at P< .05
**Significant at P< .01 FI= Field-Independent E= Experimental (Masked Slides)
***Significant at P< .001 LFI= Less Field-Independent C= Control (Unmasked Slides)

Table 32. Comparisons of Replication Task Performance Time

Table 32. Comparisons of Replication Task Performance Time

Group	Treatment	F-D	N	Max. Score	Sum of X's	Mean	Std Dev	df	Anova	F	Prob.
1	E	FI	15	N.A.	2769	185	72.09	28	1-way	<1	
	C		15		2925	195	71.99				
2	E	LFI	15		3233	216	71.90	28		1.16	
	C		15		4089	273	192.39				
3	E	FI	15		2769	185	72.09	28		1.38	
		LFI	15		3233	216	71.90				
4	C	FI	15		2925	195	71.99	28		2.14	
		LFI	15		4089	273	192.39				
5	E	FI & LFI	30		6002	200	72.47	58		1.26	
	C		30		7014	234	148.08				
6	E	FI	15		2769	185	72.09	28		2.75	
	C	LFI	15		4089	273	192.39				
7	E	LFI	15		2925	195	71.99	28		<1	
	C	FI	15		3233	216	71.90				
8	Field-Dependence		60		N.A.	N.A.	N.A.	56	2-way	3.36	.0721
9	Slide Treatment									1.30	
10	Field-Dependence X Slide Treat									<1	

Required F for P <.05 (1,28) = 4.20; (1,56) = 4.02; (1,58) = 4.01
*Significant at P <.05
**Significant at P <.01
***Significant at P <.001

FI= Field-Independent
LFI= Less Field-Independent

E= Experimental (Masked Slides)
C= Control (Unmasked Slides)

Table 33. Comparisons of Transfer Task Performance

Group	Treatment	F-D	N	Max. Score	Sum of X's	Mean	Std Dev	df	Anova	F	Prob.
1	E	FI	15	10.00	117	7.80	1.70	28		**12.56	.0014
	C		15		80	5.33	2.09				
2	E	LFI	15		92	6.13	1.19	28		< 1	
	C		15		81	5.40	2.61				
3	E	FI	15		117	7.80	1.70	28		**9.70	.0042
		LFI	15		92	6.13	1.19				
4	C	FI	15		80	5.33	2.09	28	1-way	< 1	
		LFI	15		81	5.40	2.61				
5	E	FI & LFI	30		209	6.97	1.67	58		**9.36	.0034
	C		30		161	5.37	2.33				
6	E	FI	15		117	7.80	1.70	28		**8.89	.0059
	C	LFI	15		81	5.40	2.61				
7	E	LFI	15		80	5.33	2.09	28		1.66	
	C	FI	15		92	6.13	1.19				
8	Field-Dependence		60		N.A.	N.A.	N.A.	56	2-way	2.48	.1209
9	Slide Treatment									**9.91	.0026
10	Field-Dependence X Slide Treat									2.91	.0936

Required F for P< .05 (1,28) = 4.20; (1,56) = 4.02; (1,58) = 4.01
*Significant at P< .05
**Significant at P< .01
***Significant at P< .001

FI= Field-Independent
LFI= Less Field-Independent

E= Experimental (Masked Slides)
C= Control (Unmasked Slides)

Table 34. Comparisons of Transfer Task Performance Time

Group	Treatment	F-D	N	Max. Score	Sum of X's	Mean	Std Dev	df	Anova	F	Prob.
1	E	FI	15	N.A.	7,832	522	142.23	28		3.01	.0937
	C		15		9,600	640	221.28				
2	E	LFI	15		10,115	674	162.73	28		2.60	.1181
	C		15		12,794	853	396.85				
3	E	FI	15		7,832	522	142.23	28		*7.44	.0109
		LFI	15		10,115	674	162.73				
4	C	FI	15		9,600	640	221.28	28	1-way	3.29	.0804
		LFI	15		12,794	853	396.85				
5	E	FI & LFI	30		17,947	598	168.94	58		*4.71	.0341
	C		30		22,394	746	333.76				
6	E	FI	15		7,832	522	142.23	28		**9.24	.0051
	C	LFI	15		12,794	853	396.85				
7	E	LFI	15		9,600	640	221.28	28		< 1	
	C	FI	15		10,115	674	162.73				
8	Field-Dependence		60		N.A.	N.A.	N.A.	56	2-way	*7.90	.0068
9	Slide Treatment									*5.21	.0263
10	Field-Dependence X Slide Treat									< 1	

Required F for P < .05 (1,28) = 4.20; (1,56) = 4.02; (1,58) = 4.01
*Significant at P < .05
**Significant at P< .01
***Significant at P< .001

FI= Field-Independent
LFI= Less Field-Independent

E= Experimental (Masked Slides)
C= Control (Unmasked Slides)

APPENDIX T

MEASURES OF CENTRAL TENDENCY FOR EACH OF THE MEASURED VARIABLES

Table 35. Statistical Summary for Closure Flexibility Scores of the Sample

Group	N	Mean	Standard Deviation	Variance	Median	Mode	Maximum	Minimum
Total Sample	60	77.90	24.33	591.72	75	56	124	31
Field-Independent Experimental	15	100.33	12.25	150.10	99	100	124	85
Field-Independent Control	15	99.87	9.06	82.12	97	93	119	86
Less Field-Independent Experimental	15	56.33	9.32	86.81	58	61	65	31
Less Field-Independent Control	15	55.07	7.84	61.50	56	56	64	41

Table 36. Statistical Summary for Self-Instructional Slide Sequence Viewing Time

Group	N	Mean	Standard Deviation	Variance	Median	Mode	Maximum	Minimum
Total Sample	60	2053	475.88	226461.0	2024	2020	4030	1078
Field-Independent Experimental	15	1680	336.44	113191.5	1729	1078	2129	1078
Field-Independent Control	15	2129	256.73	65912.8	2117	1698	2645	1698
Less Field-Independent Experimental	15	2091	315.24	99378.7	2101	2477	2610	1674
Less Field-Independent Control	15	2305	669.34	448013.6	2208	1231	4030	1231

Table 37. Statistical Summary for Performance on the Written Review Task Within the Training Program

Group	N	Mean	Standard Deviation	Variance	Median	Mode	Maximum	Minimum
Total Sample	60	10.67	2.64	6.97	11	12	15	3
Field-Independent Experimental	15	12.60	2.10	4.40	13	13	15	8
Field-Independent Control	15	10.53	2.45	5.98	11	11	14	5
Less Field-Independent Experimental	15	9.40	2.23	4.97	9	9	12	5
Less Field-Independent Control	15	10.13	2.83	7.98	11	9	14	3

Table 38. Statistical Summary for Replication Task Performance Within the Training Program

Group	N	Mean	Standard Deviation	Variance	Median	Mode[4]	Maximum	Minimum
Total Sample	60	4.6	1.48	2.20	5	6	6	0
Field-Independent Experimental	15	5.4	.99	.97	6	6	6	3
Field-Independent Control	15	4.4	1.18	1.40	4	4	6	3
Less Field-Independent Experimental	15	6.13	1.19	1.41	5	6	6	3
Less Field-Independent Control	15	5.4	2.6	6.82	4	5	6	0

Table 39. Statistical Summary for Transfer Task Performance

Group	N	Mean	Standard Deviation	Variance	Median	Mode	Maximum	Minimum
Total Sample	60	216.93	116.83	13648.98	190	185	820	70
Field-Independent Experimental	15	184.60	72.09	5197.40	180	120	365	105
Field-Independent Control	15	195.00	71.99	5182.14	190	170	360	70
Less Field-Independent Experimental	15	215.53	71.90	5169.83	185	185	350	130
Less Field-Independent Control	15	272.60	192.39	37013.54	190	190	820	125

Table 40. Statistical Summary for Transfer Task Performance Time

Group	N	Mean	Standard Deviation	Variance	Median	Mode	Maximum	Minimum
Total Sample	60	672.35	272.70	74367.69	597.5	460	1915	300
Field-Independent Experimental	15	522.13	142.23	20228.98	515	400	840	315
Field-Independent Control	15	640.00	221.28	48964.29	590	590	1090	300
Less Field-Independent Experimental	15	674.33	162.73	26481.67	585	575	1000	460
Less Field-Independent Control	15	852.93	396.85	157489.80	815	375	1915	375

Figure 41. Statistical Summary for Replication Task Performance Time Within the Training Program

Group	N	Mean	Standard Deviation	Variance	Median	Mode	Maximum	Minimum
Total Sample	60	216.93	116.83	13648.98	190	185	820	70
Field-Independent Experimental	15	184.60	72.09	5197.40	180	120	365	105
Field-Independent Control	15	195.00	71.99	5182.14	190	170	360	70
Less Field-Independent Experimental	15	215.53	71.90	5169.84	185	185	350	130
Less Field-Independent Control	15	272.60	192.39	37013.54	190	190	820	125

APPENDIX U

MASTER DATA SHEETS FOR SUBJECTS PARTICIPATING IN THE FULL EXPERIMENT

Table 43. Raw Data for Field-Independent Experimental Subjects

Subject	Sex	CF Score	Slide Viewing Time	Written Review Score	Replication Task Score	Replication Task Time	Transfer Task Score	Transfer Task Time
1	M	124	1078	15	6	105	10	620
2	F	116	1309	8	4	365	6	515
3	F	116	2129	12	3	120	8	460
4	F	115	1572	14	6	255	8	575
5	F	103	2060	14	6	120	10	725
6	F	100	2020	10	5	165	8	840
7	F	100	1642	15	6	145	8	315
8	F	99	2008	13	6	205	6	320
9	M	96	1729	14	5	180	10	480
10	M	95	1942	9	4	245	7	400
11	F	93	1853	12	6	185	9	605
12	F	90	1286	13	6	114	9	527
13	F	87	1248	13	6	215	8	400
14	F	86	1490	13	6	240	5	560
15	M	85	1833	14	6	110	5	490
Sum of X's		1505	25199	189	81	2769	117	7832
$\bar{X}$		100.33	1679.93	12.60	5.40	184.60	7.80	522.13

Note: Maximum possible scores were 196 on Closure Flexibility, 15 on the written review, 6 on the replication task, and 10 points on the transfer task.

Table 44. Raw Data for Field-Independent Control Subjects

Subject	Sex	CF Score	Slide Viewing Time	Written Review Score	Replication Task Score	Replication Task Time	Transfer Task Score	Transfer Task Time
16	M	119	1698	13	4	170	5	535
17	F	113	2236	13	6	195	9	1090
18	M	109	2013	14	4	155	8	315
19	F	109	1890	11	4	115	6	690
20	F	103	2025	5	3	215	3	900
21	F	101	2400	11	6	70	5	620
22	F	98	2139	9	6	190	5	445
23	F	97	2020	11	5	160	4	590
24	F	96	1800	7	3	285	3	990
25	F	95	2145	12	6	240	9	580
26	M	94	2257	12	5	360	6	640
27	F	93	2524	10	3	260	2	590
28	F	93	2645	10	3	170	5	300
29	M	92	2022	12	4	210	6	585
30	F	86	2117	8	4	130	4	730
Sum of X's		1498	31931	158	66	2925	80	9600
$\bar{X}$		99.87	2128.73	10.53	4.40	195.00	5.33	640.00

Table 45. Raw Data for Less Field-Independent Experimental Subjects

Subject	Sex	CF Score	Slide Viewing Time	Written Review Score	Replication Task Score	Replication Task Time	Transfer Task Score	Transfer Task Time
31	F	31	1726	12	6	255	6	660
32	M	44	2257	10	6	350	7	1000
33	F	48	2477	9	4	130	6	575
34	M	54	1674	7	5	180	5	580
35	F	55	2239	11	6	135	5	890
36	M	56	1700	12	5	170	6	575
37	M	57	2302	6	3	300	6	780
38	F	58	2477	5	3	140	7	525
39	F	61	2370	9	5	335	7	900
40	F	61	2101	9	5	185	7	530
41	M	63	1696	12	6	279	5	460
42	F	63	1970	9	6	165	5	585
43	F	64	1956	12	6	215	8	740
44	F	65	1903	10	3	209	8	545
45	M	65	2610	8	6	185	4	770
Sum of X's		845	31458	142	75	3233	92	10115
$\bar{X}$		56.33	2109.04	9.47	5.00	215.53	6.13	674.33

Table 46. Raw Data for Less Field-Independent Control Subjects

Subject	Sex	CF Score	Slide Viewing Time	Written Review Score	Replication Task Score	Replication Task Time	Transfer Task Score	Transfer Task Time
46	F	41	2291	9	5	135	5	625
47	F	42	2611	9	6	125	5	630
48	F	43	2065	10	1	145	9	975
49	M	51	1231	12	5	190	8	985
50	M	52	1421	11	6	190	3	375
51	F	55	2333	14	2	600	3	605
52	F	56	2932	11	2	185	5	1070
53	F	56	1966	3	4	205	7	419
54	M	58	1879	12	4	190	4	770
55	M	59	2208	12	6	255	4	460
56	M	60	2345	9	3	365	7	815
57	F	62	2174	8	5	290	4	965
58	F	63	2115	7	0	820	0	1915
59	F	64	2980	14	5	174	10	1345
60	F	64	4030	11	2	220	7	840
Sum of X's		826	34581	152	56	4089	81	12794
$\bar{X}$		55.07	2305.40	10.13	3.73	272.60	5.40	852.90

APPENDIX V

SAMPLE STUDENT COMMENTS CONCERNING THE SELF-INSTRUCTIONAL PROGRAM TAKEN AFTER COMPLETING THE TRANSFER TASK

SAMPLE STUDENT COMMENTS CONCERNING THE SELF-INSTRUCTIONAL PROGRAM TAKEN AFTER COMPLETING THE TRANSFER TASK

The following comments were made by the students on the Package "B" form immediately after completing the entire training program and transfer task. Comments are included from both the negative and positive side. Every student did not include comments. Immediately after the comment is a code in parentheses: (FE/E)field-independent subject given experimental treatment; (FI/C) field-independent subject given control (unmasked) slides; (LFI/E) less field-independent subject given experimental (masked) slides; (LFI/C) less field-independent subject given control slides.

"This has been a great experience. I really benefited from all the involvement and "transfer of training" (hope this is the right term). This is the best lab in the place. Recently I have been wanting to know how to take slides from pictures--now I have a good idea--and who knows maybe the picture might turn out." (LFI/C)

"I always wondered how all those dials worked. Now I know." (FI/E)

"I enjoyed it. Now I have to buy a camera because I like it so much." (FI/E)

"It was interesting, but I'm afraid I didn't know how to set the camera properly when taking the actual picture. I forgot a lot of steps." (LFI/E)

"It was helpful to understand the camera--but the light meter was still a bit confusing." (FI/E)

"I'm a little bit confused. I thought I understood most of this at the time, but when I actually had to record the data myself I had trouble remembering what was what. I have never had any experience with a light meter etc., so all the terms were new. If I went through it a second time after being presented with this new material it would be much easier. I also find programmed instruction frustrating. It's more helpful to ask a few questions of someone now and then to clarify things you get stuck on." (LFI/C)

"The slide show was very clear except for some confusion I had with incident lighting--had no other trouble otherwise." (FI/E)

"I enjoyed the program. I think I may have gone through the program too quickly, but I do believe it explains photographic exposure very well. I myself, am very naive when it comes to photography and I think I learned a great deal." (LFI/C)

"I think that I would like to learn more about photography!" (FI/C)

"No clue as to how to determine film speed. Went smoothly--felt fairly comfortable with cameras." (LFI/E)

"I think I am rather fascinated. I preferred the instructions and card in package B--but I wonder if it was easier because I had worked through the slide set. I feel confident I messed B because I am sure I did not pay careful attention, at least at one point--(at least one)." (LFI/C)

"The first part went well. During the section with the Ricoh, I didn't know which ASA setting to use--I forgot what the ASA setting was. This was worthwhile for me. I've never used a copystand, or light meter before, or a camera that you have to set exposure." (FI/E)

"Slides should have told how to get correct exposure reading off the film box. Didn't know for sure to use gray card with automatic meter. This type of learning would be alright some of the time, especially for a person that enjoys self learning. A little frustrating to remember which part was which." (LFI/E)

"Informative, but I'll stick to an instamatic. All the controls seem ra her complex--I'd rather just trust my eyes and shoot candid shots on the spur of the moment. I have very little patience with things like this. The method, slides, examples, etc., were effective, however." (LFI/C)

"Somewhat confusing, but helpful." (FI/C)

"Forgot to put it (aperture) on 11--and I thought the meter switch took the place of the reflected reading. This was fun, but I think I'd need a lot more practice to become familiar with it." (FI/C)

"This was great! I knew absolutely nothing about cameras when I came in here. Now I know a little. It is really exciting. I hope when you open this for everyone you don't lose any cameras. After completing this I sure would like a camera with a meter and shutter speed, etc., etc." (FI/E)

"Helpful, but I would like a more extensive course in the hardware of photography." (FI/E)

"I need about an hour to do this correctly. I was too scared of breaking the camera to relax." (LFI/C)

"I anjoyed working with this. I didn't realize it was this easy. I had a little problem determining the proper exposure on package B. I feel it was a good experience and is worthwhile. I didn't think I could do the second one on my own, but it turned out to be easier than I thought." (FI/C)

"In general, the program is very good. It is very helpful in understanding the fundamentals and use of a comcamera. About the only thing that I had a hard time with were the settings and figuring out how to transfer them from the light meter to the camera." (FI/E)

"Some things were not clear--took me a long time to figure things out. I think I learned something." (LFI/E)

"This was an interesting experience, but I doubt that I learned much more than the simple operation of the camera from this experience. Reflected and incident light readings would have to be practiced many more times--at least by me--to become proficient in this area. I have never used this type of camera before this. . .this was very informative." (LFI/E)

"Totally new experience for me. I would need to go through the program additional times. I was at times confused and found written directions very hard to follow." (LFI/C)

"Quite an interesting program. I need more lessons. I'd love for an instructor to point out the various parts for me." (LFI/C)

". . .Would take more than one sitting to feel secure in the operation." (LFI/C)

"Where do you find the ASA reading?" (FI/C)

"I enjoyed the experience. I also learned a little more about how to take pictures, other than with an Instamatic." (FI/C)

"I felt I got more out of the first part than the second. The second was too vague and didn't explain well enough. I felt confused more with the second camera than with the first." (LFI/C)

"This was very interesting I I feel it was a good learning experience." (FI/C)

"Very good program. This was my first exposure to photographic work of any nature. I enjoyed the program very much." (FI/E)

"Yes, I liked it. Very well done. I only wish I had a camera like this to use now that I know how to use it." (FI/C)

"I'm glad I had it. It forced me to get familiar with an object I was timid of. . ." (FI/E)

"Very interesting and informative. I know a lot about cameras I didn't know before." (FI/C)

"Experiencing using this type of camera is more worthwhile than trying to read directions. I'm glad I did this." (FI/E)

APPENDIX W

STATISTICAL SUMMARY OF MEAN PERFORMANCE BY SEX

Table 53. Statistical Summary of Mean Performance by Sex

Sex	F-D	T	N	Closure Flexa-bility	Slide Viewing Time	Written Review Task	Replica-tion Task	Replication Task Time	Trans-fer Task	Transfer Task Time
M	FI	E	4	100.00	1645.50	13.00	5.25	160.00	8.00	497.50
F	FI	E	11	100.45	1692.45	12.45	5.45	193.55	7.28	531.09
M	FI	C	4	103.50	1997.50	12.75	4.25	223.75	6.25	518.75
F	FI	C	11	98.55	2176.45	9.73	4.45	184.55	5.00	684.09
M	LFI	E	6	56.50	2039.83	9.17	5.17	244.00	5.50	694.17
F	LFI	E	9	55.38	2156.13	9.63	4.75	200.50	6.75	663.17
M	LFI	C	5	56.00	1816.80	11.20	4.80	238.00	5.20	681.00
F	LFI	C	10	54.60	2549.70	9.60	3.20	289.90	5.50	938.90

FI = Field-Independent
LFI = Less Field-Independent
E = Experimental (Masked Slide) Treatment
C = Control (Unmasked Slide) Treatment

APPENDIX X

AB SUMMARY TABLES

AB SUMMARY TABLES

When: A = Field-Dependence; A_1 = Field-Independent;
A_2 = Less Field-Independent

B = Slide Treatment; B_1 = Experimental (Masked);
B_2 = Control (Unmasked)

Table 47. Slide Viewing Time

	A_1	A_2	Total
B_1	25,199	31,358	56,557
B_2	31,931	34,581	66,512
	57,130	65,939	123,069

Table 48. Written Review Task

	A_1	A_2	Total
B_1	189	142	331
B_2	158	152	310
	347	294	641

Table 49. Replication Task

	A_1	A_2	Total
B_1	81	75	156
B_2	66	56	122
	147	131	278

Table 50. Replication Task Time

	A_1	A_2	Total
B_1	2,769	3,233	6,002
B_2	2,925	4,089	7,014
	5,694	7,322	13,016

Table 51. Transfer Task

	A_1	A_2	Total
B_1	117	92	209
B_2	80	81	161
	197	173	370

Table 52. Transfer Task Time

	A_1	A_2	Total
B_1	7,832	10,115	17,947
B_2	9,600	12,794	22,394
	17,432	22,909	40,341

APPENDIX Y

ABRIDGED OPERATING INSTRUCTIONS FOR THE RICOH SINGLEX CAMERA

Operating the Ricoh Singlex Camera

General Description

The Ricoh Singlex is a single-lens reflex camera with a built-in exposure meter. The camera has a lens which can be placed in automatic or manual mode. The shutter and aperture can be varied manually. The film transport lever both cocks the shutter and transports the film.

Automatic Lens Switch

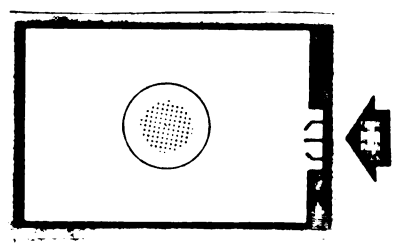
The switch or lever to place the lens in automatic or manual mode is located at the base of the lens at the bottom of the camera.

Operating the Built-in Meter

Setting the ASA Number - The ASA knob is located just below the letters, "TLS". ASA numbers are set in the small window by lifting up on the circular knob and setting to the desired ASA number.

Turning the Meter on - The exposure meter is turned on by lifting the switch next to the name Ricoh.

Determining Exposure - Proper exposure is determined by placing the needle, observed as you look through the viewfinder on the right side, between the brackets as pictured below:



Aligning the needle between the Brackets - You can rotate either the shutter speed dial or the aperture ring to move the needle into position between the brackets. The aperture ring makes very fine needle movements possible. Turn off the meter after positioning the needle.

Focussing - Turn off the exposure meter switch before focussing on your subject so you will see a bright image through the finder which will be easy to focus.

APPENDIX Z

PROCEDURES FOR PREPARING THE SLATE FOR THE EXPOSURE PROGRAM

PROCEDURES FOR PREPARING THE
SLATE FOR THE EXPOSURE PROGRAM

Preparing the Booth

1. Getting Package "A" and "B" Ready

   * Place ditto sheets for Package "A" in envelope marked Package "A".
   * Place ditto sheets for Package "B" in box marked Package "B".
   * Select program tray "E" or "C" as per schedule on program sheet. Place the tray on the projector and advance to the title slide before turning off the projector remote switch on the carrel.
   * Be certain the Pentax camera, gray exposure meter, and cable release are all in the orange box. Change the settings on the camera to a shutter speed of 1/500th and f/stop at f/2.
   * Check Package "B" to be certain all the contents listed on the outside of the box are actually in the box.

2. Reset timer in projection carrel (after setting projection tray into position and turning off the projector) to 59 minutes (red pointer) and zero seconds (white pointer).

3. Direct the individual to the proper booth and give short pre-test. Explain that he can work at a comfortable pace and that he may reverse the slides if necessary. Tell the subject he cannot return to the slides once he is through with them. Also tell the subject that the copystand lights only have to be on during exposure readings and picture taking.

End of Program

1. Ask subject how many shots he made with the Ricoh camera and indicate this on the bottom of form "B".

2. Record time from timer and write it on form "A" (top).

3. Reread and follow the steps 1-3 in preparing the booth.

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